The Institutional Determinants of Private Sector Participation in the Water and Sanitation Sector in Developing Countries

Olivia Jensen
London School of Economics

Frédéric Blanc-Brude
King's College London

Abstract

Private sector participation (PSP) in the water and sanitation sector has received much less attention in the academic literature than other infrastructure sectors. In part, this is due to the smaller flow of investments in this sector. It is also due to the limitations in the existing data on projects with private involvement and on sector-level institutions and performance. In this paper we present descriptive statistics from the new Water and Sanitation PSP database that has been developed by the authors for the purposes of this research.

We use a negative binomial regression model to investigate the factors influencing the number of PSP projects in a sample of 60 developing countries with 460 PSP projects. The regression results provide support for the hypotheses that PSP is greater in larger markets where the ability to pay is higher and where governments are fiscally constrained. We test six models using indicators for different aspects of institutional quality. The protection of property rights and the quality of the bureaucracy emerge as the most important institutions that encourage PSP. Rule of law and the control of corruption are significant, but at a lower level while contracting rights and political stability are not robustly significant.

Comments should be addressed to:

Olivia Jensen
London School of Economics and Political Science
Development Studies Institute
Houghton Street
London WC2A 2AE

+44 7985 796 404
o.jensen@lse.ac.uk

Frédéric Blanc-Brude
King's College London
Department of Management
Franklin-Wilkins Building
150 Stamford Street
London SE1 9NN

+44 7985 934 330
frederic.blanc-brude@kcl.ac.uk

1 - Introduction

In comparison to other infrastructure sectors, private sector involvement in the water and sanitation sector has received relatively little attention in the quantitative academic literature. This is due both to the lower level of private investments in this sector (limited number of data points) and to the paucity of data available about these investments. Likewise, information on the institutions shaping the water sector is not systematically collected, and comparative data is very limited compared to other infrastructure sectors like electricity and telecoms. At the same time, the Millennium Development Goals include ambitious targets for improvements in water and sanitation. Investment needs to be mobilised if developing countries are to meet these goals, while operations and management of water utilities need to be made more efficient.

This research is motivated by the disjuncture between our understanding of the sector and the urgency of the water and sanitation challenge facing the majority of developing countries. We construct the Water and Sanitation Private Sector Participation database (Watsan PSP) with details of more than 700 projects with PSP in the water and sanitation sector in 79 developing countries. This improves significantly on existing datasets. We then analyse a sample of projects from the database using a negative binomial regression count model. The analysis reveals that institutions that provide investors with protection from expropriation, the rule of law and bureaucratic quality, as well as corruption control, are related to the level of private sector activity in a country's water sector. This analysis is a first step in investigating the relationship between institutions and investment in the water sector. Further work needs to be done unpacking these institutional indicators and identifying the impact of water sector-specific institutions on the level of private sector activity.

The rest of the paper is structured as follows: Section 2 provides an overview of PSP in the water sector and highlights important characteristics of the sector that distinguish it from other types of infrastructure. Section 3 reviews the theoretical and empirical literature relevant to infrastructure investment. Section 4

presents the dataset, while Sections 5 and 6 introduce and analyse the model. Section 7 presents the results of the analysis and their implications, and Section 8 concludes.

2 - PSP in the Water Sector

The World Bank's PPI database is the usual reference point for information on private sector investment in infrastructure sectors.[1] For the water sector, the database records 261 projects signed between 1990 and 2003. A recent review of projects in the database finds that the water sector has the least activity of the infrastructure sectors.

> Water has lagged far behind other infrastructure sectors in private activity. In 1990–2004 water projects attracted just 5 percent—around US$41 billion—of the investment commitments in infrastructure projects with private participation in developing countries. The annual average, US$2.7 billion, was also small relative to sector needs. Just meeting the Millennium Development Goals in water and sanitation has been estimated to require US$6.7 billion a year. (Izaguirre and Hunt 2005)

Water has tended to lag behind other sectors even during periods in which private investment has surged. Baietti notes that in a period of great investor enthusiasm in the East Asian economies, between 1994 and 1999, water accounted for only US$7.5 billion or 10 per cent of investment commitments and 7 per cent of the projects signed (Baietti 2001:13). This investment is dominated by two large projects, the concession contracts in Manila and Jakarta, and actual investment in these two projects has diverged widely from the original investment commitments.[2]

[1] The World Bank Private Participation in Infrastructure Database tracks information on infrastructure projects with private investment in the energy, telecommunications, transport, and water and sewerage sectors in low- and middle-income countries. It is updated annually using commercial news databases, specialised and industry publications and internet resources. See: http://ppi.worldbank.org/

[2] Interviews with Maynilad, Manila Water and MWSS in Manila and Pam Jaya, Palyja and TPJ in Jakarta (2004). These two contracts followed a common pattern: the government was unable to deliver on tariff increases necessary for the financial viability of the concessionaires. The contracts were then renegotiated to reduce the required level of capital investment by the concessionaires.

The water sector has also suffered the most severe downturn in recent years. Izaguirre and Hunt find that water and sewerage was the infrastructure sector most affected by the broad decline in private activity. Annual investment commitments to the sector averaged US$1.9 billion in 2001-04, less than half the average commitment of US$4.2 billion in the period 1995 to 2000 (Izaguirre and Hunt 2005). Existing projects have also run into trouble: in 2005, for example, Suez (Ondeo), one of the world's two largest water service companies, announced that it was withdrawing from two major projects, in La Paz-El Alto (Bolivia) and Buenos Aires (Argentina). Overall, the World Bank database identifies 20 projects that were either cancelled or have become 'severely distressed,' accounting for 7 percent of projects and 37 percent of investment commitments in 1990–2004 (Izaguirre and Hunt 2005:2). Our Watsan PSP database records 28 terminated projects or 4 per cent of the total number.

Water projects have also proved susceptible to renegotiation. In a study of Latin American concessions, Guasch (2004) finds that 74% of all water projects are renegotiated.[3] The story looks similar in Asia, where the region's two largest concession projects in the cities of Manila and Jakarta have undergone several rounds of renegotiation. This fluidity in contracts for the water sector suggests that regulatory regimes are not well established. Indeed, comparing water once again to other infrastructure sectors, we can see that structural reform of the sector and the establishment of a regulatory agency is much rarer than in the telecoms and power sectors (Estache and Goicoechea 2005).[4] In the sample of countries covered in the Estache and Goicoechea review, 23% of countries have an independent regulatory agency for the water sector, compared to 57% for electricity and 64% for telecoms.[5]

Latin American governments were the first to pursue a policy of privatisation, either through divestiture, as in Chile from 1988, or by concession as in Argentina and later Mexico, Brazil, Peru and others (Foster 2005). In Latin America, reform of the water sector and the creation of a system of regulation have

[3] This compares to 54.7% for transport, 9.7% for electricity and 30% for all sectors.
[4] This is a preliminary review of PSP and regulation in three infrastructure sectors. The authors describe it as a 'rough snapshot' and the results should be taken only as an indication of the spread of reform in infrastructure.
[5] For developing countries only, the proportion of countries in the Estache-Goicoechea sample with an independent regulatory agency are 24%, 50% and 66% for the water, electricity and telecoms sectors respectively.

generally preceded liberalisation of the sector to private investment. Restructuring and regulation is more widespread in the region than PSP.

In other regions, the situation is reversed: PSP is more widespread than regulation (Estache and Goicoechea 2005). PSP has the longest history in Africa. In Cote d'Ivoire, water has been provided by a private contractor since 1959 (Ménard, Clarke et al. 2000a). Guinea also has a long-running contract for water services (Ménard, Clarke et al. 2000b). As for the majority of contracts in the water sector, regulatory rules and principles are defined in the contract and not in national legislation. In Asia, where PSP is now widespread, the development of regulatory regimes has been much more limited. Plans for a national regulator have recently been floated in Malaysia, and the possibility of a national regulatory body is envisaged in Indonesia's Water Law (approved in 2004). In other cities with PSP, regulation takes the form of contract monitoring. Similarly, in Central and Eastern Europe, regulatory decisions are generally taken by the local government.

The retreat of large international investors from water and sanitation projects in developing countries has become a familiar refrain. These companies have professed their intention to concentrate on 'core' markets in Europe and North America and are withdrawing from their existing commitments in emerging markets. However, PSP in water did pick up in 2004. According to the World Bank PPI Database, 28 projects in 9 countries were invested in 2004 in the water sector worth US$2bn. The database reports 28 projects in 9 countries for 2004, located mainly in Chile, China and Mexico. Our Watsan PSP database reports 60 new projects in 14 countries in 2004, dominated by very high levels of activity in the Chinese market.[6] Much of this activity is accounted for by local or regional companies, which seem to be filling the gap left by the big international players.

[6] The difference between these two counts is due to (1) better coverage of China in the authors' database. Chinese projects account for 52% of the total signed in 2004; (2) the inclusion of dual desalination and power projects in the authors' database, which make up 8% of projects recorded in 2004 and (3) the cut-off project value for the World Bank database. "The Private Participation in Infrastructure (PPI) Project Database lacks good coverage of small-scale providers of water and sewerage services because projects involving such providers usually are not reported by the sources it uses." (Izaguirre & Hunt 2005). Small projects accounts for 17% of the new contracts awarded in 2004.

In this context, it is useful to re-examine the relationship between national characteristics and the level of private sector interest in the water sector. In particular, it is important to incorporate the factors of interest to domestic investors, who are taking the place of multinational companies in a growing number of developing countries.

The water and sanitation sector attracts fewer investors for a number of reasons. Firstly, tariffs are generally below full cost recovery levels (operating plus capital costs), limiting the returns that investors can expect to earn (Sirtaine, Pinglo et al. 2004). Systematic tariff increases are supported by few governments. Investors also recognise the need for 'willingness to pay' and take the view that the household's water bill should not rise above 1-2 per cent of total household expenditure.[7] Using this rule of thumb, PSP may not be financially viable in cities where a large proportion of the population live on very low incomes. Secondly, water sector projects tend to have long time-lags before investments can be recouped, in comparison to the telecoms sector, for example. This increases the risk of expropriation faced by the investor. Thirdly, water project revenues are denominated in local currency, creating a mismatch between the currency of revenues and that of debt service for international investors, subjecting foreign investors to exchange rate risk. This is exacerbated by the shallowness of local capital market in most developing countries.

China is an important exception on several of these counts: local currency is widely available and the central government is committed to raising tariffs. This helps to account for the important flows of both domestic and international investment capital that the Chinese water market has managed to attract in recent years (Blanc-Brude and Jensen 2004).

[7] Interview with Steve Clarke, Suez representative in China (Hong Kong, July, 2004)

Systematic analysis of PSP in the water sector has been hindered by data limitations. In contrast to the power and telecoms sectors, for which international data on the extent of liberalisation and relevant sectoral regulation is collected by the World Bank and International Telecommunication Union respectively, no such information is collected for the water and sanitation sector. This is partly due to the fact that water tends to be the responsibility of municipal or regional levels of government and information on investment and regulatory structures is not collected at the national level. Exceptions tend to be small countries, like Singapore or Panama, where there is a single national utility. In some countries, the central government plays a role in developing policies and guidelines but is not able to regulate the sector directly, while in a few countries, mainly in Latin America, state-level service providers are regulated centrally. Thus there can be considerable variation in the institutional arrangements for water provision within as well as across countries. The dispersed nature of responsibility for water and sanitation services may also account for difficulties in implementing reform programmes spearheaded by the central government (Foster 2005).

A further distinctive characteristic of the water sector related to decentralisation is that PSP contracts are often agreed in the absence of a national regulatory framework defined in law. Instead, a set of contracts is agreed on ad hoc basis that govern the relationship between public authorities, state enterprises and the private sector. A regulatory agency of some kind may be created on the basis of contractual provisions to monitor and enforce the terms of a specific contract, as for example in the water concession contracts for Jakarta and Manila. In effect, the regulatory regime is specific to a city or region. In these cases, it would be inaccurate to describe the *country* as having an economic regulator for the water sector. This degree of specificity makes the task of collecting accurate information of water regulation across countries even more challenging.

Equally, data on infrastructure penetration and sector performance is not regularly collected. International coverage data for access to "improved water supply" and "improved sanitation" is collected by the WHO-UNICEF Joint Monitoring Programme using national sources and is updated irregularly.[8]

The current debate about PSP in water is based upon certain stylised facts about the sector[9]:

- PSP worldwide has been on a downward trend since the Asian crisis.
- The risks associated with investments in the sector are too high given the returns available to international investors.
- International water service companies have lost interest in investments in emerging markets but local and regional companies are taking the place of international investors and are expanding into other countries (as in China, Peru, Chile and Malaysia).
- International companies are no longer willing to engage in high-risk capital investments (especially concessions). Contract types without equity risk like management and operations contracts are replacing concessions and divestitures in the water sector.

We will compare these perceptions of the sector with the evidence provided by our Water PSP database.

The discussion above has demonstrated the pressing need for better data and analysis of PSP in the water sector. This paper is a first attempt to address this gap, firstly by presenting the newly constructed Watsan PSP dataset, and secondly, using this dataset to investigate the determinants of PSP 'supply' – the private investor's decision to enter a country – and 'demand' – the government's decision to open the sector to private investment.

[8] The WHO-UNICEF Joint Monitoring Program collects data on 'access to improved water supply' and 'access to improved sanitation' for a large sample of countries. Cross-country data is available for two years: 1990 and 2002. The figures are based on data collected in national surveys or censuses in preceding years. See http://www.wssinfo.org/en/welcome.html

[9] These views were expressed, for example in the Water Operators Roundtable session of the World Bank Water Week 1-3 March 2005 (Washington D.C.) See: http://www.worldbank.org/watsan2/waterweek/6.htm

3 - Institutions, Infrastructure and Investment

Starting with North, economists have increasingly emphasised the role of institutions in long-term development outcomes (North 1981). One strand of this literature has sought to test the relationship between institutions and macroeconomic growth, adopting an instrumental variables strategy to cope with endogeneity but treating institutions as a 'package'.

Recently, a number of promising developments have been made in unpacking the notion of institutions. Acemoglu and Johnson (2003) separate property rights institutions and contracting institutions as possible candidates for significant institutions. They test these two types of institutions separately and find that contracting institutions have little effect on long-run economic development. Property rights, on the other hand, retain their significance when contracting rights are held constant. A second avenue of research is pursued by Rigobon and Rodrik (2004) who find that rule of law has a significant impact on economic performance when considering the multiple channels of interaction between institutions and development, while democracy has a much smaller impact. Rule of law and property rights institutions therefore emerge as promising candidates in explaining the level of PSP.

The theoretical literature on contracts points to the importance of the government's 'commitment' not to renegotiate the terms of a contract or change regulatory arrangements ex post. Williamson (1985) shows that where one party to a long-term contract expects the other party to renege on the terms of the contract after investment has been sunk, the party will invest less in 'relationship-specific' assets (assets that cannot be put to alternative use outside the contract). In the water sector, such relationship-specific assets constitute a very high proportion of the total investment as water treatment and distribution assets are not readily adaptable to alternative uses. Thus we would expect the ability of the government to show commitment not to expropriate investments made by the private sector to be an important determinant of PSP.

The government's ability to demonstrate commitment will be affected by the country's institutions. Easterly and Serven (2003) highlight political stability, policy credibility and the existence of a sound regulatory framework as the necessary factors to lower the investor's perceived risk of expropriation. Other aspects of the institutional environment that may be important to commitment are the ability of the bureaucracy to implement policy or enforce regulation, or the quality of the legal and judicial systems and the level of corruption.[10]

The importance of government commitment not to change regulatory rules over the life of long-term contracts has been investigated empirically in several papers. Levy & Spiller (1994) analyse five case studies from the telecoms sector, focusing on the quality of the judicial system. They find that lower levels of commitment are associated with lower levels of investment by private companies. They argue that countries with an independent judiciary can achieve commitment by using the appropriate regulatory structure for PSP. In countries with a strong contract law tradition, governments can demonstrate commitment by establishing regulatory principles in a contract with the private company. On the other hand, countries with a strong tradition of administrative law, regulatory commitment can be achieved through an independent regulatory agency. While the evidence presented by Levy & Spiller in five case studies does not conclusively demonstrate the validity of their argument, it does support the view that commitment is important to sustain levels of private investment.

Henisz and Zelner (2001) and Bergara, Henisz and Spiller (1998) test the relationship between commitment and investment in the telecoms and electricity sectors respectively, using long-term panel data. They develop an index of political constraints to proxy for "commitment". The index reflects the number of veto points in the structure of the country's political institutions and the degree of contestation between and within the legislature and executive. As a dependent variable, the authors select a measure of

[10] The relationship between corruption and private investment is investigated by Everhart and Sumlinski Everhart, S. S. and M. A. Sumlinski (2001). "Trends in Private Investment in Developing Countries and the Impact on Private Investment of Corruption and the Quality of Public Investment." International Finance Corporation Discussion Paper **No. 44**.. They find that the mechanism driving the negative effect of corruption on private investment levels is due to the detrimental impact of corruption on the quality of public investment.

infrastructure quality, which they argue reflects the level of public and private investment over time. Their analysis finds that government commitment, measured by the political constraints index, is a significant determinant of investment in infrastructure.

Other papers examining infrastructure sectors have drawn attention to sector-level institutions in determining the level of private sector interest. Wallsten (2002) examines the relationship between sector regulation and private investment in the electricity sector, and in particular the existence of a separate regulatory agency not directly under control of the Ministry. He finds that countries with a regulator have more private sector investment and that regulation has a positive impact on the prices investors are prepared to pay for privatised assets. Looking at the sequencing of reform and privatisation, Wallsten finds that the establishment of a regulator prior to privatisation is significantly and positively correlated with infrastructure penetration and investment levels. But his analysis also generates the surprising result that regulatory independence has a robust negative correlation with investment. He suggests that 'too much independence from political influence may be harmful' to the firm's interests (Wallsten: 13). This explanation echoes the argument of Levy & Spiller (1994) against discretionary regulatory bodies under certain political systems and is backed up by the views expressed by investors in the Water Operators Roundtable (World Bank 2005) and in field interviews, as well as Pargal's results, discussed below.

Looking at data from Latin American countries, Pargal (2003) finds that the passage of legislation liberalising the investment regime is a significant determinant of investment volumes. His results show that the existence of a regulatory body loses its significance when legislation is controlled for, and he concludes that the legal basis for reform is more important than specific aspects of the institutional framework for PSP. However, when Pargal breaks the results down by sector, he finds that the relationship between legislation and investment does not hold for the water sector. He suggests that the powerful natural monopoly characteristics of the sector and the 'essential' nature of the service make the water sector riskier than others, and he argues that investors require more than just a sector law to reassure

them of a fair and consistent regulatory regime. Furthermore, the ad hoc nature of PSP contracting in the water sector means that sectoral legislation is neither necessary nor sufficient for private investment.

Empirical analysis of the impact of institutions raises the problem of endogeneity because private investment could be driving regulatory reform. The water sector seems particularly susceptible to this error as PSP has frequently preceded sectoral restructuring legislation. In these circumstances, the private partner may exert a direct influence on the kind of regulatory regime created and the nature and powers of any regulatory agencies created. Indeed, the regulator may be created at the behest of the private partner as a condition for their involvement. We may not therefore maintain the assumption that causation runs exclusively from the regulatory arrangements to the level of private investment.

Saleth and Dinar (2004) emphasise the feedback effects between institutions and outcomes in their work on the water sector. They construct a series of simultaneous equations to model the interactive effects of changes in water sector institutions and water sector outcomes. Their work represents a useful first step to dealing explicitly with endogeneity, but it is not clear that the data they use to test their model is adequate. Ideally, their model could be tested on a dataset combining objective and perceptions indicators, better suited to test the complexity of the interaction between institutions and outcomes at the sector level. An alternative approach to the problem of endogeneity that we employ here is to use institutional variables that are not affected by private investment in the water sector. We choose institutional variables that are sufficiently general, such as the 'rule of law', that we can be confident that the direction of causation runs from the institutions to outcomes in the water sector. Thus we can isolate the effect of institutions on private investment.

The firm's decision to invest will be influenced by the expected risk and return associated with the project. In a portfolio of investment projects, we would expect investors to balance high risk-high return projects with low risk-low return projects. Many of the factors determining the expected risk-return outcomes will

be project-specific. However, others will be associated with macroeconomic characteristics. In this research, we capture these risks using a composite measure, the ICRG Index of economic risk.

Considering PSP from the government's point of view brings a further set of considerations. The decision by a government to consider PSP in the water sector may be influenced by a number of factors. In particular, a crisis such as a severe drought or flooding might prompt the government to consider reforms, including PSP. A financial crisis at the sector level, in which one or many water utilities were unable to service their debts, might also prompt action from the government. Secondly, loans or grants from multilateral institutions and donors directly or indirectly related to the water sector (such as an urban or rural development project) might also be associated with the decision of the government to open the sector to PSP.[11]

A third catalyst of change might be a macroeconomic crisis, leading to reductions in government spending. Infrastructure investment tends to be cut more severely and sooner when governments are undertaking programmes of fiscal retrenchment than other types of expenditure (Calderon, Easterly et al. 2003). In their review of the Latin American experience with economic stabilisation programmes, Easterly and Serven show that governments expect privatisation to improve the fiscal balance by: generating revenues in the short-term through asset sales; reducing government expenditure on operating and capital expenditures; raising tax revenues, although the medium-term fiscal effects of privatisation are not necessarily positive (Calderon, Easterly et al. 2003). This view is also backed up by case studies (Ménard, Clarke et al. 2000a, for example.)

Coverage and service quality is low in most low- and lower-middle income countries, yet we should not assume that governments choose to reform the sector as a result of poor coverage. In fact, it is common for the water sector to be stuck in a low-level equilibrium of low tariffs, low investment and low service

[11] Field research in Malaysia (Johor State) and Indonesia (Jakarta) revealed a common pattern: the water utility in each case received a loan from a donor or development bank to carry out service improvements which was linked to considering models for private sector participation in water service delivery.

quality (Savedoff, Spiller et al. 1999). Instead, we should see reform in the context of the political economy and the result of a confluence of factors strengthening the interest groups in favour of reform (Estache 2005). We would expect that governments would introduce reform when the coalition of interests in favour of reform had become sufficiently strong to overcome entrenched interests, notably private sector unions.

This review of the theoretical and empirical literature points to the importance of the following factors in private infrastructure investment:

(a) Institutions, in particular the rule of law and the protection of property rights. Sector level institutions are less likely to be important in the water sector because of the high degree of within-country variability in regulatory structures and the absence of sector legislation in many countries.
(b) The fiscal status of the government emerges as a likely explanatory factor in the government's decision to liberalise the sector for private investment.
(c) Low levels of coverage or poor service quality that strengthen the coalition of interests in favour of water sector reform and therefore should be associated with greater openness to PSP.

We use the new Watsan PSP dataset to test the following key hypotheses emerging from the literature:

- H1: Governments in developing countries will allow PSP when implementing fiscal retrenchment
- H2: Governments will be more likely to engage in PSP where demands for increasing coverage or quality are strong
- H3: Private water companies will be more likely to enter countries where household incomes are high enough to support 'willingness to pay' for water services
- H4: Private investors will be more likely to engage in PSP where institutions support government commitment to upholding contracts or implementing established regulatory rules. The relevant institutions are: protection of property rights; enforcement of contracts; rule of law; ability of the bureaucracy to implement policies and rules; political stability; control of corruption.

4 - Descriptive Statistics

Detailed descriptive statistics of the dataset are presented in Annex B. Several points are worth noting. The number of projects recovers in 2004, after a steady decline since 2000. Most of this recovery is due to high levels of activity in China. The proportion of new BOT projects signed out of total projects seems to be falling back to the levels of the mid-1990s (Graph 2). The falling popularity of BOT projects may be explained by the experience that many countries, particularly in the Asian region, have had with this structure.[12]

The widely held view that concessions are no longer an attractive model for private investors is contradicted by the evidence presented here, which shows the number of new concessions signed each year has been constant or rising since 2000. Leases and management contracts are growing in popularity as contract models, which can be explained by the increasing reluctance of private companies to take equity risk in developing regions. China, once again, in an exception to this pattern: there have been several large equity deals in recent years.[13]

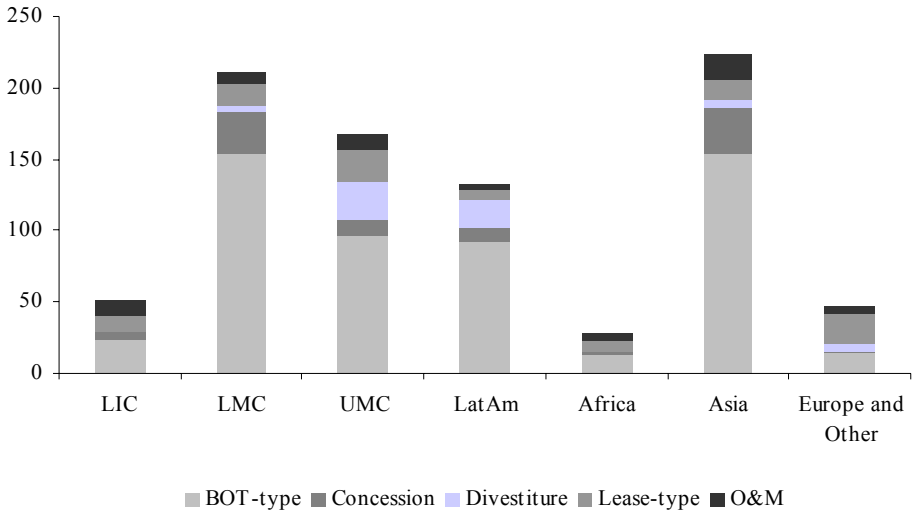
The frequency of contract types varies across regions and income groups (Graph 1). There have been no divestitures among low income countries, but divestitures are the second most frequent model in the upper middle income group. Concessions appear to be most important in the lower middle income group. Across regions, concessions have been very rare in Europe and most frequent in Asia. Divestitures are concentrated in the Latin American region, although there are also some examples in Europe. These figures are consistent with the view that investors are more willing to take equity risk (in BOTs, divestitures and concessions) in higher income countries.

[12] High tariffs paid to BOT suppliers for treated water near to or exceeding the tariffs paid for water by consumers have undermined the financial viability of public water utilities, rendering some projects unsustainable. In some cases, as in Chengdu, China, demand projections proved to be over-estimated in take-or-pay contracts, obliging the public utility to use treated water from the high-cost BOT supplier before using lower-cost sources (Blanc-Brude and Jensen 2004).

[13] Veolia acquired shares in the water companies serving Shanghai Pudong in 2002, and Shenzhen in 2003, the latter in partnership with a local partner, Beijing Capital. Chinese municipalities show little or no interest in management contracts and generally require capital investment by the private sector (Blanc-Brude and Jensen 2004).

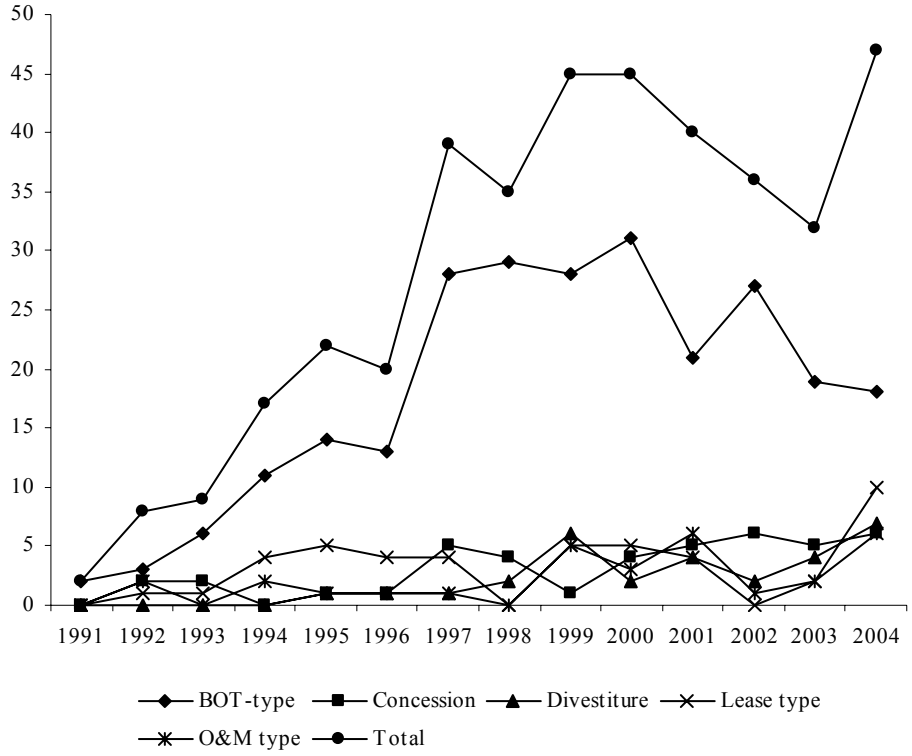
PSP in the water sector is not entirely dominated by a small number of international companies. In fact, projects without international involvement constitute the majority of projects in Malaysia and China and recent deals in Latin America (Chile and Peru) also point to the ascendancy of domestic companies (Graph 3). This trend is not exclusive to countries in the higher income groups. However, in Europe there are no projects without international involvement and there is only one project of this kind in Africa.

Graph 1: Number of Projects by Contract Type (1990-2004)

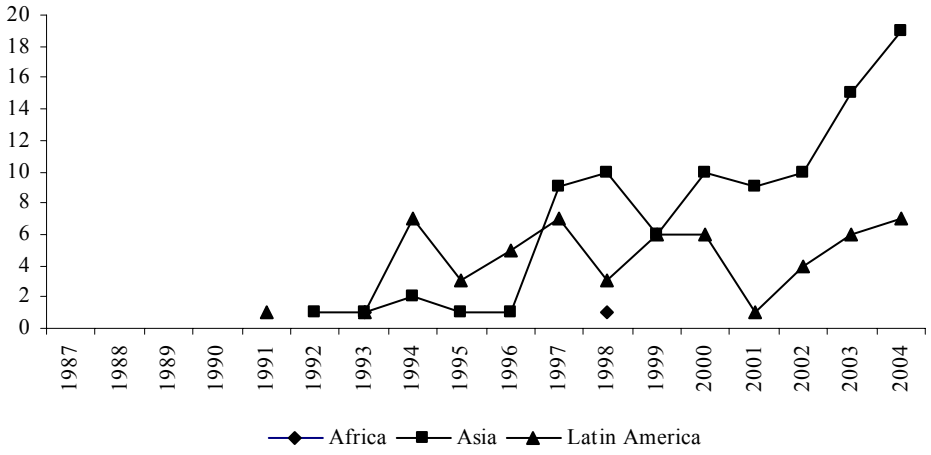


Graph 3 also shows that most of the new investments in Latin America involve only domestic companies while the level of international involvement has collapsed (Graph 4). In contrast, in Asia, the growth in project numbers is due to both domestic and foreign investors. Moreover, the latter include many regional investors such as Malaysian companies investing in China.

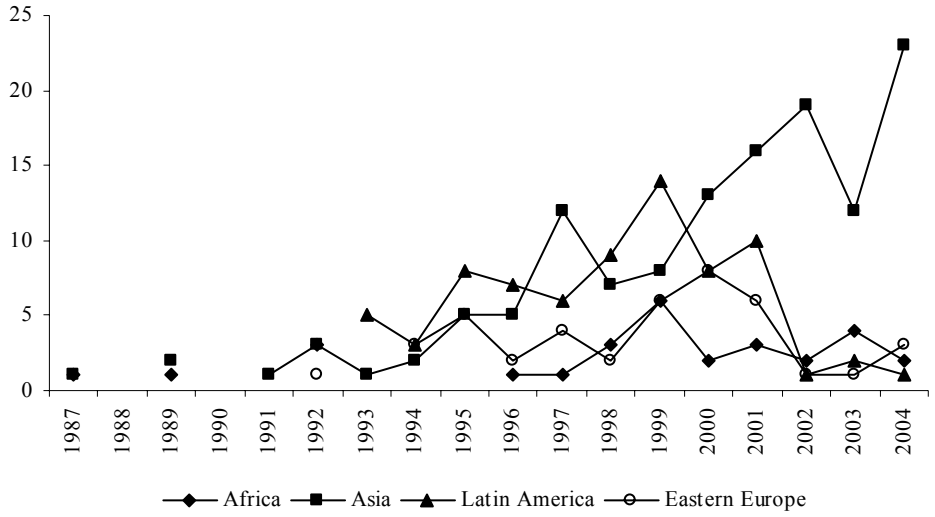
Graph 2: Water and Sanitation Contracts Awarded (1990-2004)



Graph 3: Number of Projects by Local Investors



Graph 4: Number of Projects by Foreign Investors



5 - The Model

We choose to test count models for a sample of countries from our Water and Sanitation PSP database. We use a Poisson Regression Model (PRM) and a Negative Binomial Regression Model (NBRM) to examine the determinants of the number of PSP projects that have occurred (or not) in our sample. Following our hypotheses, the model we choose to estimate is the following:

PSP = *f*(Market Size, Market Risk, Ability-to-pay, Sector Performance, Public Finance, Institutions) *(full model)*

The model controls for market size and risk while testing our four hypotheses about the determinants of water PSP. The model is assumed to be nonlinear in the variables (but linear in the parameters) and a number of variables are transformed into their natural logarithms.

Market size, market risk, ability-to-pay and public finance are assumed to have nonlinear relationship with the predicted mean of project count (see next section for a detailed explanation of count models). We assume that these relationships are best described by the natural log function: beyond a certain threshold, the effect of the variable tends to wear off. For instance, we hypothesise that the ability to pay for service will partly determine the extent of private sector involvement, but beyond a certain level of wealth, this is unlikely to make a difference.

Next, we test for correlation between independent variables. The correlation matrix in Annex A shows that institutional variables are highly correlated. To avoid multicolinearity and loss of explanatory power, we chose to test each institutional variable separately. We thus have seven different models.

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance) *(basic model)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Rule of Law) *(model1)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Gov. Efficiency) *(model2)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Pol. Stab.) *(model3)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Corruption) *(model4)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Contract Enfor.) *(model5)*

PSP = *f*(Mkt Size, Mkt Risk, Ability-to-Pay, Sector Perf., Public Finance, Prop Rights) *(model6)*

The Dependent Variable

The data currently available on global private investments in the water sector is inadequate for statistical analysis of the sector. The World Bank PPI Database records only a subset of the contracts awarded in the sector. While it has good coverage of large projects and those involving international investors, its coverage of smaller projects and those involving domestic investors is less consistent. These smaller projects without international involvement constitute a significant proportion of projects in the sector and unlike in other infrastructure sectors, small capital investments may be enough to lead to significant changes in sector performance at the municipal level. Similarly, the water sector is well suited to local investment as sophisticated technology is not necessary, revenues are in local currency and capital needs per project are lower.

We were prompted by the limitations of the existing data to develop a new dataset. The Watsan PSP dataset covers both water and sanitation projects in lower and middle income countries for the period

1990-2005. The data has been collected from multiple sources and cross-checked.[14] Data was collected on the extent and nature of private involvement, the origin of private partners, investment volumes and contract type. This information was not available for all projects.

A subset of data, including only signed projects from a sample of developing countries is used for the analysis. This contains 460 project observations in 45 countries. 15 further developing countries with no active PSP projects in the water and sanitation sector are included in the sample. The countries selected have all indicated a willingness to consider PSP in the water and sanitation sector, either by introducing a national policy to that effect or engaging in negotiations with one or more private investors for a project in the sector. Countries in which PSP in the water sector is expressly forbidden by law or policy are not included.[15]

Despite the clear distinctions that are often drawn between divestitures, concessions, leases and management contracts, in practice these distinctions may often be blurred. We therefore classify the contracts into broad types.[16]

We employ the number of PSP contracts awarded as our dependent variable for the regression analysis. A small number of projects have been terminated, yielding different figures for the number of contracts signed and the number of projects that are currently active. The literature and qualitative research undertaken by the authors on concession contracts reveal that the decision to terminate a contract is very complex and we therefore choose to model this separately from the decision to engage in PSP in forthcoming research.

[14] The sources of data are: World Bank, Thomson Financial, Global Water Intelligence, Water Market China (Blanc-Brude and Jensen 2004), Water Market Asia (Blanc-Brude and Jensen, forthcoming) and numerous media and company releases. These data are cross-checked in interviews with operators, financiers, legal advisers and international institutions.

[15] Uruguay introduced a constitutional amendment in 2004 to prevent private provision of water services. However, as this decision was made only at the end of the period that we are considering (1990 and 2004), we include Uruguay in the dataset.

[16] 'BOT-type' includes BROT, BOOT, ROT and DBO contracts. Lease-type contracts include TOT and DBL. O&M type includes all contracts that do not provide for the private party to take any decisions on capital investment.

Other papers on PSP employ investment volumes as the dependent variable. However, for water PSP we have concerns about the quality of the data available for investment volumes. Investment figures are also only available for a smaller sample of projects. These tend to be the largest transactions, those involving international investors, and divestitures rather than concessions, generating a biased sample of the population of water PSP contracts. A second problem arises in the way that the figures are collected. For divestitures, the recorded investment figures refer to the purchase price of equity. For concessions, the figures refer to the investment commitments made by the concessionaire under the contract. In the World Bank PPI Database, equity sales are recorded in the year of the transaction, while investment commitments for concession are recorded in the year of financial closure, or in the year of the transaction, where the investments are phased and if this information is known.

However, after the initial transaction, information on investment levels for concessions is often not made available publicly. Where information is available, it seems that the actual level of investment by the private firm may diverge widely from the commitments made in the contract. Additionally, a large proportion of PSP contracts in the water sector are renegotiated and it is common for the revised contract to include the rescheduling of investment commitments (Guasch 2004).[17]

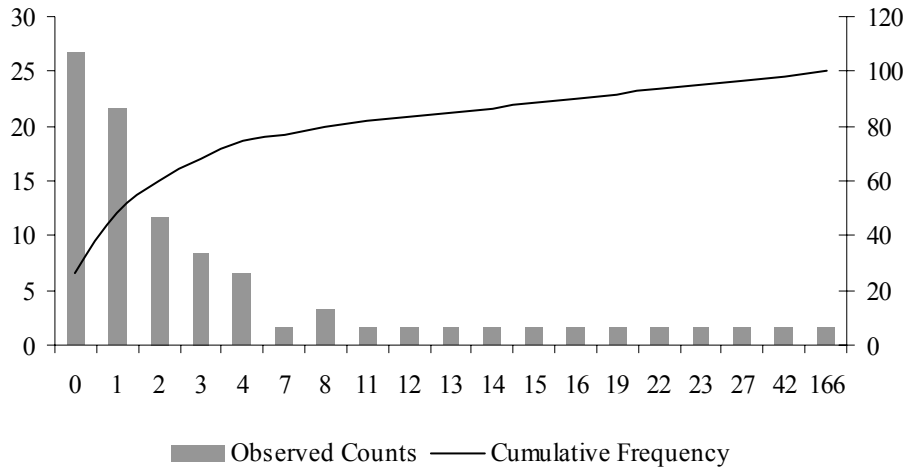
Henisz and Zelner use service outcomes (the number of lines per capita) as the dependent variable in their analysis of the telecoms sector (Henisz and Zelner 2001). This approach allows the authors to deal with the problem of unproductive investments, but does not allow us to isolate the effect of institutional variables on private investment, rather than public investment. In the water sector, private sector involvement is often relatively recent, and covers only a small section of the population. We would therefore expect the relationship between the level of private sector involvement and infrastructure penetration to be weak and we do not pursue the use of outcomes as a dependent variable. Furthermore,

[17] Field interviews conducted in Manila and Jakarta further substantiate this point.

insufficient data are available on the production volumes or population served by projects and those data available come from multiple sources and may be inconsistent and unreliable.

The count of projects awarded does not reflect the importance of the private sector in providing water and sanitation services in a particular country, but in the context of the present research, this is not a problem. We attempt to explain the decision of the government and the firm to engage in a partnership to provide water rather than on the scale of the project entered into.

Graph 5: Frequency of Watsan PSP Counts



The Independent Variables

We build a cross section of independent variables (IV) for our sample of 60 countries. Since the DV is the cumulative number of PSP projects awarded over a 15-year period, we use mean values to build the cross-section of IVs. We consider IVs from the following categories:

- **Market Size**: proxied by mean population (1990-2004)
- **Market Risk**: proxied by the ICRG Economic Risk Index (2004)
- **Ability-to-Pay**: proxied by mean GDP per capita (1990-2004)
- **Sector Performance**: proxied by urban "Coverage Gap" (mean urban population multiplied by the inverse of the 2002 WHO water coverage estimate for the urban sector)

- **Public Finance**: proxied by mean Debt/ GNI ratio (1990-2004)
- **Institutions**: proxied by the World Bank governance indicators for government efficiency, rule of law, political stability, control of corruption (all standardised indices) as well as contract enforceability (in number of days to enforce) and the ICRG investment profile index. All values for 2004.

Annex C describes the variables and their sources in greater detail. While classic quantitative variables such as population of GDP per capita are available for 1990-2004, institutional and risk indices are not. Indeed, most of theses indices were 'invented' during the mid and late 1990s.

However, the nature of institutions and the way such indices are built are such that the most recent values should allow us to capture the effects that we are interested in. Substantially, institutions change very slowly and we are confident that the relative degree of, say, the rule of law has been the same for the past fifteen years between Angola and El Salvador or Ethiopia and Turkey. Second, the World Bank governance indicators and the ICRG risk indices were built for comparative purposes, to capture exactly that kind of variance between countries worldwide, and each individual value only changes very little each time the indices are updated. We are confident that using the 2004 value for these variables will allow us to capture the cross-country effects we are interested in. However, a further note of caution is necessary regarding institutional variables.

It has proved very difficult to generate indicators for institutional quality that capture the relevant aspects of institutions. These indicators fall into two categories: objective indicators and perceptions indicators. Both are subject to measurement error. Objective indicators often capture only one aspect of the underlying institutional phenomenon that is of interest to the researcher. For example, data on the number of days that it takes to enforce a contract can be used as an indicator of the quality of legal and judicial institutions. However, this is only one of several relevant features of those institutions. Others could include corruption or arbitrariness in the system, which may be more important from the investor's point

of view. Furthermore, objective indicators often do not capture the implementation of regulation or policy. On the other hand, perceptions indicators are subject to measurement error of a different kind: non-specificity and halo effects, where respondents' answers are affected by the general level prosperity in a country (Kaufmann, Kraay et al. 2005). For the purposes of this research, we employ indices which combine objective with perceptions indicators. We are nevertheless well aware of the difficulty of finding indicators that reflect adequately underlying institutional attributes.

6 - Count Outcome Models

This section describes how count outcome models can serve the purpose of testing the determinants of the PSP projects identified in our database. It borrows heavily from Long and Freese (2001).

Count variables indicate how many times something has happened. The use of regression models for counts is relatively recent but has wide ranging applications in social sciences and, in this case, in investment decision analysis. While the linear regression model has often been applied to count outcomes, this can result in inefficient, inconsistent, and biased estimates. Moreover, count distribution are rarely statistically normal. Even though there are situations in which the linear models provide reasonable results, it is much safer to use models specifically designed for count outcomes.

The Poisson Distribution

The univariate Poisson distribution is the foundation of regression models for counts. Let y be a random variable indicating the number of times an event has occurred. If y has a Poisson distribution, then:

$$\Pr(y \mid \mu) = (e^{-\mu} * \mu^{y}) / y! \qquad \text{for } y = 0, 1, 2, \ldots \qquad (1)$$

where $\mu > 0$ is the sole parameter defining the distribution

μ is the mean of the Poisson distribution. μ is also the variance. Thus, Var(y) = μ, which is known as *equidispersion*. With most datasets, many count variables have a variance greater than their mean, which is called *overdispersion*. As μ increases, the probability of a zero count decreases. For many count variables, there are more observed zeros than predicted by the Poisson distribution.

The Poisson Regression Model

The Poisson regression model (PRM) extends the Poisson distribution by allowing each observation to have a different value of μ. More formally, the PRM assumes that the observed count for observation i is drawn from a Poisson distribution with mean μi, where μi is estimated from observed characteristics. This is sometimes referred to as incorporating *observed heterogeneity*, and leads to the structural equation:

$$\mu_i = E(y_i \mid x_i) = \exp(x_i\beta) \qquad (2)$$

Using the exponential of xβ forces μ to be positive; this is necessary since counts can only be zero or positive. For each value of μ, the distribution around the mean represent the probability of each count. Interpretation of the model involves assessing how changes in the independent variables affect the conditional mean and the probabilities of various counts.

Exposure time

Different observations may have different *exposure* times i.e. each observation is 'at risk' of having a positive count for a different amount of time. In our example, each country will have been 'at risk' of having a positive count of private project for as long as the legal framework has allowed such projects.

We create an exposure variable (FIRSTPPP) which measures the number of years since the first private infrastructure project (not just in the water sector) was signed in country i. For most countries this signals

the beginning of reform of public utilities and the point after which a private water project becomes possible. The data for FIRSTPPP is drawn from the World Bank's PPI database.

Exposure times can be incorporated quite simply into count models. Let t_i be the amount of time that observation i is at risk. If the rate (i.e., the expected number of observations for a single unit of time) for that case is μi, then we would expect $t_i * \mu_i$ to be the expected count over a period of length t_i. Then, assuming only two independent variables for simplicity, our count equation becomes:

$$\mu_i * t_i = [\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2)] \times t_i \qquad (3)$$

Since $t = \exp(\ln t)$ we have $\mu_i * t_i = \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ln t_i)$

This shows that the effect of different exposure times can be included as the log of the exposure time with a regression coefficient constrained to equal 1.

Fitting the PRM

Using STATA 8.2 SE, we fit the Poisson regression for our basic model.

```
Poisson regression                                Number of obs   =         56
                                                  LR chi2(5)      =    1012.27
                                                  Prob > chi2     =     0.0000
Log likelihood = -141.09945                       Pseudo R2       =     0.7820

------------------------------------------------------------------------------
   PSPSIGNED |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  LOGPOPMEAN |   .5586395    .059013     9.47   0.000     .4429762    .6743028
LOGGDPCAPM~N |   1.066049   .0992518    10.74   0.000     .8715185    1.260578
  LOGICRGECO |   4.110727   .8939287     4.60   0.000     2.358659    5.862795
 COVERAGEGAP |   .0000853   .0000113     7.58   0.000     .0000632    .0001074
 LOGBDEBTGNI |   .2242772   .1693449     1.32   0.185    -.1076327    .5561871
       _cons |  -30.61535   3.372048    -9.08   0.000    -37.22444   -24.00626
    FIRSTPPP | (exposure)
------------------------------------------------------------------------------

Measures of Fit for Poisson of PSPSIGNED

Log-Lik Intercept Only:     -647.232     Log-Lik Full Model:         -141.099
D(50):                       282.199     LR(5):                     1012.265
                                         Prob > LR:                    0.000
McFadden's R2:                 0.782     McFadden's Adj R2:            0.773
Maximum Likelihood R2:         1.000     Cragg & Uhler's R2:           1.000
AIC:                           5.254     AIC*n:                      294.199
BIC:                          80.931     BIC':                      -992.139

Goodness-of-fit chi2  =   148.383
Prob > chi2(50)       =    0.0000
```

As with most Poisson regressions applied to real-world data, we find a poor fit. Various measures of pseudo and adjusted R-squared are suspiciously high and the Chi-Square test for the goodness of fit of the regression forces us to reject the null hypothesis that our distribution is a Poisson distribution.

The bad fit of the PRM is not a surprise since the standard deviation of our distribution is about three times the mean[18].

The Negative Binomial Regression Model

The PRM accounts for observed heterogeneity (i.e., observed differences among sample members) by specifying the rate μ_i as a function of observed x_k's. In practice the PRM rarely fits due to *over-dispersion*. That is, the model underestimates the amount of dispersion in the outcome. The negative binomial regression model (NBRM) addresses the failure of the PRM by adding a parameter α that reflects *unobserved* heterogeneity among observations.2 For example, with three independent variables, the PRM is:

$$\mu_i = \exp(\beta 0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3}) \qquad (4)$$

The NBRM adds an error ε that is assumed to be uncorrelated with the x's,

$$\mu_i = \exp(\beta 0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \varepsilon_i)$$
$$= \exp(\beta 0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3}) \exp(\varepsilon_i)$$
$$= \exp(\beta 0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3}) \delta_i$$

where the second step follows by basic algebra, and the last step simply defines $\delta \equiv \exp(\varepsilon)$. To identify the model, we assume that $E(\delta) = 1$ which corresponds to the assumption $E(\varepsilon) = 0$ in the LRM. With this assumption, it is easy to show that:

[18] This is partly due to the very high number of PSP projects in China. Even after for correcting for outliers (China), the SD of the distribution (9.34) is still almost twice the mean (5.6) – See Annex B for detailed descriptive statistics.

$$E(\mu) = \mu E(\delta) = \mu$$

Thus, *the* PRM *and the* NBRM *have the same mean structure*. That is, if the assumptions of the NBRM are correct, the expected rate for a given level of the independent variables will be the same in both models. However, the standard errors in the PRM will be biased downward, resulting in spuriously large *z*-values and spuriously small *p*-values (Cameron and Trivedi 1998).

The distribution of observations given both the values of the *x*'s *and* δ is still Poisson in the NBRM. That is,

$$\Pr(y_i \mid \mathbf{x}_i, \delta_i) = (e^{-\mu i} * \mu^{yi}{}_i) / y_i! \qquad (5)$$

Since δ is unknown, we cannot compute Pr (y | **x**). This is resolved by assuming that δ is drawn from a gamma distribution (see Long (1997: 231-232) or Cameron and Trivedi (1998:70-79) for details). Then we can compute Pr (y | **x**) as a weighted combination of Pr (y | **x**, δ) for all values of δ, where the weights are determined by Pr (δ). This leads to the negative binomial distribution:

$$\Pr(y \mid \mathbf{x}) = [\Gamma(y + \alpha^{-1})/ y! * \Gamma(\alpha^{-1})] * [\alpha^{-1} / (\alpha^{-1} + \mu)]^{\alpha-1} * [\mu/(\alpha-1 + \mu)]^{y}$$

where Γ is the gamma function. (6)

The larger value of α, the greater spread in the data; indeed, if $\alpha = 0$, the NBRM reduces to the PRM, which turns out to be the key to testing for over-dispersion.

We estimate our basic model with the NBRM in STATA 8.2 SE.

```
Negative binomial regression                    Number of obs   =         56
                                                LR chi2(5)      =      62.83
                                                Prob > chi2     =     0.0000
Log likelihood = -122.88584                     Pseudo R2       =     0.2036
```

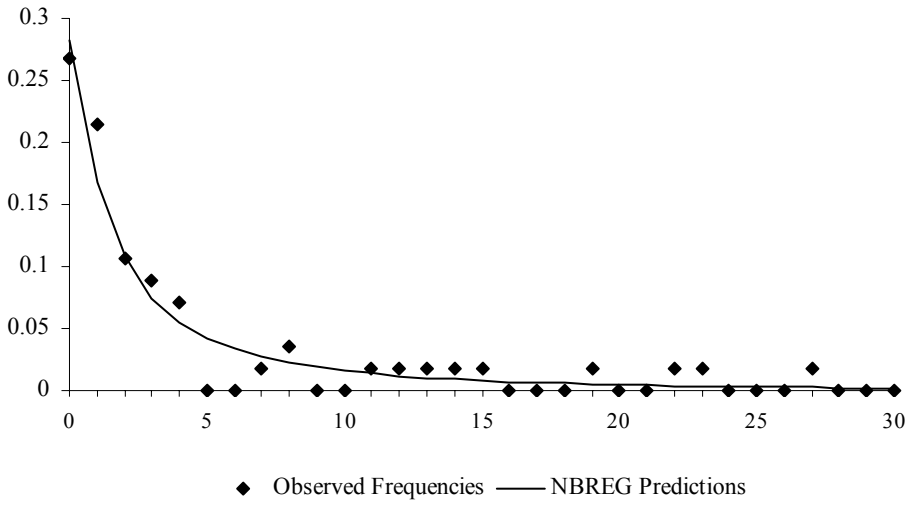
PSPSIGNED	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LOGPOPMEAN	.5880215	.1261757	4.66	0.000	.3407216	.8353213
LOGGDPCAPM~N	.9950203	.2148994	4.63	0.000	.5738251	1.416215
LOGICRGECO	3.25384	1.808789	1.80	0.072	-.2913212	6.799002
COVERAGEGAP	.0000794	.0000312	2.54	0.011	.0000181	.0001406
LOGBDEBTGNI	.5546001	.3261312	1.70	0.089	-.0846054	1.193806
_cons	-28.54979	6.39603	-4.46	0.000	-41.08578	-16.01381
FIRSTPPP	(exposure)					
/lnalpha	-.8124094	.3793467			-1.555915	-.0689036
alpha	.4437875	.1683493			.2109962	.9334167

Likelihood-ratio test of alpha=0: chibar2(01) = 36.43 Prob>=chibar2 = 0.000

Measures of Fit for nbreg of PSPSIGNED

Log-Lik Intercept Only:	-154.302	Log-Lik Full Model:	-122.886
D(49):	245.772	LR(5):	62.833
		Prob > LR:	0.000
McFadden's R2:	0.204	McFadden's Adj R2:	0.158
Maximum Likelihood R2:	0.674	Cragg & Uhler's R2:	0.677
AIC:	4.639	AIC*n:	259.772
BIC:	48.529	BIC':	-42.706

Graph 6: Observed and Predicted Frequencies of PSP Counts



The output is similar to that of Poisson, with the exception of the results at the bottom of the output. While the model was defined in terms of the parameter α, STATA estimates ln (α) with the estimate given in the line "lnalpha". This is done because estimating ln (α) forces the estimated α to be positive. The value of α is given on the next line.

The LR test for H0: alpha = 0 is highly significant and we can reject the null hypothesis and conclude that there is significant evidence of over-dispersion. From this and the Bayesian Information Criterion (BIC) we can see that the NBRM is to be preferred to the PRM. Graph 6 plots the observed and predicted

frequencies using the NBRM-fitted model. We can see that the model fits the data correctly even though it tends to slightly over estimate the number of zeros[19]. Having determined that the NBRM fits our data best, we can now test the different versions of the model.

7 - Results and interpretation

The results for the regression of the different models can be found in Annex A. It follows from (5) that for a change of δ in x_k, the expected count increases by a factor of $\exp(\beta_k * \delta)$, holding all other variables constant. The following table summarises the results in percent change in expected PSP project count for a unit change in X, holding other variables constant.

Percent change in expected count for a one unit change in X								
Variable	**Transf.**	**Basic Model**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Population	Natural Log	80***	90.2***	86.9***	95.6***	89***	102.1***	92.3***
GDP per capita	Natural Log	170.5***	142***	136.6***	138.5***	134***	228.4***	169.4***
Debt/GNI	Natural Log	74.1*	89.4**	97.4**	76.8*	89.2**	110.5**	116.4***
ICRG Economic Risk Index	Natural Log	2489*	1323.5	691.1	1778.3*	1343	736.8	948.9
Urban Coverage Gap	Raw	0***	0***	0***	0***	0***	0***	0***
Rule of Law	Raw		63.3**					
Government Effectiveness	Raw			49.6***				
Political Stability	Raw				42.5*			
Control of Corruption	Raw					81.6**		
Contract Enforcement	Raw						-0.1*	
ICRG Investment Profile	Natural Log							304.3***

**** Significant at 1%; ** significant at 5%; * significant at 10%*

The results should be read (looking at the first cell for the basic model): an increase of one unit of the log of the population variable increases the expected mean of project count by eighty percent with 99% confidence. The use of logarithmic transformations accounts for the size of some of the observed effects.

For instance, the ICRG Economic risk index seems to have a massive effect on the predicted mean of project count. This is due to the way the index is built and the use of a logarithmic transformation. The log of the ICRG Economic Risk Index (LOGICRGECO) in our cross-section of 60 countries has a mean of 3.56 and a standard deviation of 0.10. A one unit increase would thus represent an extremely large change

[19] The PRM fitted with the same data tends to underestimate zero counts.

in a country macro-economic risk conditions, hence the massive effect on predicted mean of project count, albeit not statistically significant.

Similarly, for the institutional indices variables that were not transformed, an increase of one unit represents a major shift in governance practices (Rule of Law, Government Effectiveness, Political Stability and Control of Corruption are zero-centred indices with min/max values of -2.5/2.5). Thus, an increase in one unit of the rule of law index, which corresponds to the difference between Angola and El Salvador, or Ethiopia and Turkey, increases the expected mean of project count by 63.3%.

For the purpose of our analysis, we concentrate on the *relative* size and statistical significance of these effects.

Overall, the results of the regression provide strong support for our hypotheses. The basic components of demand for water services, the size of the population and its ability to pay are significant at the 1% level and take the expected positive sign in all the models. We also observe that ability-to-pay has an impact on PSP that is twice as important as the effect of market size.

Turning next to the factors which drive government demand for the involvement of the private sector, we find that level of indebtedness of a country is significant in all the models, generally at the 5% level. The size of this effect is on the same scale as the effect of market size.

We understand this relationship to operate through the following mechanism: governments of more highly indebted countries find it more difficult to access credit, putting pressure on the government to engage in fiscal stabilisation. Governments then reduce their investment expenditure on infrastructure as part of their stabilisation efforts as this is less politically costly than reducing current expenditures. In order to compensate for this reduction in infrastructure expenditure, the government turns to the private sector.

A second possible mechanism would be that countries with high levels of indebtedness are more likely to come under pressure from international financial institutions. However, the effect of the volume of multilateral lending (not shown here) did not generate a significant result and had to be dropped. This may be because countries which receive large volumes of loans from multilaterals are less likely to have PSP projects for other reasons.

A third mechanism linking debt to PSP is the effect on macroeconomic risk faced by investors. More indebtedness raises macroeconomic and sovereign risks, discouraging investors from engaging in projects. However, the positive sign on the coefficient indicates that the effect of indebtedness on government demand for PSP is more powerful than any risk effect on investors.

A more general measure of macroeconomic risk, the ICRG economic risk index, does appear as significant at the 10% level in some of the models, but this finding is not robust across all the specifications. As we would expect macroeconomic risk to influence the investor's decision, we interpret this finding as an indication that investors are willing to take on more risk if the expected returns from the investment are high enough. This is supported by the high proportion of foreign investors in the sector, most of whom make investment decisions on a portfolio basis and are thus open to facing high risks in emerging markets. Unfortunately, at this stage, we are not able to include a measure of returns in our models. An alternative explanation for the absence of significance of the risk variable is that project due diligence can be poor and risks badly evaluated *ex ante*. This last point is supported by many of our field interviews with practitioners and legal counsels.

The second driver of government demand for PSP that we test is the urban coverage gap. This s an indicator of poor water sector performance and may proxy for the strength of interest group demand for the extension of service networks in cities. Ideally, we would be able to include a measure of service

quality as well, to reflect the demands of existing utility customers for better services, but this data is not available at the national level. The urban coverage gap appears as highly significant in all our models, but with a very small positive coefficient which does not allow us to observe its effect. The explanatory value of this variable is therefore limited, but its significance suggests that it would be worth developing an improved indicator. One interpretation is that poor sectoral performance is not what makes government open up their water sector to PSP and is consistent with the literature. Similarly, poor sector performance, implying the need for high capital expenditure, is not what attracts private investors.

Turning to the institutional characteristics of countries, we find that the indicators chosen perform well. In particular, we can see that the protection of property rights, reflected in the ICRG investment profile indicator, is significant at one percent, as is our measure of bureaucratic quality, 'government effectiveness'.

Because the four World Bank governance indicators have the same format and follow the same transformation, their effects are directly comparable. We find that the control of corruption has the biggest positive effect, followed by the rule of law, government effectiveness and political stability.

The rule of law indicator, which captures the quality of the judiciary, as emphasised by Levy and Spiller (1994), is significant at the 5% level. This somewhat lower level of significance may reflect the fact that this variable captures aspects of the rule of law that are less directly relevant to investors in the infrastructure sector, like the costs of common and organised crime and the quality of the police. A similar argument for the dilution of the effect of the variable may be made for political stability, which encompasses armed conflict and the risk of terrorism as well as the more directly relevant aspects of stability such as frequent or violent regime change or the extent of civil unrest.

The contract enforcement variable performs less well, consistent with Acemoglu and Johnson's findings (2003). This variable may reflect better the problems associated with enforcing contracts between private

parties, which are distinct from the problems associated with public-private agreements. An alternative explanation is that infrastructure investment in emerging markets has little to do with enforceability, especially for foreign investors, who rely on international arbitration for dispute resolution. Few PSP contracts attribute legal competence to local courts and even the likelihood of arbitration awards being enforced is usually limited. In the words of a senior project finance lawyer based in Asia: "a good contract gives you a seat at the negotiation table, not more."[20]

The very positive effect of the control of corruption can be surprising at first in a sector (construction) that is very prone to corruption and where competitive bidding has not always been the norm. This finding is however consistent with most studies of the link between investment, particularly FDI, and corruption (Moosa 2002).

8 – Conclusion

Quantitative research on private participation involvement in the water sector has been held back until now by limitations in the data. The poor quality of the data is in turn due to the relatively lower levels of investment in water and sanitation and the smaller average project size, compared to other infrastructure sectors. International data on infrastructure penetration and the operating and financial performance of water utilities that can be used for cross-country analysis is very limited because of the highly fragmented structure of the sector. Many national governments do not collect information from municipal and regional providers.

The development of the Watsan PSP database is a first step towards closing this gap in the literature. This new database includes well over twice the number of projects covered by the best existing source, the World Bank PPI Database. While this constitutes a significant improvement, we are currently deepening and strengthening the Watsan PSP database further to allow for more extensive analysis.

[20] Interview: Milbank LLP, Singapore, February 2004

With the information available, we are able to use a negative binomial count regression model to carry out a first analysis of the factors affecting PSP in the water and sanitation sector. We find that demand for higher coverage levels and constraints on government finances are significant variables. Institutions that support the government's commitment to uphold its agreements with private partners and to maintain stable regulatory arrangements are also important. Among these, investor protection against expropriation and the quality of the bureaucracy emerge as the most significant.

This initial analysis of the new dataset has delivered promising results and suggests a number of areas worthy of further investigation. Firstly, the institutions captured in indices like the 'rule of law' and 'government effectiveness' developed by the World Bank need to be unpacked. More precise measures of the institutions relevant to private investment in infrastructure need to identified and tested. Secondly, more information on legal and regulatory structures for water and sanitation across countries is needed to study the relationship between these sector-specific institutions and the level of private investment in the sector. The operational and financial performance of the sector seems a likely driver for PSP but cannot be tested because of the absence of country-level data. Thirdly, the role of international financial institutions in shaping government preferences with regard to PSP needs to be investigated further. Recent research pointing to a political backlash against policies linked with IFI involvement suggests a complex and interesting relationship (Henisz and Zelner 2004). Finally, it would be interesting to extend the analysis to include the exit decision of investors and the circumstances in which investors choose to terminate a water PSP contract.

These preliminary findings point to the existence of economic and institutional determinants to private infrastructure and water investment decisions that are sector specific and not necessarily in line with traditional findings for investment decisions (especially FDI). The characteristics of the sector, its political

economy, the type of investors involved and the financing of PSP have to be further explored to better characterise private sector participation in the water and infrastructure sectors.

*

ANNEX A: Regressions & Correlation Matrix

Negative Binomial Count Model for Watsan PSP in Developing Countries

Variable	Transf.	Basic Model Coef (z values)	Model 1 Coef (z values)	Model 2 Coef (z values)	Model 3 Coef (z values)	Model 4 Coef (z values)	Model 5 Coef (z values)	Model 6 Coef (z values)
Population	Natural Log	.5880215 (4.66)***	.6427902 (5.20)***	.6256657 (5.34)***	.6708151 (5.19)***	.6366447 (5.27)***	.7036564 (5.00)***	.6539809 (5.35)***
GDP per capita	Natural Log	9950203 (4.63)***	.8835992 (4.16)***	.8610534 (4.23)***	.8692786 (4.02)***	.8501009 (3.97)***	1.189205 (5.29)***	.9911512 (4.86)***
Debt/GNI	Natural Log	.5546001 (1.70)*	.638496 (2.01)**	.6800456 (2.17)**	.5698847 (1.84)*	.6376125 (2.03)**	.7445108 (2.16)**	.7721402 (2.37)***
ICRG Economic Risk Index	Natural Log	3.25384 (1.80)*	2.655701 (1.52)	2.068255 (1.19)	2.932969 (1.70)*	2.669317 (1.55)	2.124386 (1.14)	2.350292 (1.32)
Urban Coverage Gap	Raw	.0000794 (2.54)***	.0000809 (2.71)***	.000079 (2.74)***	.000065 (2.10)**	.0000828 (2.81)***	.0000752 (2.44)***	.000094 (3.14)***
Years since 1st Infra PPP	Raw	(exposure variable)	(exposure variable)	(exposure variable)	(exposure variable)	(exposure variable)	(exposure variable)	(exposure variable)
Rule of Law	Raw		.490248 (1.92)**					
Government Effectiveness	Raw			.6573652 (2.45)***				
Political Stability	Raw				.3540364 (1.80)*			
Control of Corruption	Raw					.5965077 (1.99)**		
Contract Enforcement	Raw						-.0014658 (-1.70)*	
ICRG Investment Profile	Natural Log							1.397096 (2.35)***
Intercept			-26.38656 (-4.26)***	-24.18575 (-3.91)***	-27.22815 (-4.44)***	-26.09864 (-4.25)***	-27.19408 (-4.35)***	-29.8503 (-4.83)***
Observations		56	56	56	56	56	56	56
Likelihood Ratio Chi-Square		62.83***	66.38***	68.44***	65.90***	66.71***	63.07***	67.01***
Pseudo-R2		0.2036	0.2151	0.2218	0.2135	0.2162	0.2158	0.2182
Chi/Square(1) test of alpha = 0		36.43***	26.30***	23.52***	26.05***	25.49***	28.01***	31.51***

**** Significant at 1%; ** significant at 5%; * significant at 10%*

Correlation Matrix

	Population (ln)	GDP per Capita (ln)	ICRG Eco Risk (ln)	Urban Coverage Gap	Debt/GNI (ln)	Rule of Law	Government Effectiveness	Political Stability	Control of Corruption	Contract Enforcement	ICRG Invest Profile (ln)
Population (ln)	1										
GDP per Capita (ln)	-0.3424	1									
ICRG Economic Risk (ln)	-0.0325	0.5563	1								
Urban Coverage Gap	0.6856	-0.2406	0.0882	1							
Debt/GNI (ln)	-0.1104	-0.499	-0.3544	-0.2503	1						
Rule of Law	-0.3152	0.6434	0.3823	-0.2283	-0.3802	1					
Government Effectiveness	-0.1747	0.6475	0.4753	-0.0857	-0.4441	0.9443	1				
Political Stability	-0.408	0.5769	0.3719	-0.1734	-0.3075	0.8529	0.8126	1			
Control of Corruption	-0.3497	0.6981	0.4091	-0.2416	-0.3949	0.9455	0.9259	0.7768	1		
Contract Enforcement	0.0977	0.0214	-0.146	0.004	0.0722	-0.2505	-0.2749	-0.2084	-0.245	1	
ICRG Investment Profile (ln)	-0.3468	0.5224	0.3409	-0.2883	-0.3684	0.7205	0.6879	0.7181	0.7062	-0.0706	1

ANNEX B: Descriptive Statistics

Descriptive statistics

	Whole sample	LIC	LMC	UMC	LatAm	Africa	Asia	Eastern Europe
Country	60	20	23	17	16	19	13	12
Number of contracts awarded	460	50	241	168	132	28	253	47
Mean*	7.67	2.50	10.48	9.88	8.25	1.47	19.46	3.92
SD	22.29							
Skewness	6.190355							
Kurtosis	43.97063							
Active projects	433	43	225	165	130	26	230	47
Early termination	27	8	16	3	2	2	23	0
active/total	94%	86%	93%	98%	98%	93%	91%	100%
term/total	6%	16%	7%	2%	2%	7%	9%	0%

**Mean (outliers correction i.e. China): 5.6, SD (outliers correction): 9.34*

Projects with international participation 460 Observations

	Whole sample	LIC	LMC	UMC	LatAm	Africa	Asia	Eastern Europe
Foreign Investor	272	29	138	105	73	27	127	45
Domestic Investor	188	22	103	63	59	1	126	2
intl/tot	59%	58%	57%	63%	55%	96%	50%	96%

Project type Contracts awarded 430 Observations

	Whole sample	LIC	LMC	UMC	LatAm	Africa	Asia	Eastern Europe
BOT-type	273	24	153	96	92	13	154	14
Concession	47	5	30	12	10	3	32	2
Divestiture	30	0	4	26	20	0	5	5
Lease type	49	12	15	22	6	7	15	21
O&M	31	10	9	12	4	5	17	5

Contracts Awarded by Type and Year 424 Observations

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Number of contracts signed	2	8	9	17	22	20	39	35	45	45	40	36	32	47	27
BOT-type	2	3	6	11	14	13	28	29	28	31	21	27	19	18	20
Concession	0	2	2	0	1	1	5	4	1	4	5	6	5	6	5
Divestiture	0	0	0	0	1	1	1	2	6	2	4	2	4	7	0
Lease type	0	1	1	4	5	4	4	0	5	5	4	0	2	10	2
O&M type	0	2	0	2	1	1	1	0	5	3	6	1	2	6	0

PSP Counts Frequency Distribution

PSP Signed	0	1	2	3	4	7	8	11	12	13	14	15	16	19	22	23	27	42	166
Freq.	16	13	7	5	4	1	2	1	1	1	1	1	1	1	1	1	1	1	1
Percent	26.7	21.7	11.7	8.33	6.7	1.67	3.3	1.67	1.67	1.7	1.67	1.67	1.7	1.67	1.67	1.7	1.67	1.67	1.7
Cum.	26.7	48.3	60	68.3	75	76.7	80	81.7	83.3	85	86.7	88.3	90	91.7	93.3	95	96.7	98.3	100

ANNEX C: Independent Variables

Variable	Source	Years	Description
Number of contracts awarded (Sum)	Watsan PSP Database	1990-2004	Database compiled by the authors. Sources: World Bank PPI Database, Thomson Financial, Global Water Intelligence and other media sources, Water Market China. Cross-checked through interview with practitioners
Population (Average)	Economist Intelligence Unit	1990-2004	
GDP per capita (Average)	Economist Intelligence Unit	1990-2004	
ICRG Economic Risk	PRS Group International Country Risk Guide	2004	Composite index of GDP, GDP growth, inflation, budget balance and current account balance. The economic risk index scores range from 0-50 points. See: **http://www.icrgonline.com/page.aspx?page=icrgmethods**
Urban Coverage Gap	Authors	2002	The variable is constructed using data for urban population and access to improved water supply. Urban coverage gap = Urban population x (1-urban access to improved water supply) Average urban population 1990-2004 (EIU) Access to improved water supply (urban areas) 2002 (WHO JMP). See **http://www.wssinfo.org/**
Years since first infrastructure PPP (No.)	World Bank PPI Database	1990-2004	Count of number of years between the first recorded private investment in infrastructure recorded in the database and 2004. A first investment in 2004 receives a score of 1. A first investment in 1990 receives a score of 15.
Rule of Law	World Bank Governance Indicators	2004	Measures the extent to which agents "have confidence in and abide by the rules of society". Includes: incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. Scores are normalized around 0. See: **http://www.worldbank.org/wbi/governance/govdata/**
Government Effectiveness	World Bank Governance Indicators	2004	Measures the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. Scores are normalized around 0. See: **http://www.worldbank.org/wbi/governance/govdata/**
Political Stability	World Bank Governance Indicators	2004	Measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence and terrorism. Scores are normalized around 0. See: **http://www.worldbank.org/wbi/governance/govdata/**
Control of Corruption	World Bank Governance Indicators	2004	Measures perceptions of corruption, defined as "the exercise of public power for private gain." Includes small-scale and 'grand' corruption. Scores are normalized around 0. See: **http://www.worldbank.org/wbi/governance/govdata/**
Contract enforcement	World Bank Doing Business Database	2004	Average number of days to enforce a contract
ICRG Investment Profile	PRS Group International Country Risk Guide	2004	Composite index reflecting contract viability, profits repatriation and payments delays. Scores range from 0-15, with a score of 15 for the most attractive investment profile See: **http://www.icrgonline.com/page.aspx?page=icrgmethods**

Bibliography

Acemoglu, D. and S. Johnson (2003). "Unbundling institutions." National Bureau of Economic Research. Working Paper Series **No. 9934**: 1-[63].

Baietti, A. (2001). Private infrastructure in East Asia : lessons learned in the aftermath of the crisis. Washington, D.C., World Bank.

Bergara, M. E., W. J. Henisz, et al. (1998). "Political institutions and electric utility investment: a cross-nation analysis." California Management Review **40**: 18-35.

Blanc-Brude, F. and O. Jensen (2004). Water Market China: Projects and Opportunities in the Water and Wastewater Sectors. Oxford, Media Analytics.

Calderon, C., W. Easterly, et al. (2003). Infrastructure Compression and Public Sector Solvency in Latin America. The Limits of Stabilization: Infrastructure, Public Deficits and Growth in Latin America. W. Easterly and L. Serven. Washington D.C., IBRD/World Bank.

Calderon, C., W. Easterly, et al. (2003). Latin America's Infrastructure in the Era of Macroeconomic Crisis. The Limits of Stabilization: Infrastructure, Public Deficits and Growth in Latin America. W. Easterly and L. Serven. Washington D.C., IBRD/WorldBank.

Cameron, A. C. and P. K. Trivedi (1998). Regression Analysis of Count Data. Cambridge, UK, Cambridge University Press.

Easterly, W. R. and L. Serven (2003). The limits of stabilization : infrastructure, public deficits and growth in Latin America. Washington, DC, World Bank.

Estache, A. (2005). "PPI partnerships versus PPI divorces in LDCs." World Bank Policy Research Working Paper(3470).

Estache, A. and A. Goicoechea (2005). "How widespread were private investment and regulatory reform in infrastructure utilities during the 1990s?" World Bank Working Paper (draft).

Everhart, S. S. and M. A. Sumlinski (2001). "Trends in Private Investment in Developing Countries and the Impact on Private Investment of Corruption and the Quality of Public Investment." International Finance Corporation Discussion Paper **No. 44**.

Foster, V. (2005). "Ten Years of Water Service Reform in Latin America: Toward an Anglo-French Model." World Bank Water Supply and Sanitation Sector Board Discussion Paper Series (Paper No 3).

Guasch, J. L. (2004). Granting and renegotiating infrastructure concessions : Doing it Right. Washington, D.C., World Bank.

Henisz, W. J. and B. A. Zelner (2001). "The Institutional Environment for Telecommunications Investment." Journal of Economics and Management Strategy **10**(1): 123-147.

Henisz, W. J. and B. A. Zelner (2004). Resistance to Illegitimate Multilateral Influence on Reform: The Political Backlash Against Private Infrastructure Investments. Mimeo, University of Pennsylvania.

Izaguirre, A. K. and C. Hunt (2005). "Private Water Projects." World Bank Public Policy for the Private Sector Series **Note No. 297**

Kaufmann, D., A. Kraay, et al. (2005). "Governance Matters IV: Governance Indicators for 1996-2004." World Bank

Levy, B. and P. T. Spiller (1994). "The institutional foundations of regulatory commitment: a comparative analysis of telecommunications regulation." Journal of Law, Economics and Organization **10**(2).

Long, J. S. (1997). Regression Models for Categorical and Limited Dependent Variables. Los Angeles, UCLA.

Long, J. S. and J. Freese (2001). Regression models for categorical independent variables. College Station, Texas, STATA Press.

Ménard, C., G. Clarke, et al. (2000). Reforming the water supply in Abidjan, Cote d'Ivoire : mild reform in a turbulent environment. Washington, D.C., World Bank Development Research Group Public Economics.

Ménard, C., G. Clarke, et al. (2000). A transitory regime : water supply in Conakry, Guinea. Washington, D.C, World Bank Development Research Group Public Economics and Regulations and Competition Policy.

Moosa, I. A. (2002). Foreign Direct Investment: Theory, Evidence and Practice. Basingstoke, Hampshire, Houndmills.

North, D. C. (1981). Structure and change in economic history. New York, Norton.

Pargal, S. (2003). Regulation and Private Sector Investment in Infrastructure : Evidence from Latin America. Washington, D.C., World Bank Corporate Secretariat Policy Support Division.

Rigobón, R. and D. Rodrik (2004). "Rule of law, democracy, openness and income: estimating the interrelationships." Centre for Economic Policy Research. Discussion Paper Series **No. 4653**: 1-28.

Saleth, R. M., A. Dinar, et al. (2004). The institutional economics of water : a cross-country analysis of institutions and performance. Cheltenham, U.K. ; Northhampton, Mass.A, E. Elgar Pub.

Savedoff, W. D., P. T. Spiller, et al. (1999). Spilled water : institutional commitment in the provision of water services. Washington, D.C., Inter-American Development Bank.

Sirtaine, S., M. E. Pinglo, et al. (2004). "How Profitable are Infrastructure Concessions in Latin America? Empirical Evidence and Regulatory Implications " World Bank Report

Wallsten, S. J. (2002). "Does Sequencing Matter? Regulation and Privatization in Telecommunciations Reforms." World Bank Policy Research Working Paper(No 2817).

Williamson, O. E. (1985). The Economic Institutions of Capitalism. New York, Free Press.

World Bank (2005). Water Operators Roundtable Report, Washington D.C., World Bank

*