

Regulation and Private Sector Investment in Infrastructure

Evidence from Latin America

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Abstract

Pargal assesses the importance of the regulatory framework as a determinant of private sector investment in infrastructure. She uses recently compiled data on private and public sector investment in the water, power, telecommunications, railroads, and roads sectors between 1980 and 1998 in nine countries in Latin America. The author finds that the most significant institutional determinant of private investment volumes is the passage of legislation liberalizing the investment regime. This is important because it indicates that the legal basis for reform is probably more critical in

determining the quality of the investment climate than specific aspects of the institutional framework governing private sector participation. In accordance with intuition, the author's results indicate that government action to increase regulatory certainty and minimize the perceived risk of expropriation through the establishment of independent regulatory bodies is a critical determinant of the volume of private investment flows. She also finds that the general relationship of private to public investment is one of substitutability.

This paper—a product of the Policy Support Division, Corporate Secretariat—is part of a larger effort in the Bank to understand the role of institutions in development. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Sheoli Pargal, room MC11-153, telephone 202-458-1951, fax 202-522-1630, email address spargal@worldbank.org. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. April 2003. (43 pages)

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**Regulation and private sector investment in infrastructure: Evidence from
Latin America**

by

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I. Introduction

This paper assesses the importance of the regulatory framework as a determinant of private sector investment in infrastructure, using recently compiled data on private and public sector investment in the water, power, telecommunications, roads and railways sectors in nine large countries in Latin America. Controlling for standard determinants of investment, we analyze the impact of variables that represent different aspects of the prevailing regulatory regime on a country's ability to attract private investment in infrastructure.

During the last decades of the twentieth century many countries in Latin America undertook public sector reform and introduced private participation in formerly state-dominated sections of their economies through management contracts, concessions or outright privatizations. In the infrastructure sectors this was motivated by a desire to improve performance and increase efficiency in service provision, as well as by the fact that governments were constrained in increasing service coverage or improving public utility performance by limited fiscal resources and a multitude of competing claims on these resources. But investment in infrastructure is characterized by large up-front, usually sunk, costs that lead to a high risk of expropriation, long gestation lags before revenues are generated and revenues that are usually generated in local currency. These aspects lead to a need for both long-term commitment and long-term financing in local currencies. However, the limited depth of nascent capital markets is rarely able to generate funding of the maturity and volume that were necessary to finance private infrastructure investment in Latin America, which resulted in an effort to attract foreign capital.

Analysts agree that an environment of macroeconomic and political stability, policy credibility, and the existence of a sound regulatory framework are necessary for lowering the perceived risk of expropriation and thus for attracting private capital. In particular, the character

of the entities entrusted with regulation determines confidence in the integrity of the system as a whole (see, e.g., Kerf et al 1998). In this paper, we relate the amount of private investment attracted in each infrastructure sector in the countries studied to a set of independent variables that includes the characteristics of regulatory entities. This is a first attempt to test the assertion that the lack of independent regulation can be a major hindrance to attracting private sector investment in infrastructure in developing countries.

The study is of particular relevance for reforming countries since the LAC region is, among the regions in the world, furthest along the road to deregulation of basic infrastructure services. It faces second-generation issues of appropriate regulation that others have yet to encounter. By characterizing regimes in terms of their ability to attract private investment in infrastructure, the analysis provides an empirical foundation for policy choices related to institutional structure and regulatory frameworks. In accordance with intuition, our results indicate that government action to increase regulatory certainty and minimize the perceived risk of expropriation through the establishment of independent regulatory bodies is a critical determinant of the volume of private investment flows.

This paper is organized as follows. Section II provides background on the broad experience of the countries being studied and the approach taken here towards assessing the quality of the regulatory environment. Section III discusses the data. Section IV and V describe the estimation strategy and empirical findings of the analysis.

II. Private investment in infrastructure in Latin America

Our study covers Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru and Venezuela between roughly 1980 and 1998. Average annual public and private investment

levels by sector and country before and after the passage of legislation permitting private entry are shown in appendix I (Table 5a). Appendix II displays the evolution of private and public investment by sector and country over the period studied.

Telecommunications, power, and roads are the sectors for which almost all the countries in our sample had passed liberalizing legislation by the mid 1990s. There is wide variation in the year in which legislation was passed in these countries, with Chile and Argentina being the earliest movers -- the first infrastructure regulatory agency in Chile (Subtel) was established in 1977. Liberalization (through the introduction of competition and private sector participation) has also been deepest and most wide-ranging in Chile and Argentina. For example, these are the only countries to have enacted legislation opening the water sector to private investment. Interestingly, the passage of legislation permitting private entry was not always a pre-condition for private sector investment in different sectors. In Bolivia, for instance, three railway concessions were granted in 1996 while the relevant legislation was enacted only in 1998. However, in general, the enactment of legislation formalizes the liberalization of the sector and provides greater security about the irreversibility of the process of opening up.

The striking increase in average annual investment in telecommunications and electricity, as well as the large jump in the share of private sector investment in these sectors and in the roads sector after liberalization are illustrated in Figures 1 through 6. In telecommunications and power the average annual share of public spending in total investment spending declined to significantly less than 50% almost across the board after liberalization. Prior to the opening of the sector, in fact, private investment in telecommunications was negligible or actually zero. Following liberalization, private investment increased and public investment declined, so that by 1998 private investment exceeded public spending in the sector in almost all the countries

studied. Most countries in the sample granted initial exclusivity periods to privatized telecommunications firms or set limits on entry into the sector.¹ In general, the liberalization of access and tariffs came later. Similarly, between 1980 and 1998, public investment in the power sector generally declined while private investment increased, ultimately exceeding public spending. Liberalization in the power sector was usually accompanied by the restructuring of vertically integrated utilities.

While legislation permitting private entry into the roads sector had been approved in five of the nine countries by 1993, the role of the state continued to be substantial even after that. With the striking exception of Mexico, which launched an ambitious toll-road program in the late 1980s, annual public investment in roads in most Latin American countries remained much higher than private investment. Private investment in roads increased slowly – the share of the private sector in total investment after liberalization typically remained below 50%.

Public investment in the water sector also greatly exceeded private investment in Latin America throughout the period, reflecting the limited liberalization of the sector. This was true even in Chile. However, largely driven by the concession contract for Buenos Aires, private investment in water in Argentina grew to exceed public spending during the 1990s. Interestingly, private investment in Bolivia's water sector also rose to substantially exceed public spending, particularly after 1991 – despite in the absence of the passage of enabling legislation.

A possible explanation for the difference in the average share of private investment in roads and water as compared to power and telecommunications may lie in the natural monopoly elements of the roads and water sectors. The low traffic density of rural and secondary road networks means that they are less amenable to cost covering tariffs and thus less attractive to

¹ Colombia and Ecuador did not privatize. However, Colombia allowed “controlled competition” in long distance and free entry in fixed line local service.

private concessions. So there is likely to always be a need for public spending on roads. A similar argument relating to the cost of provision and scale economies has been applied to rural water systems. In addition it is often politically difficult to “auction off” the responsibility to ensure road access or the responsibility for basic water service to the private sector because of the perception that these are core infrastructure services that it is the state’s obligation to provide. Finally, water and power are the sectors in which the need for tariff adjustment is usually most pressing. This makes the political economy of private entry especially relevant in these sectors. Particularly in the case of water, where the general public (and not a small group) is often affected, anecdotal evidence points to the political difficulty of raising tariffs to cover costs. In fact, such tariff increases led to the failure of several concession contracts in the late 1990s.

III. Analytical approach

While there is a large empirical literature on the determinants of investment, including investment in infrastructure, this literature has mainly focused on testing traditional economic theories of investment behavior (see Everhart and Sumlinks (2001) for a recent overview) rather than on assessing the contribution of the regulatory framework to the environment for investment. Recent empirical work has, however, demonstrated the critical role of the institutional environment in determining the magnitude of investment flows. For instance, the option approach to investment reviewed by Serven (1996b) underlines the deterrent effect of uncertainty on private investment, especially when investment is sunk. Investor perceptions about the probability of reform reversal are often a key determinant of their willingness to invest. The general lesson from this analytical and empirical literature is that, by affecting investor confidence, the stability and predictability of the incentive framework may be even more

important than the level of investment incentives in determining the volume of private investment.

Recent econometric work by Scott Wallsten (2001a, 2002) on telecommunications reform in developing countries is very relevant to the analysis described in this paper. Wallsten (2001a) finds that country level telecommunications performance is positively related to regulation, as measured by a dummy indicating whether the country had established a separate telecommunications agency not directly under the control of a ministry. That study uses a fixed effects approach to explore the impact of privatization, competition and regulation on telecommunications performance in Africa and Latin America between 1984 and 1997. Wallsten (2002) shows that countries that established separate regulatory authorities prior to privatization saw increased telecommunications investment compared to countries that did not, and, also, that investors are willing to pay more for telecommunications firms in such countries. These findings are consistent with the hypothesis that investors require a risk premium to invest where regulatory rules remain unclear. Our analysis contributes to this literature on the role of regulation in private sector development. We use detailed data on measures of regulatory independence in addition to sectoral data on both private and public investment across the major economies of Latin America. This allows us to more thoroughly investigate the importance of independent regulatory institutions for the climate for private investment.

The effectiveness of regulatory institutions depends on the structure and process of regulation, key aspects of which are the independence, competence and clarity of mandate of the regulatory agency, the transparency and openness of the regulatory process and the existence of formal oversight and timely judicial review.² Smith (1997a, b) discussing the “desirable” attributes of utility regulators considers independence from the regulated firm, customers and

² See Noll (2000) for an exposition.

political authorities as being essential. He underlines the important trade-off between the need to limit regulatory discretion (as, for example, through regulation by contract) in order to reduce the risk of expropriation and the need to retain the flexibility to respond to new environmental and market conditions (for example, in rapidly changing sectors like telecoms). The openness and transparency of the regulatory process lessen the probability of capture by different interest groups. An important additional consideration is the country's stability and reputation for respecting private property rights -- which can go a fair way in assuaging investor concerns, and would allow the regulator to retain substantial discretion without significantly increasing the cost of capital. But the ultimate accountability of the regulator is critical.

In this paper we have described the regulatory environment in the countries and periods under study in terms of the following aspects:

- The passage of legislation that permits private investment in sectors traditionally reserved for the public sector. The passage of enabling legislation is particularly important because Latin American regulatory frameworks are rooted in civil law.
- The existence of a regulatory body.
- Whether the regulator is autonomous or not. Autonomy or independence is captured by the regulator's attributes – whether the regulatory body is housed outside the government; whether the regulator has a separate source of funding (i.e., independent of the vagaries of annual budgetary appropriations); and, the degree of popular support for the regulator, measured by whether both the legislature and the executive branch are involved in appointing the regulatory body. Lacking data, we were unable to assess the importance of aspects of independence such as security and nature and length of tenure of regulators (e.g., staggered terms that are not coincident with the electoral cycle), etc.

- The size of the regulatory agency. A larger body would limit the probability of capture by different interest groups (as well as the government). Whether or not the prospect of being able to capture the agency would make a smaller agency more attractive to private investors is an empirical question. A larger size would allow for a range of professional expertise and diversity of opinion (see, e.g., Smith 1997a, b, c), both critical to the competence of the agency. On the other hand, commentators have argued that a smaller agency could be more efficient in decision making and more predictable and that individual regulators might be more accountable than those in large commissions – which would all make a smaller agency more attractive from the investor point of view. Thus, the direction of the relationship between the size of the regulatory body and private investment would depend on the net effect of these factors.
- The degree of risk borne by the investor as measured by whether the tariff regime is rate of return or price-cap. Rate-of-return tariff regulation limits the risk taken by the investor vis a vis a price-cap regime and might hence be positively related to private investment in infrastructure. Also, Alexander and Irwin (1996) present evidence that price-cap regulation, by subjecting firms to greater risk, increases the cost of capital.

IV. Data

Data sources are described in Table 1. Macroeconomic data are taken from the World Bank's World Development Indicators database and the IMF's International Financial Statistics. Investment data by sector were obtained from official publications and directly from the governments of the countries studied. (Further details are provided in Calderon and Easterly (2001)). Data on regulatory variables were obtained from Guasch (2001).

As a control variable, we use a physical measure of the infrastructure capital stock each year by sector. This consists of the following: for roads, total road length and paved road length; for railroads, total length of the rail network; for telecommunications, the number of telephone mainlines; for energy, the electric generating capacity in kilowatts, and, for water, the growth in the percentage of the population with access to clean water. Pritchett (2000) has pointed out that standard expenditure-based units of capital, particularly public capital, are often inaccurate in what they measure. Especially when it comes to the public sector and in countries where the government is a large investor, the divergence between investment effort and public sector capital stock is very high.³ This renders suspect analyses that equate public spending on infrastructure to the value of infrastructure capital. With that caveat in mind, we have chosen to use physical measures of capital stock as controls, even though they are not comparable across sectors.

The regressions include a dummy that is 1 in years following the passage of legislation permitting private investment in utilities (since these sectors were often considered the prerogative of the state). Even though private entry had commenced prior to the passage of relevant legislation or the setting-up of formal legal and judicial frameworks for private participation in some countries, we use the passage of legislation (rather than the earliest private entry into the sector in each country) as our measure of liberalization since there is greater certainty implied by the existence of a formal legal basis for private investment.

Summary descriptive statistics for the entire dataset and for the set of variables measuring regulatory structure are included in Appendix I, Tables 1a and 2a. Since, for the most part,

³ "(T)he potential contribution to current and future production of a capital stock is not the same as what happened to have been spent on it, especially when governments are the investors." Pritchett (2000), pp xx.

liberalization and the development of regulatory frameworks started only in the 1990s, there are substantially fewer observations on the regulatory variables.

Table 1. Data sources

Variable	Data source
Real GDP	WB World Development Indicators
Investment deflator	WB World Development Indicators
GDP deflator	WB World Development Indicators
Interest rate	IMF IFS
Real public investment	Calderon and Easterly, 2001
Real private investment	Calderon and Easterly, 2001
Regulatory variables	Guasch, 2001
Physical capital stock	Calderon and Easterly, 2001

Appendix I, Table 3a is the correlation matrix for the complete dataset and indicates how different determinants of private investment flows in infrastructure hang together. Public and private investment are significantly negatively correlated, supporting the idea that they are overall substitutes. Private investment is also significantly positively correlated with the dummy for the passage of reform legislation and with the existence of a regulatory body. The passage of reform legislation and the existence of a regulatory body are highly positively correlated but not perfectly so – reform legislation had been passed in only 40% of sector-country combinations prior to the establishment of a regulatory authority. Appendix I, Table 4a is the correlation matrix for the set of variables measuring aspects of the regulatory regime. The correlation between private investment levels and the passage of legislation opening the sector to private investment is significantly more positive in this subset of the data.

V. Estimation

This paper examines two basic models in which fixed effects regressions are used to explore the relationship between different groups of independent variables and private infrastructure investment. In all models the dependent variable is the log of real private sector investment by country, year, and infrastructure sub-sector.

The first model examines the determinants of private infrastructure investment using (1) a dummy for whether or not a regulatory body existed that year, and (2) a dummy for whether enabling legislation had been passed by that year, as the only indicators of the regulatory environment. This model is also estimated for the four major sectors separately – telecommunications, roads, electricity and water – in an effort to capture sector specific idiosyncrasies. The second model is estimated for the years during which a regulatory body exists. This permits the inclusion of characteristics of the regulatory regime as explanatory variables in the analysis and provides an opportunity to assess the impact of the type of regulatory regime on private investment flows to infrastructure.

The reduced form equation being estimated, for each country i , sector j , and year t is:

$$I_{ijt} = f(Ig_{ijt}, GDP_{it-1}, r_{ijt}, p_{ijt}, K_{ijt-1}, R_{ij}, D_{ijt}),$$

where,

I_{ijt} = Private sector investment

Ig_{ijt} = Public sector investment

GDP_{it-1} = Gross domestic product lagged

r_{ijt} = Real rate of interest

p_{ijt} = Price of investment goods

K_{ijt-1} = Previous period physical capital stock in the sector

R_{ij} = Regulatory regime

D_{ijt} = Dummy for whether or not a reform law has been passed

We are agnostic about whether public sector investment is complementary to or a substitute for private investment in the sector, noting the lack of consensus on this issue in the literature. Lagged capital stock would be expected to be negatively related to investment based on standard accelerator theories as well as marginal productivity and cost of capital arguments. The sign on lagged GDP is expected to be positive since higher income should lead to greater capacity to invest. The real rate of interest is included to capture the impact of the cost of financing on investment decisions, and a measure of overall investment goods prices⁴ is included to account for the actual cost of investment. Both these “price” variables reflect the opportunity cost of capital and are expected to have a negative relationship with the amount of private investment attracted to a particular sector.

The existence of a regulatory body and the passage of reform legislation would both be expected to be positively related to the volume of private investment flows since both represent government commitment to constraints on its own power. This results in less scope for discretionary/arbitrary action (e.g., against investor interests) and thus would imply a more certain business environment. The notion that investors require a risk premium to invest where regulatory rules remain unclear is supported by Wallsten (2002), who finds higher investor willingness to pay for telecommunications firms in countries that have established regulatory authorities.

In the second set of regressions the dummy for the passage of reform legislation is augmented by the following regulatory indicators: whether regulatory decisions involve ministerial input or the regulatory body is part of a ministry; whether the appointment of regulators involves both the legislature and the executive or only the executive; the size of the regulatory body; whether the regulatory body is funded solely by the government; and, whether

⁴ Investment price is calculated as the ratio of the investment deflator to the GDP deflator.

the tariff regime is rate of return or not. Most of these variables capture the degree of autonomy of the regulator from the executive branch and the susceptibility of the regulatory regime to government control or subversion by capture (e.g., by regulated entities).

Regulators who are appointed by the executive branch of the government and those that are entirely dependent on the government for funding are unlikely to be independent. Low autonomy, as indicated by these two variables, is expected to be negatively related to investor confidence and private investment flows.

One would expect that the regulatory body being housed in a ministry or ministerial involvement in decision-making would be negatively related to private sector confidence since an arms-length relationship between the regulator and the government is generally desired. On the other hand, a ministerial stamp can be an important signal of commitment for private investors, which would imply a positive relationship with private investors.

The expected sign on the coefficient of agency size is ambiguous: To the extent that a larger agency is likely to be more balanced and competent -- and less likely to be captured -- a positive relationship between the size of the regulatory body and private investment might be expected. However, ease of capture might be attractive in some governance contexts.

VI. Empirical findings

This exploration of the determinants of private infrastructure investment over time uses the log of annual private sector investment (in millions of 1992 US\$) in each sector and country (e.g., telecommunications in Argentina in 1995) as the dependent variable. Economy-wide control variables are: the log of public investment in the sector and country each year, real GDP lagged one year, one period lagged physical capital stock in the sector in the country, the real

price of investment goods, the real rate of interest, whether or not a law permitting private entry has been passed, and whether or not a regulatory body for the sector exists in the country. We include a time trend and sector dummies (omitted sectors are railways and gas) and pool the data over all years, sectors and countries covered. The estimation accounts for the panel structure of the data by using country fixed effects.

We report results of regressions in which both the investment price and the real rate of interest are included although including the real rate of interest leads to the loss of some 200 observations. This is because comparable real interest rate data was not available for some countries during the earliest years covered in this analysis.⁵

Determinants of private sector investment

The results of the primary regressions are presented in Models I-II in Table 2. Model I is largely consistent with intuition. The overall relationship of private investment and public investment is one of substitutability. As might be expected, private investment is positively related to past period real GDP, indicating that richer economies generate higher private investment flows. A 1% increase in previous period real GDP is associated with an increase of 4.6% in private investment levels. We use lagged real GDP as the explanatory variable to reflect the potential causal relationship between GDP and private investment.⁶

⁵ Dropping the real rate of interest from the regressions and using only the investment price led to higher significance of the latter and no changes of note in the signs or significance of the coefficient estimates on the other variables.

⁶ Since the dependent variable is private investment in different infrastructure sub-sectors, and not total investment in the economy, the issue of reverse causality from investment to income or GDP is less likely to be a problem. We expect the effect *on* GDP of private investment to be very attenuated and, given that infrastructure investment has long gestation lags, to act only over time.

Table 2. Country Fixed Effects Estimation

Dependent variable: Log of real private investment				
	Model I		Model II	
	Coef.	t	Coef.	t
Log of real public investment	-.1201513	-2.033**	-.3324242	-3.109**
Log of lagged real GDP	4.607274	6.695**	6.830853	2.893**
Trend	.2715046	5.483**	.3513241	2.157**
Lagged capital stock	2.94e-07	2.488**	-1.80e-07	-0.482
Regulatory body in place	.2573572	0.497		
Real rate of interest	-.0118967	-3.775**	-.0131696	-0.420
Investment price	-.131716	-0.112	.7038148	0.145
Dummy: Passage of legislation opening the sector	3.640372	7.026**	6.087679	5.717**
Dummy: Telecommunications	.5296759	0.819	6.806443	3.200**
Dummy: Roads	.6889568	1.258	1.643749	1.179
Dummy: Water	-2.344596	-4.135**	1.604541	0.982
Dummy: Electricity	.9701421	1.789*	1.725853	1.181
Regulatory body inside the ministry			4.018742	2.858**
Dummy: Appointment of regulator approved by legislature			-5.512656	-2.370**
Number of members of regulatory commission			.2788061	1.556
Dummy: Regulator's budget solely from government			-5.512654	-3.489**
Dummy: Rate of return legislation			-.9717241	-0.472
Constant	-55.26021	-6.700**	-86.95147	-3.107**
Number of Obs.	693		183	
R-sq within	0.5122		0.6469	

* Significant at 10% level

** Significant at 5% level

Investment volume is negatively related to the real rate of interest and to the price of investment goods but significantly positively related to whether or not legislation enabling private entry has been passed - the mere act of liberalizing private entry into a sector increases private investment by 3.6%. Interestingly, the dummy for passage of such legislation absorbs a fair amount of the effect of having a regulatory body in place and indicates that in many cases the legal basis for private entry is probably more important than the actual institutional framework governing private sector participation.⁷ Using a dummy to capture the opening of the sector is limiting in that it does not capture critical elements of the competitive environment post-

⁷ When we ran the regressions without including the dummy for legislation liberalizing private entry we obtained higher significance on the existence of a regulatory body.

opening/privatization which would affect incentives to invest. Whether a firm facing competition is likely to invest more or less than a monopoly is an empirical question. In several cases Latin American state-owned infrastructure firms were privatized as monopolies or granted “exclusivity periods” of varying lengths, as in the telecommunications sector. As shown by Wallsten (2001b) in his study of telecommunications privatization in developing countries, granting a monopoly concession seriously reduces investment by the privatized firm relative to firms that face competition. Unfortunately such data were not available for most of the sectors and countries studied.⁸

The estimation includes previous period capital stock since the coefficient on it is highly significant, although it is a physical measure that varies by sector and is not easy to interpret. The coefficient on capital stock is positive, which is contrary to what theory would suggest. However, this appears to be an artifact of aggregation since it is uniformly negative in the regressions disaggregated by sector.⁹ Finally, the primary regressions show that after controlling for other factors, the water sector received significantly less private investment than the other sectors, while private investment in power was relatively higher than in the other sectors.

Characteristics of the regulatory system

Given that a regulatory body exists, what aspects of the regulatory structure are critical to attracting private investment in infrastructure? Model II in Table 2 presents the results of a fixed effects regression restricted to the years after a regulatory body had been established. The

⁸ In a study of Latin American countries, Martin et al (2001) show that infrastructure privatization has an impact on GDP per capita, with the effect both, being dependent on whether privatization occurs in the transport or the utilities sectors and *varying by the form of privatization*: whether it is through greenfield investment, divestitures or concessions. Since our investment data are not disaggregated by the form of private participation we have used the date of the passage of legislation opening up the sector in the analysis.

⁹ Dropping this variable made no difference to the sign or significance of other variables.

passage of legislation opening the sector is still a significant and positive determinant of the volume of private investment flows, and public investment volumes are clearly being substituted for by private investment. While the sign and significance of the other economy-wide variables are unchanged, the real rate of interest and investment price index are no longer significantly different from zero. Also, after controlling for regulatory factors, the telecommunications sector appears to attract significantly more private investment than the others.

In terms of the regulatory variables, some results warrant deeper analysis. For instance, private investment volumes are significantly positively related to the regulatory body being located inside a ministry or with ministerial involvement in regulatory decision-making.¹⁰ In addition, systems in which regulators are appointed by the executive are associated with greater private investment than those in which the selection of the regulator involves both the legislature and executive. On the face of it, both these aspects of the regulatory structure should militate against private investor interest since they imply lower constraints on the government's power to expropriate the value of an investment. However, on more reflection, these results may underline the critical need of investors for regulatory predictability and credibility. For instance, investors are likely to expect that decisions taken by a regulator housed in a ministry will not be overturned. In addition, a regulatory body appointed by the executive may be considered stronger by virtue of having the full power of the executive branch behind it, and be perceived to speak with a clearer voice than a regulatory body whose appointees have to go through approval by the legislature. A natural question is whether these considerations are specific to Latin

¹⁰ Smith (1997a) notes that a dedicated regulatory unit set up within a ministry is often a first step in the transition from the traditional model of ministerial regulation to a fully autonomous agency. Such a unit coordinates regulatory activity and fosters the development of the necessary technical skills and professional norms, often contracting outside professionals for technical tasks. Alternatively, as in some agencies in Colombia, ministerial participation in the regulatory agency is observed, although the agency has most of the attributes of an independent entity.

America. They may result from the historical existence of generally strong executive branches on the continent, which would mean that such arrangements increase investor certainty about government intentions and would, thus, result in higher private investment than otherwise.

Consistent with intuition, , private investment is positively associated with the regulator not being funded *solely* by the government. This is an important element of regulatory independence. In addition, the number of commissioners or regulators is positively related to investment volumes (significant at 12%) reflecting the possibly greater independence, broader expertise, and lower likelihood of capture of a larger commission.¹¹ Although not significant, investment volumes are negatively related to rate-of-return tariff regulation which limits both downside and upside risk and also caps possible returns to investment. Alternative tariff regulatory mechanisms such as price caps would provide the opportunity to earn higher than the fixed rate of return, which would compensate for the higher risk of investment in sectors like infrastructure.

Sector specific results

Table 3 presents the results of the base regression for the telecommunications, roads, electricity and water sectors separately. Multicollinearity among the indicators of regulatory structure and lack of variation of these variables over time within each country led to the decision not to run sector specific models with regulatory variables included.

Public and private investment in telecommunications and power are strong substitutes. A somewhat weaker but still substitutable relationship is observed in the water sector. In roads the relationship is complementary but not significant. A complementary relationship between public

¹¹ As noted earlier, ease of capture could go either way in attracting investor interest. It is likely, however, that the true relationship between the size of the regulatory body and private investment is non-linear – reflecting the trade-offs in terms of speed of decision-making vs. risk of capture between small and large regulatory bodies.

and private investment in the roads sector would indeed be expected because of the difficulty of obtaining private financing for non-primary highways.¹² In all cases higher lagged GDP is associated with higher private investment volumes, and, in contrast to the findings of Models I and II, lagged capital stock is negative and significant in all the sectoral regressions apart from the one for water.

Table 3. Fixed Effects regressions by sector

In_pvt	Telecoms		Roads		Power		Water	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t
Log of real public investment	-0.2942	-3.189**	0.1825	0.409	-0.7662	-2.500**	-1.0194	-1.55
Log of lagged real GDP	5.8493	4.356**	5.7597	4.312**	4.0419	3.435**	6.4141	4.003**
Trend	0.4144	3.608**	0.3525	3.278**	0.5119	4.703**	0.3059	2.852**
Lagged capital stock	0.0000	-2.168**	0.0000	-4.703**	-0.0004	-4.101**	0.0018	0.000
Regulatory body in place	-1.0046	-1.077	-0.6995	-0.692	0.1993	0.202	0.3486	0.292
Investment price	1.3759	0.628	4.2064	1.815*	1.6965	0.783	1.7566	0.798
Real rate of interest	-0.0058	-0.967	-0.0059	-1.007	-0.0092	-1.620	-0.0205	-3.493**
Dummy: Legislation opening the sector	5.2836	5.6**	5.4172	5.148**	1.8347	1.780*	1.8979	1.476
Constant	-67.5412	-4.189**	-66.2719	-4.447**	-41.5051	-2.912**	-76.1823	-3.974**
Number of Obs.	159		142		159		109	
R-sq within	0.7068		0.6322		0.5499		0.5274	

* Significant at 10% level

** Significant at 5% level

The passage of legislation opening the sector to private entry is significantly positively related to private investment volumes in telecommunications and roads but less significant in the power sector and virtually not at all in the water sector. The result on power is somewhat surprising since liberalization of telecommunications and power has been deeper and wider than of the other sectors, with a decline in the importance of government investment going hand-in-hand with the increase in private participation. This may reflect the fundamentally competitive

¹² Consistent with our findings on roads, Dailami and Leipziger (1998)'s analysis of credit risk premiums in foreign currency private loans to greenfield infrastructure projects in developing countries finds that road projects commanded the highest risk premium in 1994-96.

nature of power generation, which may make the formal liberalization of entry less important than in other less contestable sectors. As in the regression on pooled data (Model I), the existence of a regulatory body is not a significant determinant of private investment in any sector after controlling for the passage of enabling legislation.

This leads to the question of whether the water sector perhaps differs in some crucial respect from other infrastructure sectors. As mentioned earlier, the natural monopoly aspects of water distribution and transmission are stronger than in other utilities. Also, opening up the water sector to private investment, which may require an increase in tariffs to cover costs, generally tends to be politically more difficult than liberalization in “non-essential” sectors.¹³ Investors may thus expect higher scrutiny for water sector investments. In view of the risks deriving from both the political sensitivities of privatizing water service provision and the huge sunk costs of investment in the sector, investors are likely to be less willing to invest in water simply because the necessary legislation permitting private entry into the sector has been passed. They may look for a better developed regulatory framework and more detailed investor protections before committing funds to the sector. Finally, it is worth noting that private entry into the water sector has usually taken place through the award of large concession contracts – which may not be linked to the passage of legislation. All these factors would lead to the observed lack of correlation between private investment and the passage of legislation permitting private entry.

¹³ Perhaps in view of the perceived higher political risk of investments in water, the number of large private international operators is lower than in the other sectors.

VII. Conclusions

This paper has presented findings on institutional factors that affect the investment climate for infrastructure using recent data from the nine largest Latin American countries. We find that the most significant determinant of private investment volumes overall (after lagged GDP) is the passage of legislation liberalizing the investment regime. This is important because it indicates that the legal basis for reform is probably more critical in determining the quality of the investment climate than specific aspects of the institutional framework governing private sector participation. We also find that the general relationship of private to public investment is one of substitutability.

The results on regulatory structure underline investors' need for stability and predictability and reflect the historical existence of strong executive branches in most Latin American countries. A particularly intuitive result is that private investment is positively associated with the independence and credibility of the regulator, particularly its ability to commit.

Over the period analyzed, controlling for other factors, the water sector received significantly less private investment than other sectors while private investment in power was relatively higher than in the other sectors. The sectoral analysis indicates that the water sector differs materially from the other three sectors: private investment in water is not significantly affected by the passage of reform legislation in the sector and public expenditure is very important and only mildly substitutable for private spending. Political economy considerations appear to make private investors more wary of entering the water sector than the roads, power and telecoms sectors.

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Appendix I

Table 1a. Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
ln_pvt	1039	-1.508701	6.58633	-9.21034	8.642539
ln_pub	1039	4.353829	3.421206	-9.21034	9.1114
ln_lgdp	995	11.10819	1.305327	8.168795	13.53596
trend	1039	6.180943	7.640273	-10	18
year	1039	1986.181	7.640273	1970	1998
lag_k	975	600168.2	1695603	-.1339746	1.74e+07
rbexist	966	.2691511	.4437484	0	1
dreform	1039	.201155	.4010567	0	1
rroi	796	10.59798	52.92596	-98.47225	388.1028
invprice	1039	1.031041	.2023544	.6601342	2.1052

Table 2a. Descriptive Statistics (If regulatory body exists)

Variable	Obs	Mean	Std. Dev.	Min	Max
ln_pvt	260	1.986591	6.069542	-9.21034	8.642539
ln_pub	260	3.5557	4.241931	-9.21034	7.889421
ln_lgdp	258	11.22734	1.275387	8.627512	13.53596
trend	260	13.96923	3.958157	0	18
year	260	1993.969	3.958157	1980	1998
lag_k	244	784008.1	2054862	-.1339746	1.74e+07
dreform	260	.6307692	.4835273	0	1
rroi	260	7.519959	15.01653	-68.56507	94.56563
invprice	260	.9823314	.168972	.7030305	1.479487
rbminis	260	.8961538	.3056492	0	1
drbelec	260	.1115385	.3154049	0	1
rbnum	195	4.333333	2.553887	1	9
rbudgov	255	.4784314	.5005169	0	1
d_ror	260	.0884615	.2845126	0	1

Table 3a. Correlation matrix for complete dataset

Obs=646	ln_pvt	ln_pub	ln_lgdp	year	lag_k	rbexist	dreform	rroi	invprice
ln_pvt	1.0000								
ln_pub	-0.2141	1.0000							
ln_lgdp	0.0006	0.2294	1.0000						
year	0.5117	-0.2134	0.0846	1.0000					
lag_k	0.2445	0.0124	0.3014	0.1308	1.0000				
rbexist	0.2978	-0.1864	0.0472	0.6419	0.0168	1.0000			
dreform	0.3371	-0.1475	0.1640	0.5442	0.1849	0.5717	1.0000		
rroi	-0.0319	0.1689	0.3266	0.0332	0.1213	-0.0779	-0.0093	1.0000	
invprice	-0.1225	0.0498	-0.2828	-0.2159	-0.0607	-0.2123	-0.2536	-0.2069	1.0000

Table 4a. Correlation matrix for regulatory variables

obs=191	dreform	rbminis	drbelec	rbnum	rbudgov	d_ror	ln_pvt
dreform	1.0000						
rbminis	-0.1293	1.0000					
drbelec	0.0013	0.1538	1.0000				
rbnum	0.2213	-0.1073	-0.1665	1.0000			
rbudgov	-0.0455	0.1394	-0.3288	-0.0854	1.0000		
d_ror	-0.0006	0.1268	-0.1185	-0.2729	0.0632	1.0000	
ln_pvt	0.4604	-0.0763	0.1662	0.1997	-0.1691	-0.0708	1.0000

Table 5a. Public and private investment per annum before and after the passage of reform legislation

Country	Sector	Investment Source	Average investment pa in 1992 US\$m -- period before liberalization	Average investment pa in 1992 US\$m -- period after liberalization
Argentina	Telecoms	Public	502.57	144.00
Argentina	Telecoms	Private	0.00	1233.00
Argentina	Electricity	Public	1814.00	437.00
Argentina	Electricity	Private	0.00	664.00
Argentina	Gas	Public	207.00	75.00
Argentina	Gas	Private	0.00	294.00
Argentina	Railways	Public	315.00	108.00
Argentina	Railways	Private	0.00	197.00
Argentina	Roads	Public	826.00	349.00
Argentina	Roads	Private	0.00	161.00
Argentina	water	Public	209.00	138.00
Argentina	water	Private	0.00	110.00
Bolivia	Telecoms	Public	23.00	0.00
Bolivia	Telecoms	Private	56.00	103.00
Bolivia	Electricity	Public	57.00	28.00
Bolivia	Electricity	Private	25.00	157.00
Bolivia	Railways	Public	19.00	21.00
Bolivia	Railways	Private	9.00	3.00
Bolivia	Roads	Public	82.00	88.00
Bolivia	Roads	Private	11.00	51.00
Brazil	Telecoms	Public	1427.00	1601.00
Brazil	Telecoms	Private	1121.00	3132.00
Brazil	Electricity	Public	4218.00	504.00
Brazil	Electricity	Private	1229.00	3806.00
Brazil	Railways	Public	887.00	73.00
Brazil	Railways	Private	912.00	259.00
Brazil	Roads	Public	747.00	311.00
Brazil	Roads	Private	131.00	326.00
Chile	Telecoms	Public	120.00	46.00
Chile	Telecoms	Private	0.00	463.00
Chile	Electricity	Public	515.00	217.00
Chile	Electricity	Private	0.00	400.00
Chile	Roads	Public	283.00	494.00
Chile	Roads	Private	0.00	165.00

Chile	water	Public	72.00	140.00
Chile	water	Private	0.00	20.00
Colombia	Telecoms	Public	164.00	378.00
Colombia	Telecoms	Private	0.00	298.00
Colombia	Electricity	Public	857.00	1421.00
Colombia	Electricity	Private	0.00	776.21
Colombia	Roads	Public	598.19	632.52
Colombia	Roads	Private	0.00	123.21
Ecuador	Electricity	Public	120.09	231.29
Ecuador	Electricity	Private	49.77	49.07
Mexico	Telecoms	Public	659.00	538.00
Mexico	Telecoms	Private	0.00	1116.00
Mexico	Roads	Public	207.97	696.26
Mexico	Roads	Private	0.00	1059.93
Peru	Telecoms	Public	75.11	131.22
Peru	Telecoms	Private	2.58	312.48
Peru	Electricity	Public	190.30	40.12
Peru	Electricity	Private	3.00	243.49
Venezuela	Telecoms	Public	177.09	13.80
Venezuela	Telecoms	Private	23.42	484.93

Table 6a. Aspects of regulatory structure by sector and country

Country	Sector	Year established	Name	In ministry or minister involved in decisions	Regulator Appointed by Legislature and Executive	Size	Tenure	Funded solely by Govt.	Tariff Regulation
ARG	Electricity	1992	ENRE	0	0	5	5	0	Price Cap
ARG	Railways	1996	CNRT	1	0	5	5	0	Price Cap
ARG	Roads	1993	MEOSP/ Ocraba	1	0	5	1	0	Price Cap
ARG	Telecoms	1990	CNC	1	0	EP	5	0	Price Cap
ARG	water	1993	ETOSS	0	0	8	6	0	Price Cap
BOL	Electricity	1994	Superintendencia de Electricidad	1	1	1	5	0	Price Cap
BOL	Railways	1995	Superintendencia de Transporte	1	1	1	5	0	Price Cap
BOL	Roads	1995	Superintendencia de Transporte	1	1	1	5	0	Price Cap
BOL	Telecoms	1994	Superintendencia de Telecomunicaciones	1	1		5		Price Cap
BOL	water	1994	Superintendencia de Agua	1	0	1	5	0	Rate of return
BRA	Electricity	1996	ANEEL	1	1	5	4	0	Price Cap
BRA	Railways	1996	Ministerio de Transportes	1	0	EP	EP	1	Price Cap
BRA	Roads	1993	DNER	1	0	EP	1	1	Price Cap
BRA	Telecoms	1997	Anatel	1	0	EP	EP	1	Price Cap
BRA	water	1995	Municipality	1	0	EP	EP	1	Price Cap
CHL	Electricity	1978	CNE	1	0	6	EP	0	Price Cap

Country	Sector	Year established	Name	In ministry or minister involved in decisions	Regulator Appointed by Legislature and Executive	Size	Tenure	Funded solely by Govt.	Tariff Regulation
CHL	Railways	1984	MOP	1	0	1	EP	0	Price Cap
CHL	Roads	1984	MOP	1	0	1	EP	0	Price Cap
CHL	Telecoms	1977	Subtel	1	0	7	5	1	Revenue Cap
CHL	water	1990	Superintendencia de Servicios Sanitarios	1	0	1	EP	1	Rate of return
COL	Electricity	1992	CREG	1	0	8	4	0	Price Cap
COL	Railways	1992	Invias	1	0	1	EP	1	Price Cap
COL	Roads	1992	Invias	1	0	1	EP	1	Price Cap
COL	Telecoms	1994	CRT	1	0	3	2	1	Price Cap
COL	water	1994	CRA	1	0	9	EP	1	Price Cap
ECU	Electricity	1996	CONELEC	1	0	7	4	0	Rate of return
ECU	Railways								
ECU	Roads		Direccion de Concesiones	1	0	EP	EP	1	
ECU	Telecoms	1992	CONATEL	1	0	6	EP	0	Price Cap
ECU	water								
MEX	Electricity	1995	CRE	0	0	1	5	1	Price Cap
MEX	Railways	1995	SCT	1	0	EP	EP	1	Price Cap
MEX	Roads	1985	Camino y Puentes Federales	1	0	5	EP	1	Price Cap
MEX	Telecoms	1996	COFETEL	0	0	4	EP	1	None
MEX	water	1989	C N A	1	0	1	EP	1	Price Cap
PER	Electricity	1993	CTE/ Osinerg	1	0	EP	EP	0	Rate of return
PER	Railways	1998	OSITRAN	1	0	4	5	0	Price Cap
PER	Roads	1998	OSITRAN	1	0	4	5	0	Price Cap
PER	Telecoms	1991	OSIPTEL	1	1	6	3	0	Price Cap
PER	water	1992	SUNASS	1	0	EP		1	Price Cap
VEN	Electricity	1992	CREE	1	0	EP	EP	0	Price Cap
VEN	Railways	1995	MTC	1	0	EP	EP	1	Price Cap
VEN	Roads	1991	MTC	1	0	EP	EP	1	Price Cap
VEN	Telecoms	1991	CONATEL	1	0	5	EP	1	Price Cap
VEN	water								

Source: Guasch, 2001.

Figure 1: Annual average share of the private sector in total Telecoms sector Investment

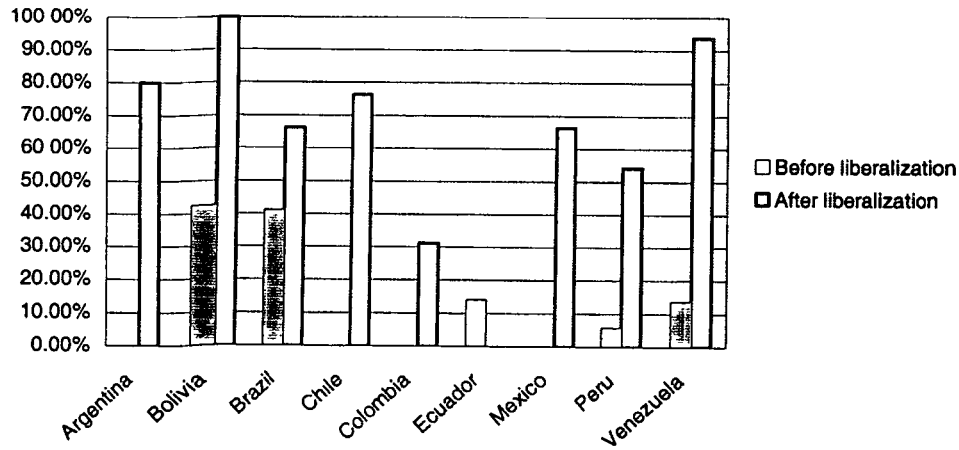


Figure 2: Annual average share of the private sector in total Electricity sector Investment

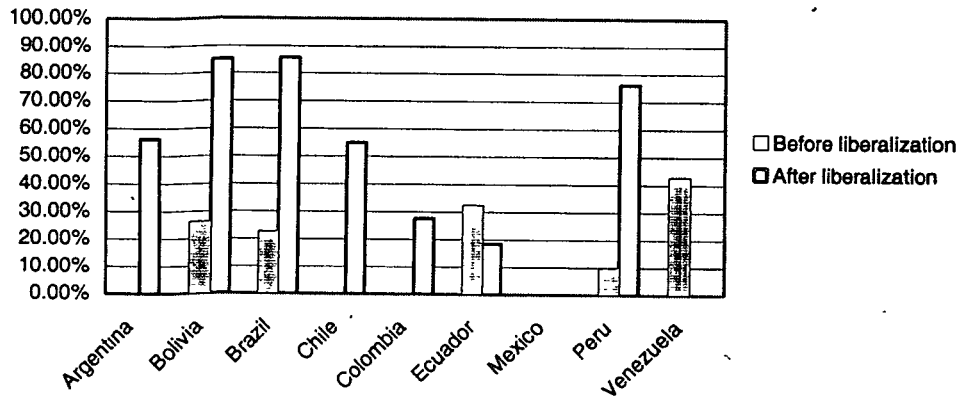


Figure 3: Annual average share of the private sector in total investment in the Roads sector

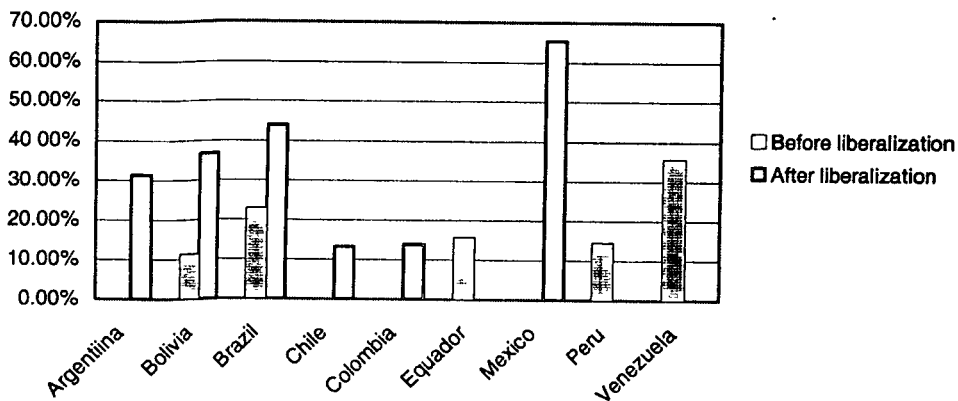


Figure 4: Average Annual Investment In Telecoms in US\$m of 1992

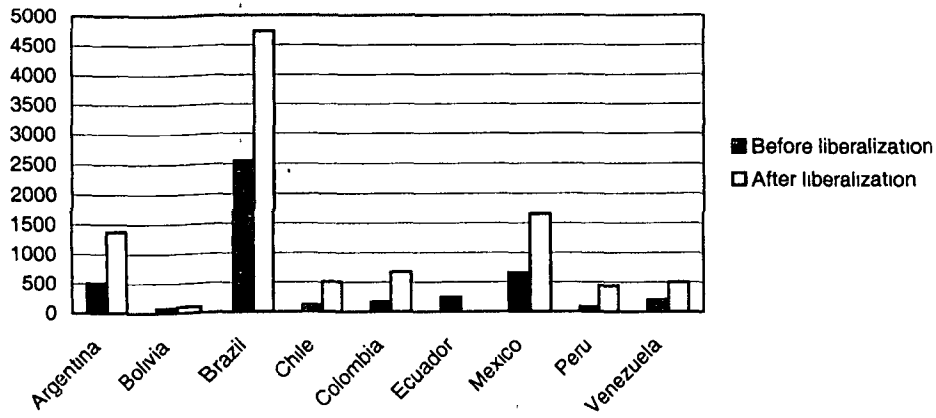


Figure 5: Average Annual Investment In Electricity in US\$m of 1992

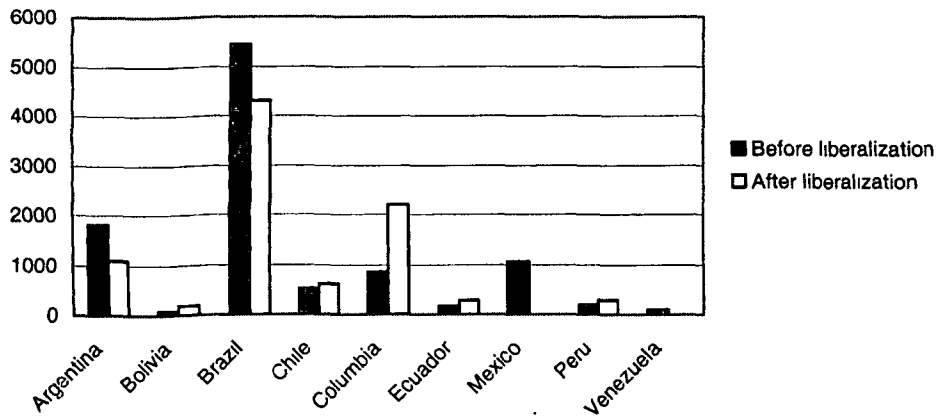
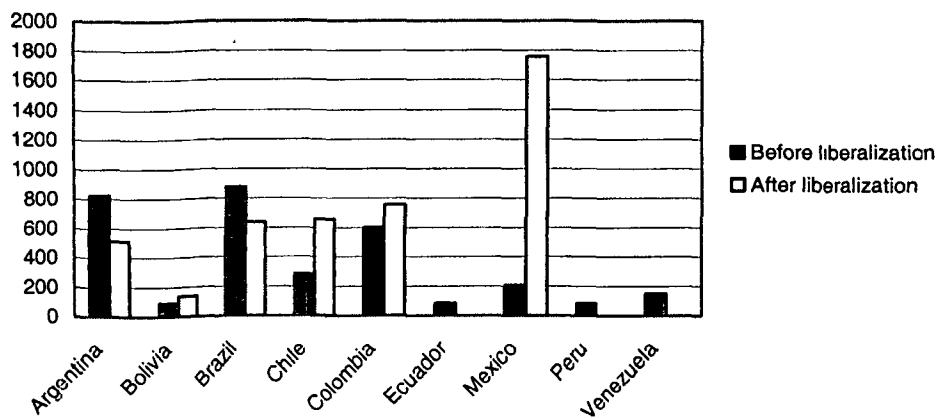
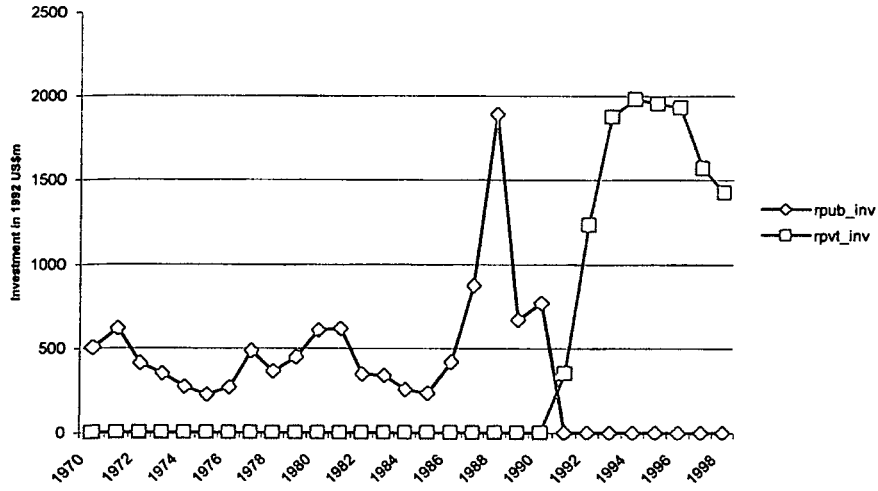


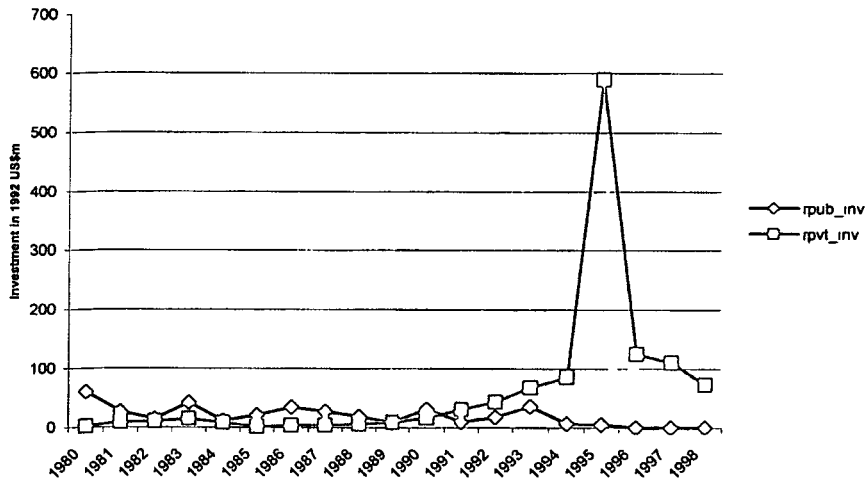
Figure 6: Average Annual Investment In Roads in US\$ of 1992



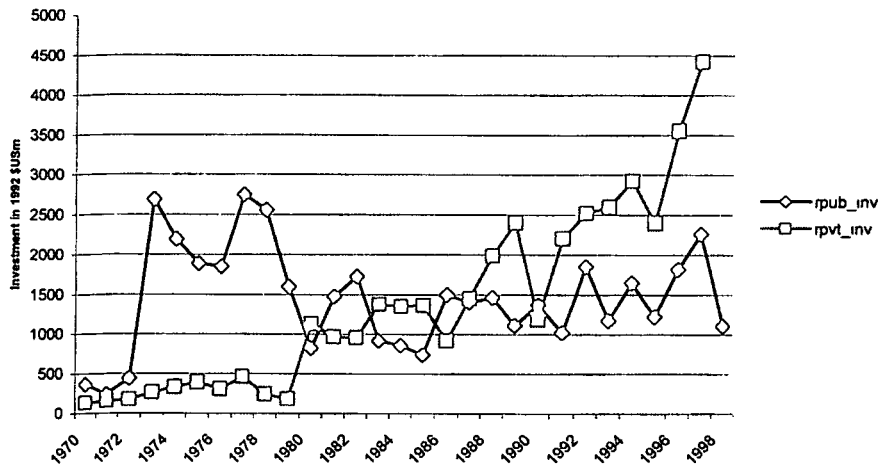
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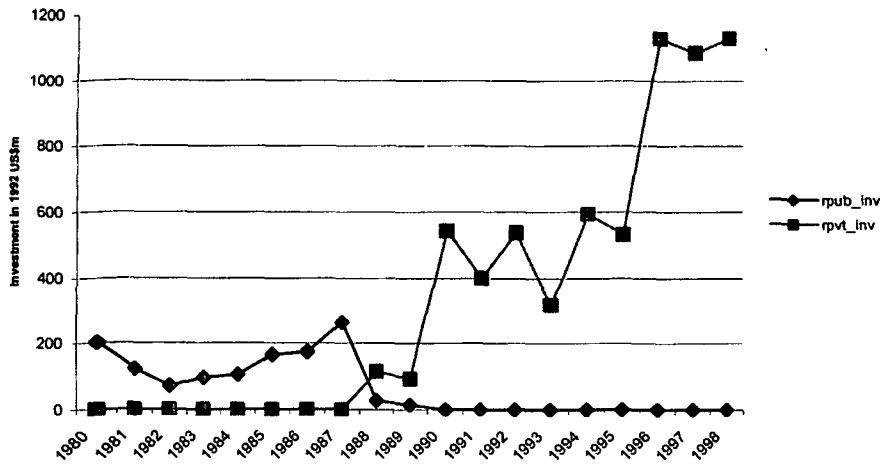
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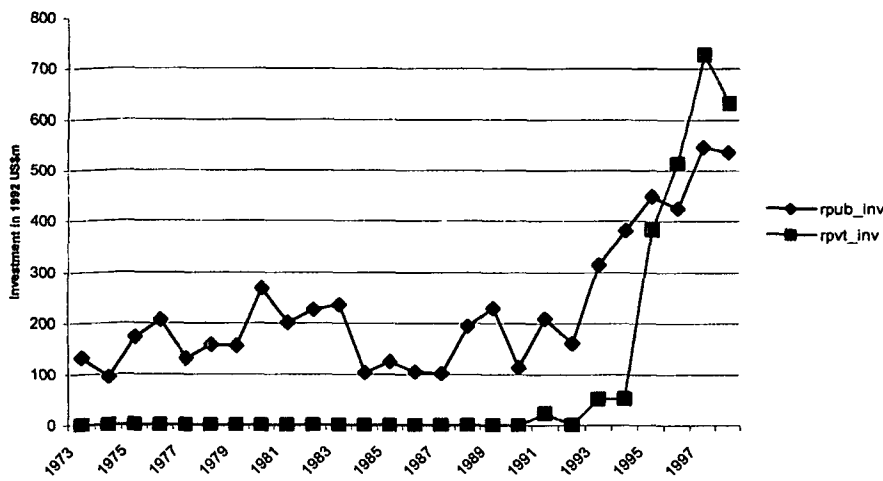
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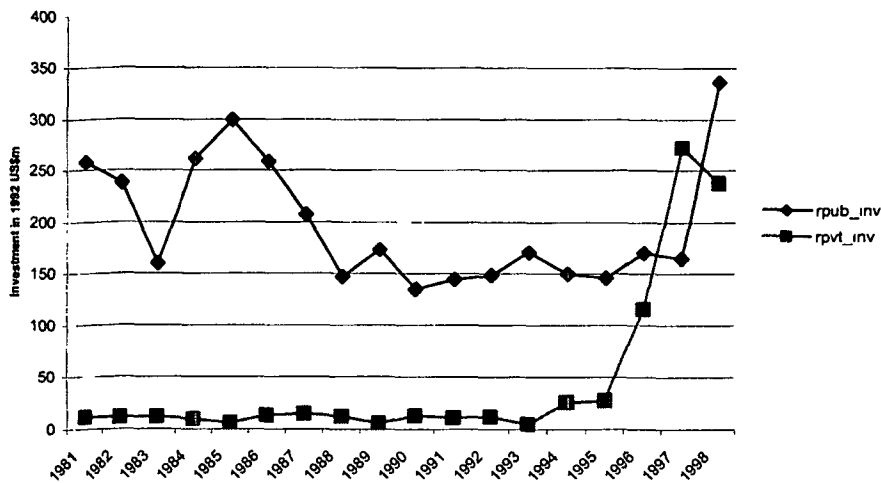
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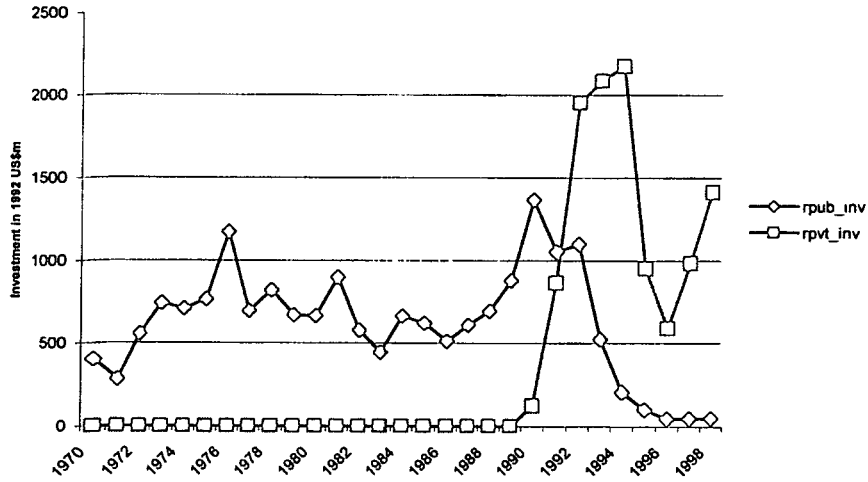
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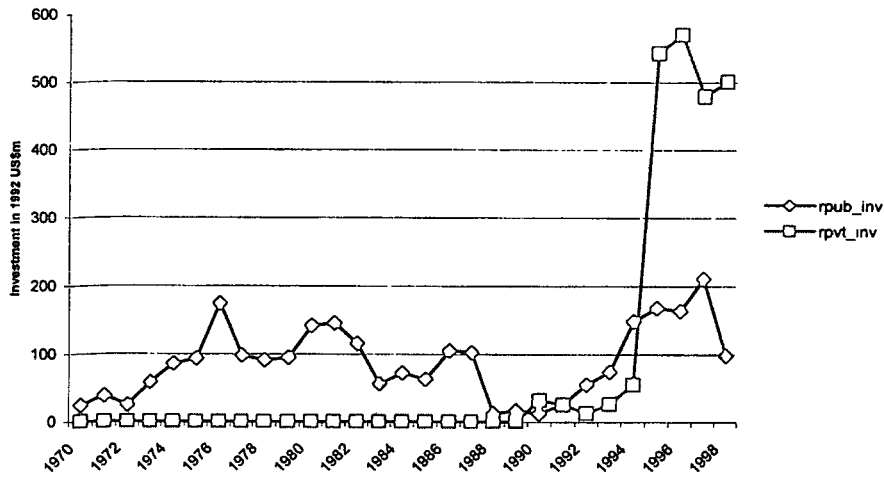
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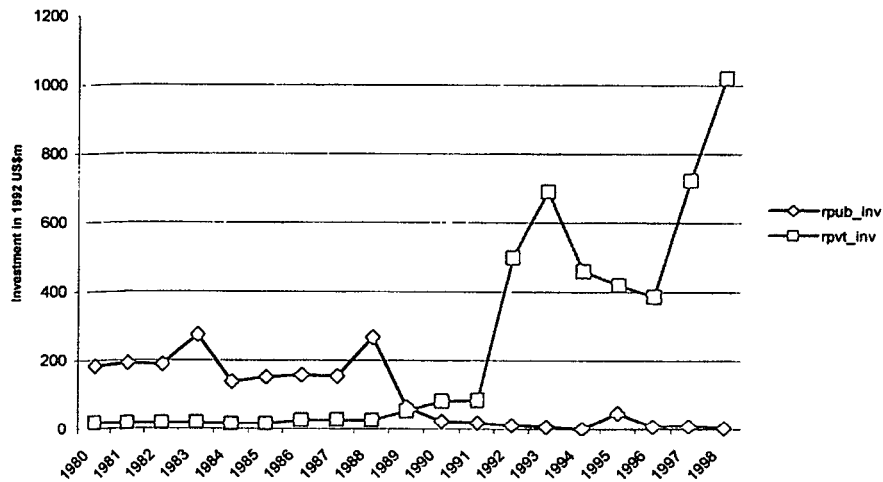
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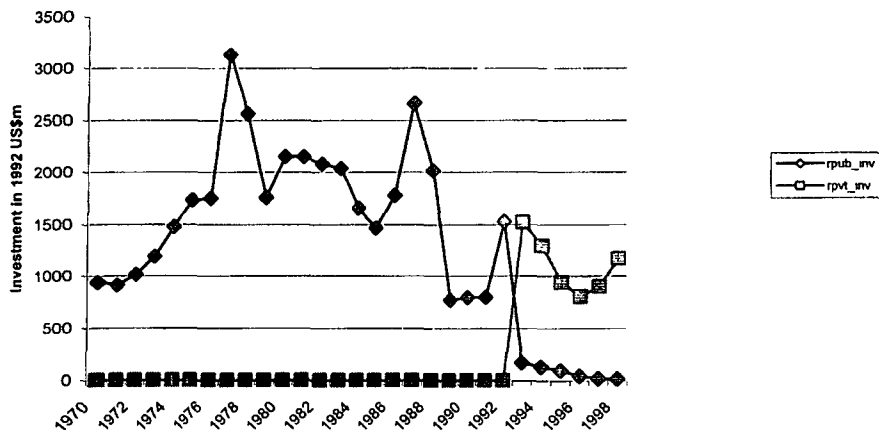
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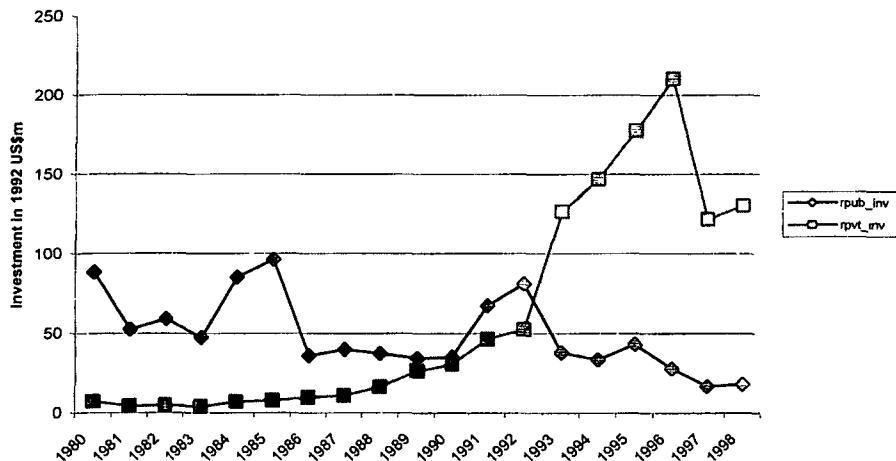
Venezuela Telecoms



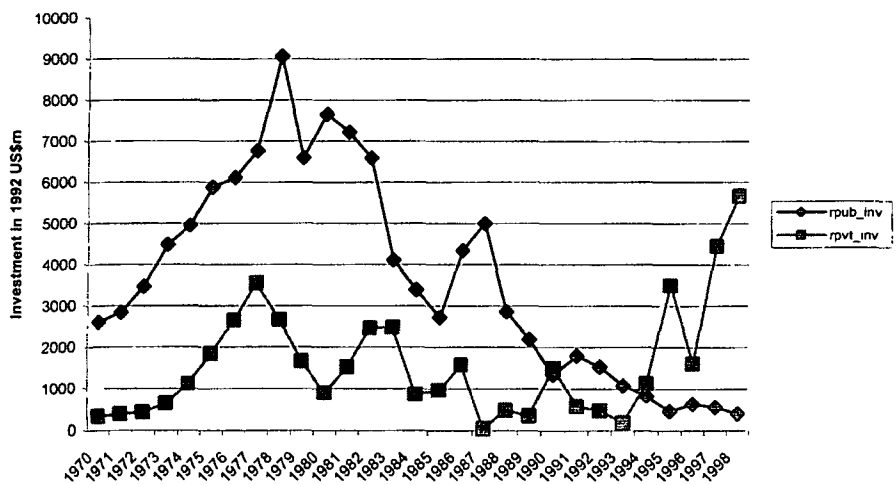
Argentina Electricity



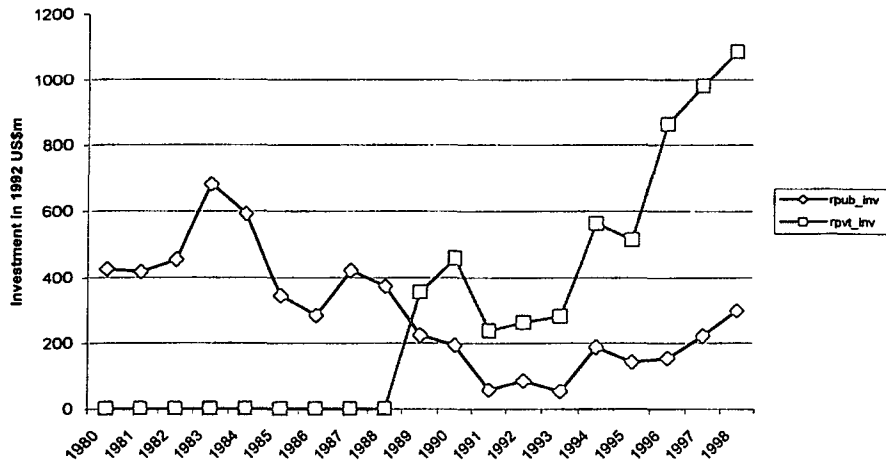
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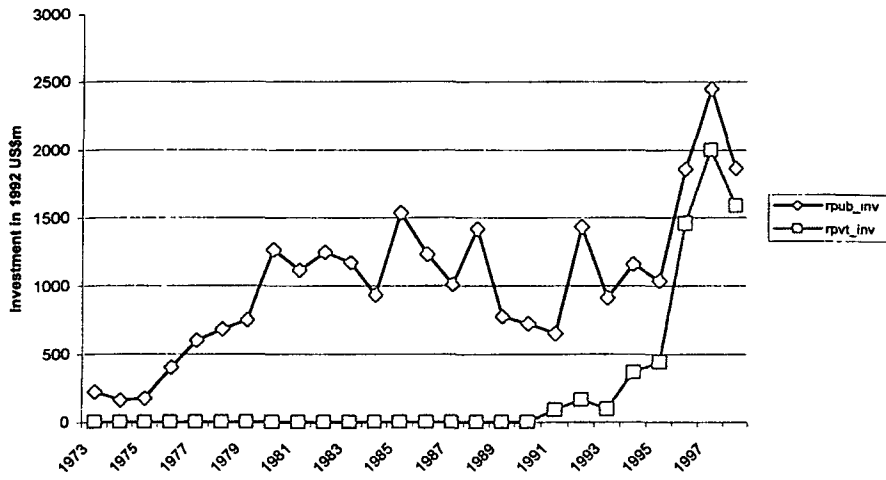
Brazil Electricity



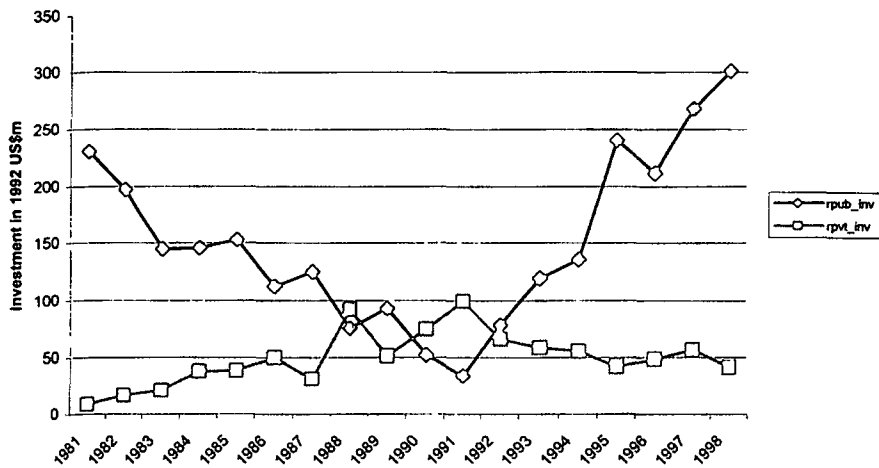
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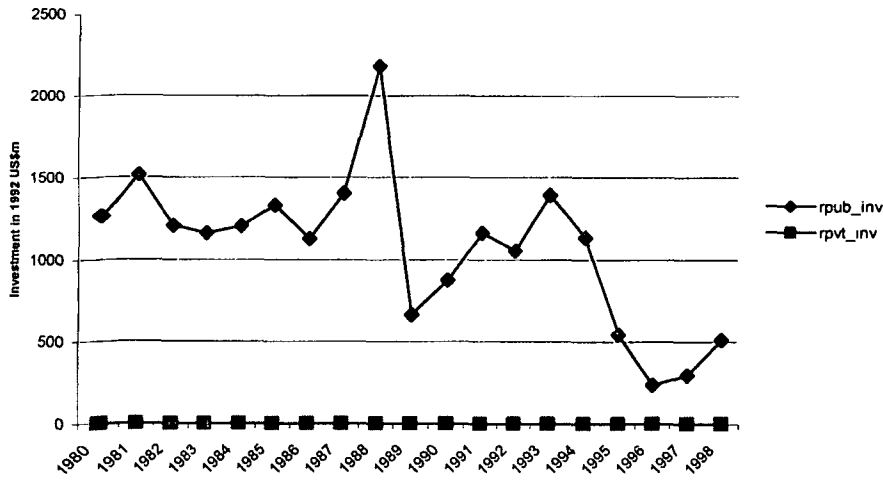
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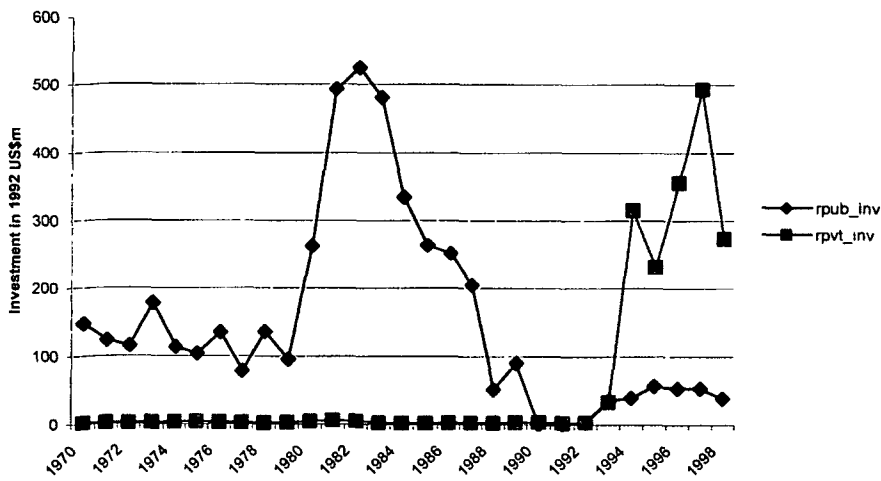
Ecuador Electricity



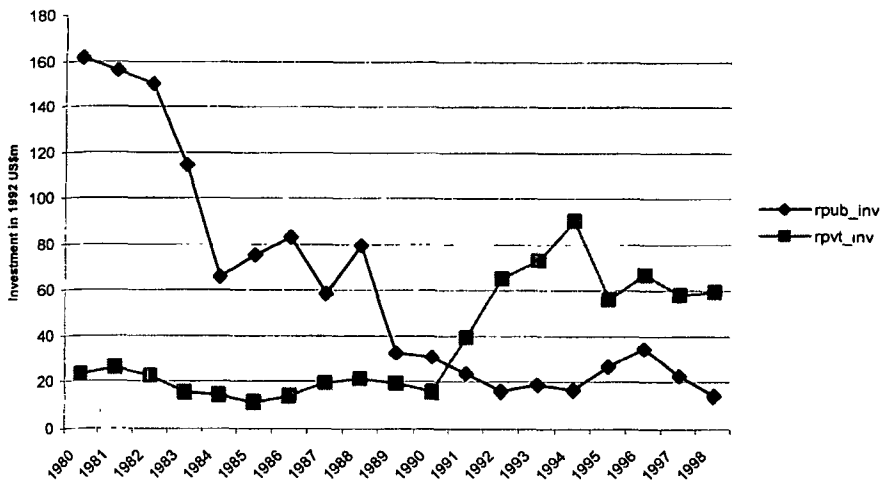
Mexico Electricity



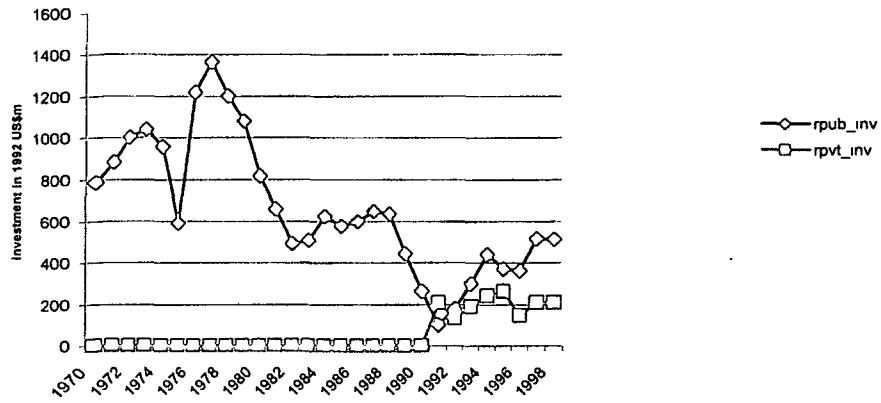
Peru Electricity



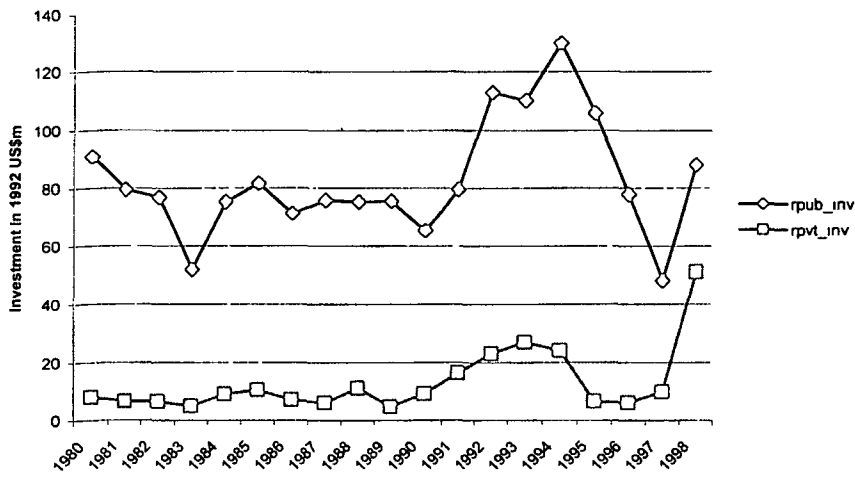
Venezuela Electricity



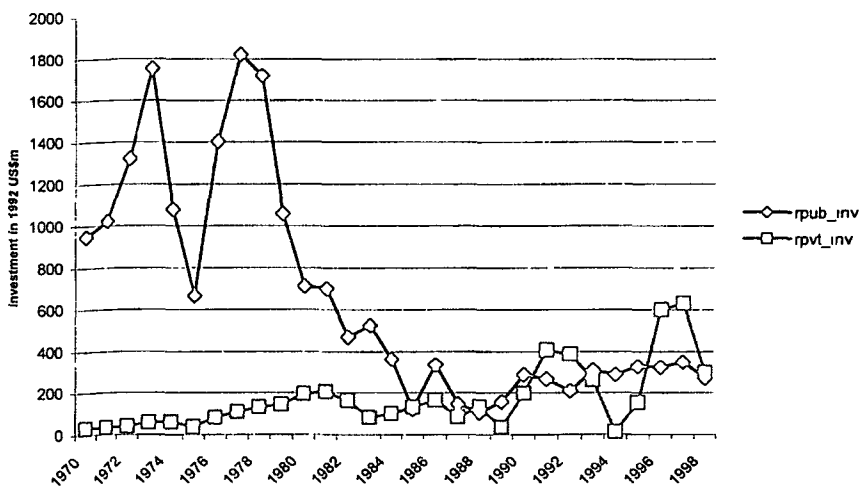
Argentina Roads



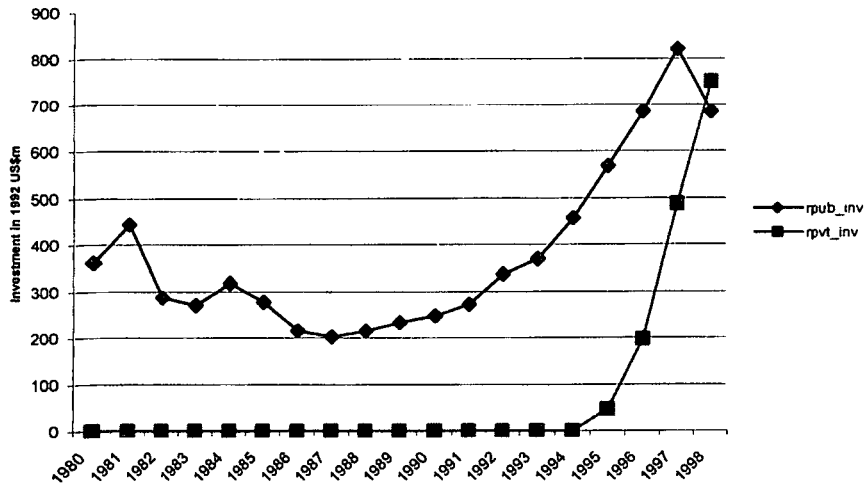
Bolivia Roads



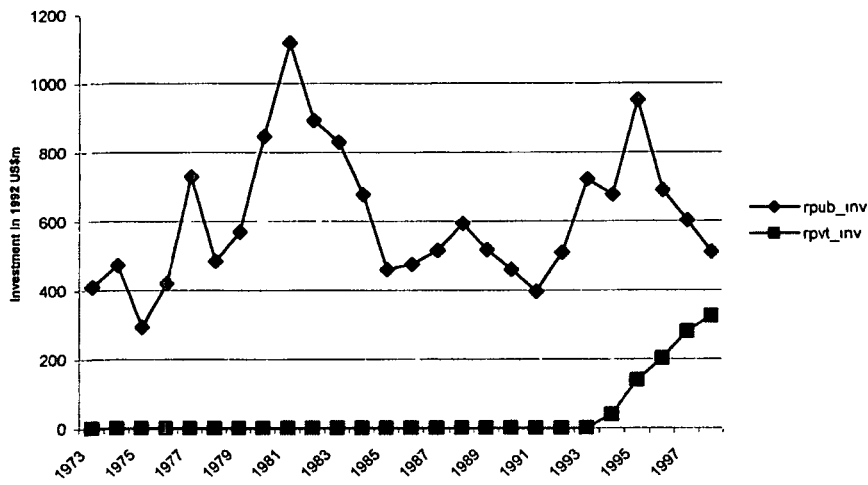
Brazil Roads



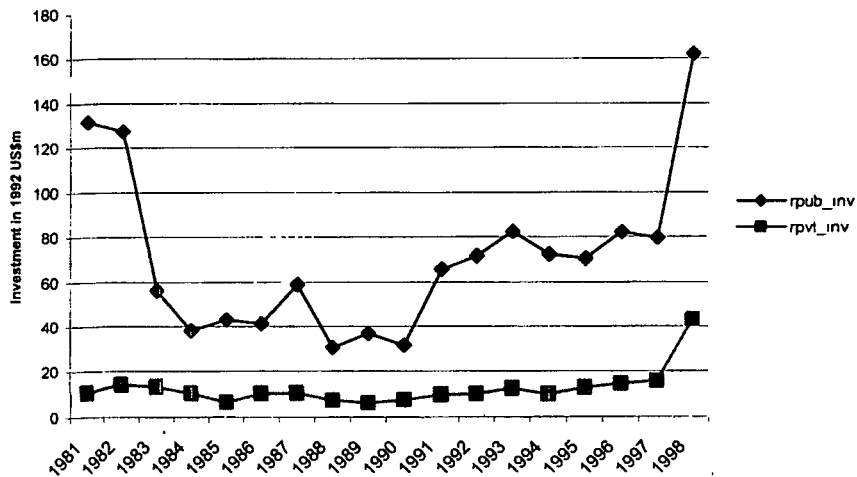
Chile Roads



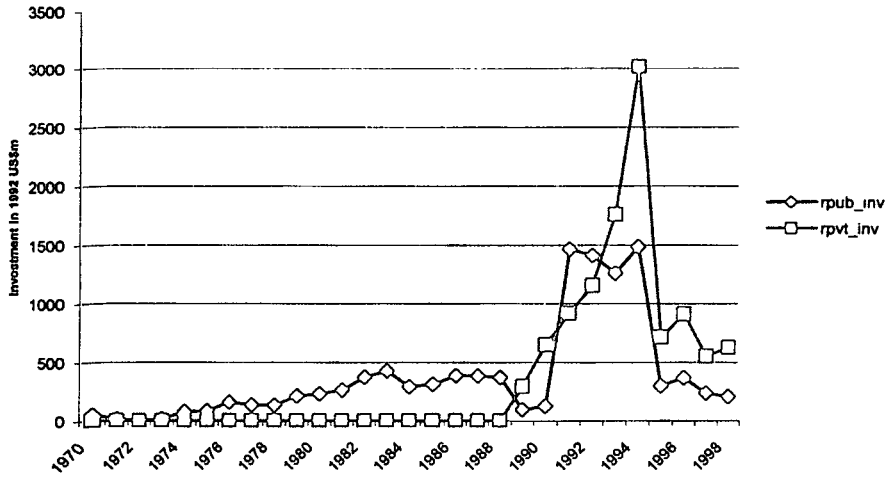
Colombia Roads



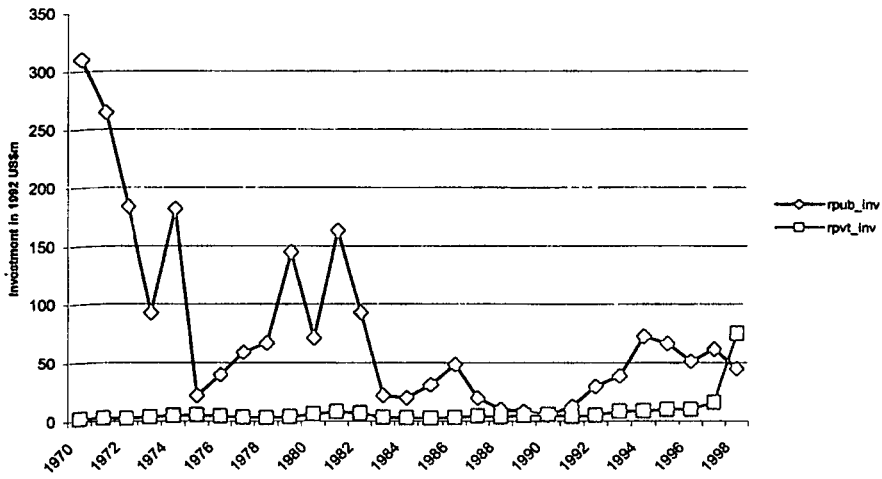
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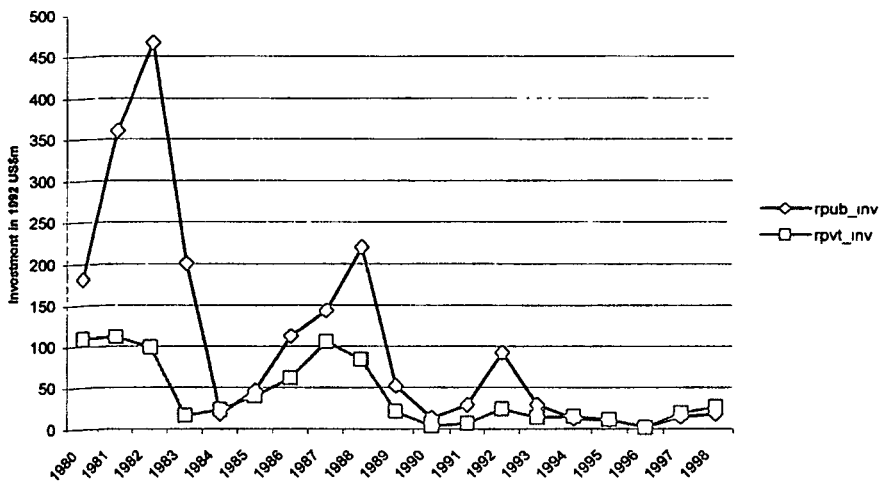
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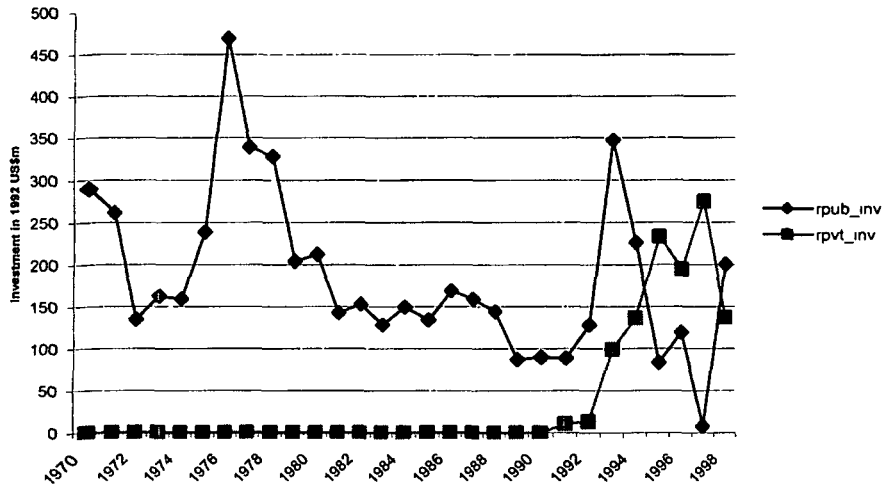
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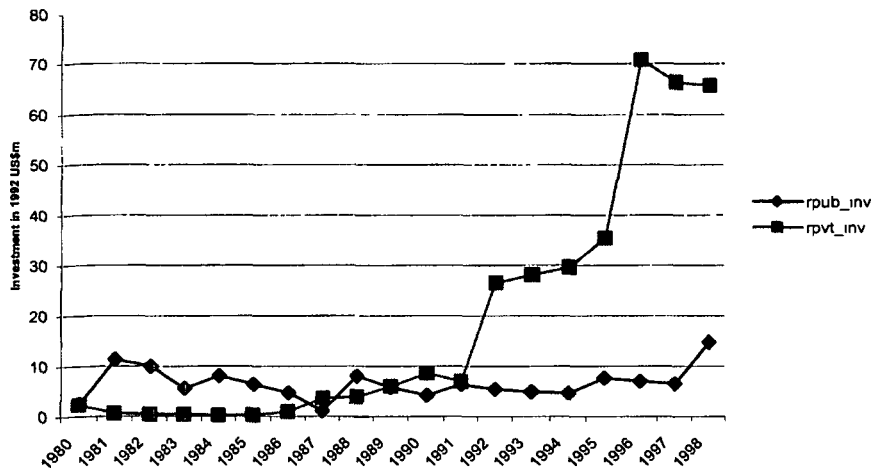
Venezuela Roads



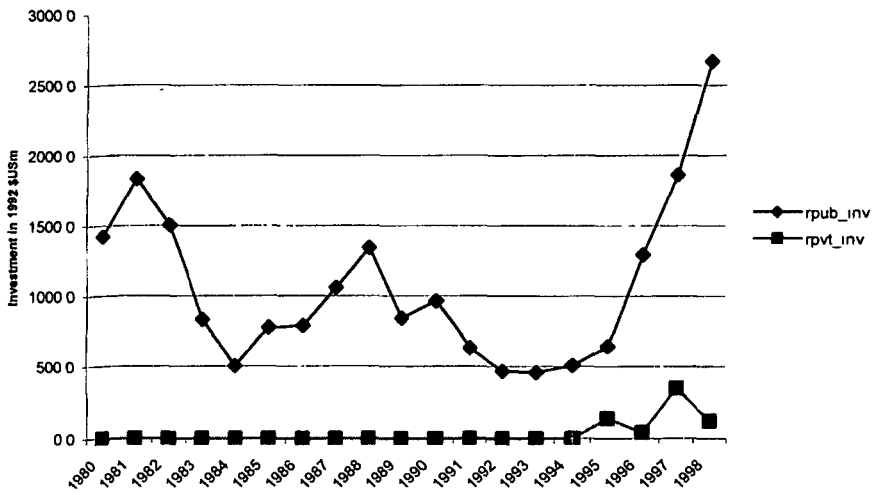
Argentina Water



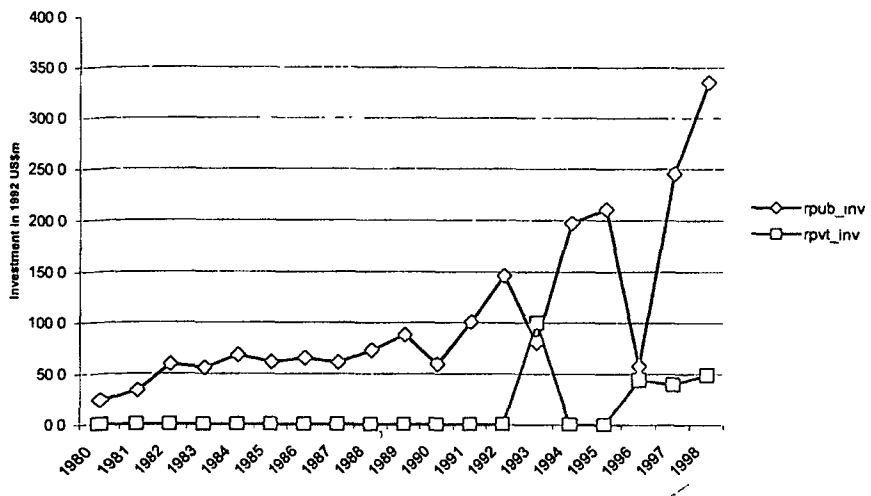
Bolivia Water



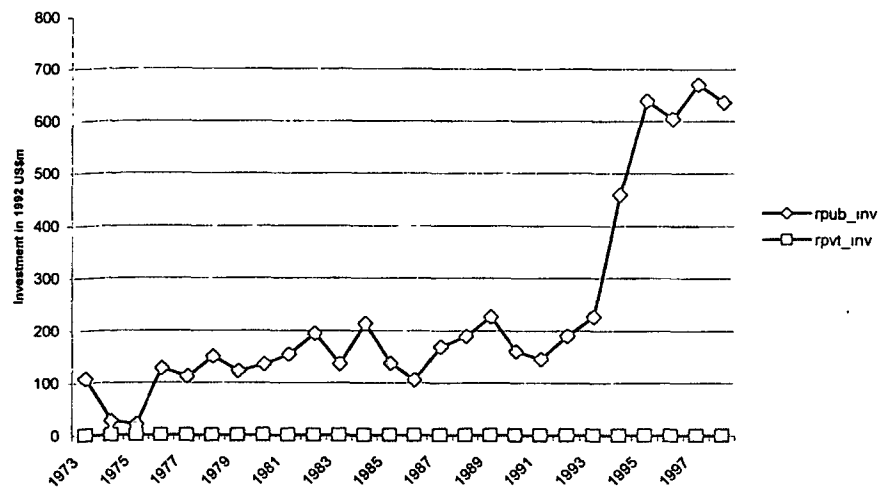
Brazil Water



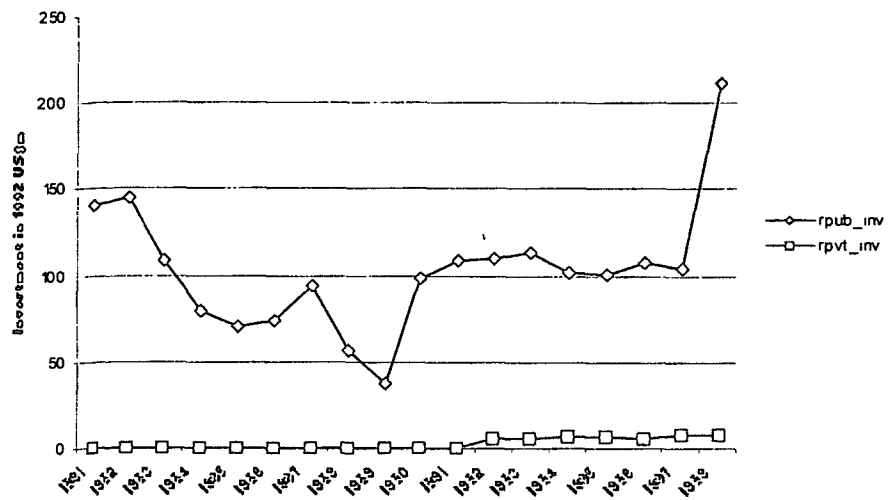
Chile Water



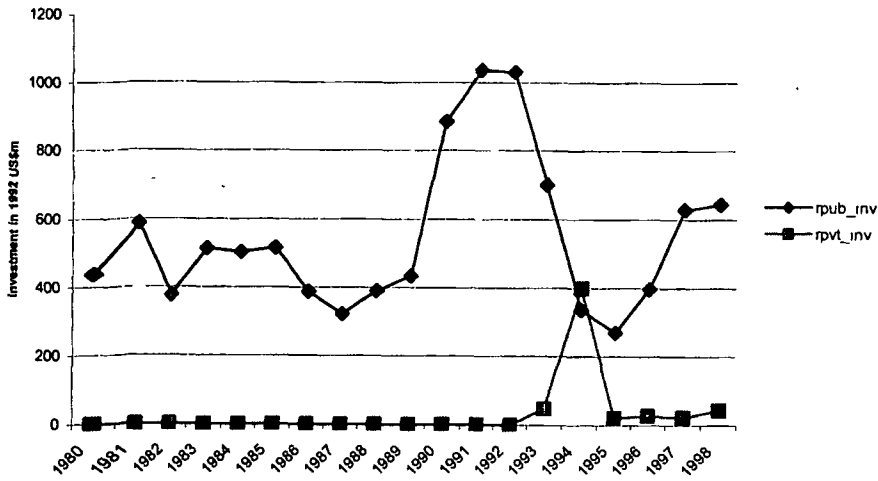
Colombia Water



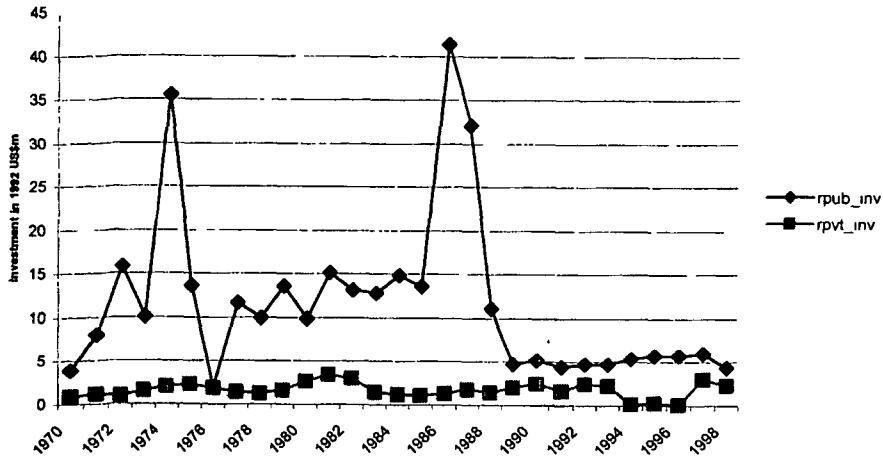
Ecuador Water



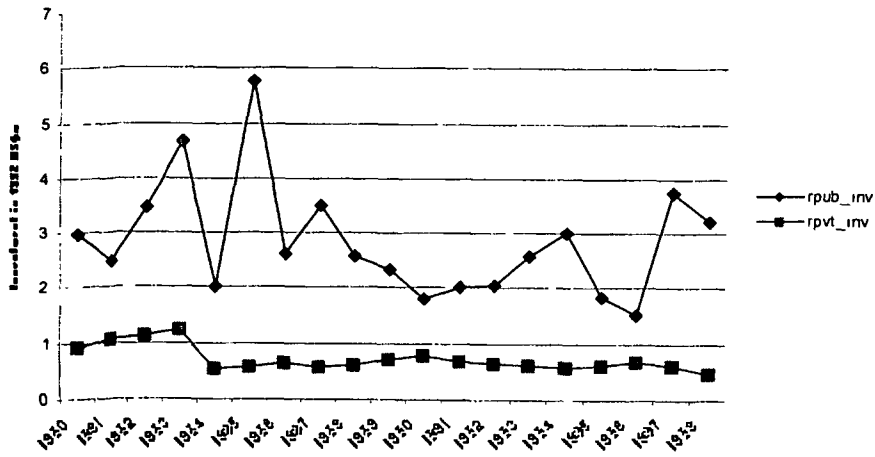
Mexico Water



Peru Water



Venezuela Water



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