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**Privatizatión in Colombia:
A Plant Performance Analysis**

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PRIVATIZATION IN COLOMBIA: A PLANT PERFORMANCE ANALYSIS

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ABSTRACT

*This paper describes the real sector privatization program in Colombia during the nineties and puts that policy in the context of general market deregulation and promotion of private investment in the provision of public infrastructure and domiciliary public services strategy. The paper evaluates the privatization program in manufacturing and power sector as case studies. It follows the ex-post measuring and econometric analysis of a set of operative and restructuring performance indicators for the privatized firms. For manufacturing, the study sample consists of 30 large manufacturing firms where the **Instituto de Fomento Industrial** was the founding partner. The main findings suggest that those firms followed a pro-cyclical behavior relative to their private competitors and undertook tight plant operative restructuring. For the power sector the paper studies the impact of the Regulatory Reform on market entry, ownership structure, market competition, and productive efficiency. The measurement of productive efficiency follows a Data Envelope Analysis technique based on a sample of 33 plants that count for 85% of the installed capacity in thermal generation. The sample units are plants that were active before the reform and the entrant ones that started commercial operations after the reform. The results suggest that efficiency scores in thermal generation have improved after the reform and that regulatory policy had a positive effect on productive efficiency.*

Key words: Privatization, Industrial Restructuring, Colombian Power Sector, and Regulatory Reform.

JEL Classification: L43, L51, L94,03

RESUMEN

El artículo describe el programa de privatización en el sector real de la economía colombiana durante los años noventa y ubica esta política en un contexto de desregulación de mercados y promoción de la inversión privada en la oferta de infraestructura pública y servicios públicos domiciliarios. El artículo evalúa el programa de privatización de los sectores manufactureros y de generación de energía eléctrica. Se hacen mediciones ex-post y análisis econométrico del desempeño de las firmas privatizadas. En el sector manufacturero la muestra analizada está compuesta por 30 firmas manufactureras de gran tamaño, donde el Instituto de Fomento Industrial (IFI) era socio fundador. Los principales resultados sugieren que estas firmas mantuvieron un comportamiento pro-cíclico relativo a su principal competidor privado, y desestimaron planes drásticos de reestructuración operativa. Para el grupo de firmas de generación de energía el artículo estudia el impacto de la reforma regulatoria en el proceso de entrada al mercado, estructura de propiedad, competencia de mercado y eficiencia productiva. La medición de eficiencia productiva usa la técnica de Data Envelope Análisis para 33 plantas que representan el 85% de la capacidad instalada en la generación térmica de energía eléctrica. La muestra está compuesta por plantas que estaban en funcionamiento antes de la reforma y las entrantes que comenzaron su operación comercial después de la reforma. Los resultados sugieren que los niveles de evidencia en la generación térmica han mejorado después de la reforma y que la política regulatoria ha tenido un efecto positivo en la eficiencia productiva.

Palabras clave: privatización, reestructuración industrial, sector eléctrico colombiano y reforma regulatoria.

Clasificación JEL: L43; L51, L94, O3.

I. INTRODUCTION

In the early nineties, the Colombian government began an economic openness program through the promotion of market competition and institutional deregulation. The economic openness package included major structural reforms in i) foreign trade policy, ii) exchange rate regime, iii) capital flow controls, iv) central bank independence, v) privatization programs, vi) labor legislation, vii) foreign investment legislation, and vii) social security and pension regimes.[1]

Historically, the size of the state in Colombia has been below the average of other Latin American economies such as Argentina, Brazil, Peru and Venezuela. However, revenues from privatization had an important impact on the government short-run fiscal policy, since during the 1994-1998 period, a majority of investment in social programs was financed with these resources. The privatization program in the real sector was dominated by the selling of assets in the power sector, natural gas transportation, manufacturing, and to a lesser degree in the water and sewage sector during the 1993-1998 period. Regarding telecommunications, the reform has induced new private investment rather than a property transfer. At the same time, the government undertook an important public divestment in the financial sector through the selling of FOGAFIN's equity shares.[2]

Colombia's most important institutional and regulatory reform during the nineties took place in the domiciliary public services sector, where free the private sector was granted free entry. This implied the setup of modern and independent regulatory commissions for electricity and natural gas, water and sanitation, and telecommunications. Hence, economic deregulation in Colombia was part of a comprehensive long-term strategy to promote the new roles of public and private sectors. However, after a decade of economic openness, this experience has not been well documented or analyzed on sectoral bases. One example is the study by Spiller & Guash (1998) about the regulatory process in Latin America, in which they literally skipped the Colombian experience despite of the advances in public utilities regulation. Furthermore, in the collective studies of privatization in Latin America such as those by Glade (1996), Baer & Conroy (1994), and Baer & Birch (1994) one finds that the reference to Colombia is usually limited in contrast to other Latin American countries.

Despite that absence, one can highlight the papers of Zuleta *et. al.* (1993), and Montenegro (1994, 1995) about the privatization process. These papers document in a preliminary manner the motivations that committed the government to rely on privatization as an economic instrument to promote market competition, but they do not provide any empirical analysis of ex-post efficiency

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[1]   The general objectives and the scope of the economic openness program are in the development plan 1990-1994 [DNP (1991a)]. The main institutional reforms are in the following laws and CONPES documents: i) foreign control regime (Law 9/1991), ii) foreign trade reform (Law 7/1991), iii) financial reform (Law 45/1990), iv) new statute of foreign investment (CONPES document - January 22/1991), v) labor reform (Law 50/1990), and vi) privatization of maritime ports (Law 1st /1991). See DNP (1991b).

[2]   FOGAFIN is a bail fund for financial institutions, whose objectives are to provide the credit lines for bank's capitalization and the savings deposit insurance. It is important to recall that the nationalization of the financial sector during the 80s was the consequence of several financial crises and the inadequate financial regulation that could not avoided the formation of economic conglomerates. Thus, the privatization and deregulation of the banking industry had different motives than those linked to the real sector.

performance. Regarding the regulatory reform in network industries, there are the papers of Gutierrez (1999) on telecommunications and Pombo (2001) on electric utilities. These sectoral-based studies document the regulatory reforms and present the evolution of some indicators that provide a partial evaluation of such reforms. Thus, the documentation of Colombia's privatization programs and regulatory reforms during the nineties is still an incomplete work that needs empirical evidence to determine the success in the designing and implementation of such economic policies.

This paper seeks to provide an ex-post performance analysis of the privatization programs based on a representative sample with emphasis in manufacturing and power plants following the benchmark approach of Meggison, Nash, & Randenborgh (1994) and Laporta & Lopes de Silanes (1999). The objective of the study is therefore two-fold. First it measures several efficiency and performance indicators with an emphasis on a sample of manufacturing and power plants that were either subject to privatization, restructured because of the new regulation, or were new entrants beginning operations under the new regulatory environment. Second, it models the determinants of technical efficiency and other performance variables controlling by industry and plant characteristics, ownership type and regulatory variables in order to evaluate the role of privatization on plant performance.

The paper is organized in five additional sections. Section 2 provides an analysis of the privatization program that puts this policy instrument in context within overall deregulation, private investment involvement in public infrastructure, and promotion of market competition policies. Section 3 specifies the privatization program by economic sector. It begins analyzing the divestiture program of former IFI enterprises from 1986 to 1997 and highlights some historical facts that put in perspective the role of IFI manufacturing enterprises during the last phase of the import-substituting industrialization in Colombia. Then it presents a brief summary of the State Oil Company (ECOPETROL) divestiture program, which bore in the natural gas and regional gasoline distributing companies. The section ends with an analysis of the regulatory reform of Colombia's power sector where privatization was deeply implemented. Section 4 presents the ex-post performance analysis. It begins with a measurement exercise of a set of performance indicators that provides a picture of the stylized facts for a sample of former IFI manufacturing firms and power utilities. Then an evaluation of changes in performance is carried out through testing the null of changes in the performance variables mean and medians. For the case of power plants, the measure of technical efficiency is based on the notion of best practice production frontier. Section five presents the econometric analysis setting estimating equations for firm's efficiency and profitability indicators controlling by plant characteristics, industry specific variables, ownership structure, and regulatory policy related variables. Section 6 offers some concluding remarks.

II. THE DEREGULATION AND PRIVATIZATION PROGRAM IN COLOMBIA: AN OVERVIEW

Privatization in Colombia was originally conceived as one instrument for economic deregulation and promotion of market competition. The designing of such program during the nineties sough to incentive and redirect private investment in public infrastructure and network industries. In that sense, one might consider multiple dimensions: i) concession contracts, ii) sales contracts, and iii) sectoral regulatory reforms. Concession contracts are an instrument that seeks to promote

the involvement of private investment in public works and domiciliary services. Concessions were virtually abolished in practice since 1930 when nationalizations and direct Government involvement in the market economy became more prevalent. Concessions had been widely used during the 19th century in railroads, mining, and crude oil exploitation. The economic deregulation policy of the 90s recovered concessions as an instrument to enhance investment in strategic sectors such as railroads, ports, airports, and highways. The bases for implementing concessions goes back to the 1991 Constitutional reform, which introduced new rules for property rights regarding domiciliary public services and the development of public infrastructure. The new legislation focused on the Government's regulatory role and ordered that it set up a flexible legislation regarding public contracting and concessions regimes [Law 80 of 1993]. One of the main objectives of the Law was the introduction of equal treatment in assigning state contracts for private and public firms, as well as extensions in the length of contracts. In particular, the Law allows the signing of contracts of more than 20 years. At roughly the same time, the 1990 Government Development Plan was addressing the new economic agenda: economic deregulation, trade liberalization, and sectoral regulatory reforms. Afterwards, several CONPES documents, as well as the laws on domiciliary public services, electric, telecommunication, and privatization set up the specific rules regarding private investment participation, the regulatory reform of network industries, and set the guideline for the upcoming privatizations.[3]

Concession type contracts were applied to public works infrastructure projects such as maritime ports, roads construction and maintenance, airports, aqueducts and sewages, railroads and mobile phone networks. The recent studies of Faimboin *et. al.* (2001) and Bonilla *et. al.* (2000) document the most important concession contracts by economic sector in Colombia. The former focuses on the contract's characteristics and the incentive mechanisms, providing a preliminary assessment. The latter analyzes the evolution of domiciliary public services and the transportation infrastructure provision in the largest cities of Colombia's Atlantic coast region. The importance of the latter case is that concessions have been more active in these cities where previous poor local governance translated into low-quality domiciliary public services provision for decades before market entry deregulation.

According to the results of those studies and several follow up CONPES documents one can conclude that concessions have had a narrow scope in their implementation. By 1998 there were 35 concession contracts signed.[4] Out of 1400 municipal and rural aqueducts within the country there were only 4 for water companies and only 3 contracts in airports out of 20 possible. In Telecommunications there only been concessions in mobile phones. Regarding local phone companies they have implemented joint-venture contracts with private investors for the network expansion. The same applies with the public long distance carrier —TELECOM. Railroads

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3   The National Council for the Economic and Social Policy (Concejo Nacional de Política Económica y Social). The CONPES documents are: 2648/1993; 2775/1995; and 2929/1997. Law 37 of 1993 rules concessions contracts for telecommunications, Law 142 of 1994 rules the domiciliary public services reform; Law 143 of 1994 supports the power sector reform; and Law 226 of 1995 specifies the all privatization sales must give an initial offer to the solidarity sector, which includes former company's worker union, worker associations and cooperative firms.

4   Appendix 1 lists the concession contracts by industry.

concessions have been limited to cargo transportation mainly with one operating concession-aire, who depends upon a commercial contract for coal transportation. In fact, in 1998 the railroad tracks network in operation was only 50% the size of the national network in 1970.[5] Despite the above, concessions have been important in promoting private investment in road maintenance, maritime ports and the building of new gas pipelines.

Privatization schemes in turn are sale contracts of equity shares from local, regional or national public institutions stakes in several enterprises among the manufacturing, network utilities, natural gas distribution and banking industry. The bases were stated in the CONPES documents 2378 (1988) and 2648 (1993), which designed the schedule for public divestiture in public and mixed capital enterprises and public financial institutions. Table 1 displays a complete list of the number of contracts of the privatized companies that took place in the real sector during the 1987-1998. One can conclude that privatization in Colombia in contrast to other Latin American experiences such as in Argentina, Chile, Mexico, and Peru was not a comprehensive process. Two reasons explain such outcome. First, privatization was designed as a complementary policy instrument for economic deregulation. In that sense, the role of the public sector was redirected toward implementing new regulatory schemes, where privatization was intended to either channel new investments in public infrastructure or ease industrial restructuring processes. Second, besides the public utilities there were not too many commercial and industrial establishments for sale. It is a well-known fact is that the size of the State in Colombia, historically, has been one of the smallest in the region. Thus, privatization contracts were specific in the selling of equity shares of mixed capital enterprises in manufacturing, gas and gasoline distribution, and in lesser degree in services and mining according to data until 1998.

Privatization in network industries arose as one instrument for promoting market competition. It came as part of ongoing sectoral regulatory reforms, which pursued to improve industry efficiency, channel private investment, and deregulate market entry especially in the provision of domiciliary public services. The power sector has been by far has been the leading sector in accumulated privatization sales [90%] according to Table 1, followed by sales in manufacturing [5.1%] and, natural gas transportation and distribution [3.6%]. The following sections turn attention to the privatization program in manufacturing, gas and power sectors respectively.

III. Privatization by Sectors

3.1 Privatization in Manufacturing

The privatization program in manufacturing was centered around the selling of the *Instituto de Fomento Industrial* (*IFI*) shares from its investment portfolio in a set of manufacturing and non-manufacturing enterprises. This financial institution was founded by the Decree-Law 1157 of 1940

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[5]   For details, see Faimboin (2001) op cit, and the CONPES documents 2648 (1993), 2775 (1995), 2928 (1997), and 2929 (1997). The first concession in airports was the construction and maintenance of Bogotá international airport second track. Regarding railroads network, there were 3,468 Km in operation in 1970 while in 1997 there were just 1852 Km. The volume of cargo transportation through railroads has risen since 1995 because of the coal exports by Drummond.

and became a strategic tool for state promotion of industrialization. The *Institute's* main objectives are: i) to provide long-term credits to private enterprises, and ii) to advance risk capital to industrial investment projects. The *Institute's* ordinary resources come from domestic saving through the issue of certificates of deposit and long-term bonds. In the international market, the institute leverages loans from multilateral agencies and commercial banks. The role of IFI in creating new manufacturing enterprises located in *late industries* was central during the fifties and sixties. Today's largest private capital enterprises in the steel, chemicals, paper, fertilizer, metalworking,

TABLE 1

PRIVATIZATION PROGRAM IN THE REAL SECTOR IN COLOMBIA 1986-1998: A SKETCH

Industry	Num Contracts	IFI MCEs	Ecopetrol MCEs	ROEs and MOEs	Total Sate Mill USD
Manufacturing	27	yes			2881.1
- Consumer Goods	8	yes			7.3
- Intermediate Goods /3	12	yes			220.8
- Capital Goods	7	yes			60.0
Minning 1/4	yes			3.5	
Natural Gas /2	2		yes		205.5
Gasoline Distribution	5		yes		41.2
Fishing	1	yes			1.5
Services	6	yes			6.9
Power Sector	12			yes	5-060.0
Water and Sanitation	1			yes	2.9
Total	58				2.9

Notes: MCE = Mixed capital enterprises; ROE = Regionally owned enterprises; MOE = Municipally owned enterprises.
/1: Mining: Carbocol is excluded since the sale was done in March 2001.
/2: Refers to the selling of Gas Natural S.A and Promigas S.A
/3: Includes Cerromatoso
Natural Gas Transportation and Distribution: Gas Natural + Promigas
Gasoline Distribution: Terpel companies = Terpel Sabana + Terpel B/manga + Terpel Centro+ Terpel Sur + Terpel Norte
Power Sector: 1996-1997 Privatization: Betania + Chivor + Tasajero + TermoCartagena + EPSA + EEB
Corelca Privatization: EAtlantico + EBolivar + ESucre+ ECordoba + EMagdalena + ECesar
TEBSA: Overhaul did not imply a selling
Water and Sanitation: Cartagena Aqueduct became as ACUACAR as mixed capital utility
Partners = City of Cartagena (50%) + Aguas de Barcelona (45%) + private investors (5%)
total utility capitalization = USD mill 4.84
Sources: Ecopetrol requested files; IFI requested files; Dager (1999), DNP (1993, 1997), Bonilla (2001), Famboim et al (2001), Pombo (2001).

and automobile sectors were former IFI associated companies. IFI's larger projects were oriented to capital-intensive industries and producers of intermediate materials as an integral part of *Import Substituting Industrialization* policy (ISI), which sought to generate a new supply of manufactured goods to the domestic market [Prebish (1959), Hirschman (1968)].

The history of the IFI firms constitutes a central piece of Colombia's industrialization process during the postwar years. The prime objective according to the *Institute's* founding statutes is to "promote enterprises dedicated to the transformation of domestic raw materials given that private capital is not able to develop by itself" [Decree-Law 1157/1940]. Thus, forming mixed-capital enterprises channeled private sector investments in new activities. It also constituted a guarantee for stability in foreign investment participation. IFI's founding statutes are specific in ordering the selling of equity shares once the government considered the new enterprises were already consolidated in the market. Through that mechanism, IFI rotates its capital to promote new industrial projects, and exercises the role of *supporter* rather than that of a *permanent investor*. IFI had an active role as financial supporter within the context of ISI until the mid-seventies when several industrial projects began operations. As a result, manufacturing firms such as —*Acerías Paz del Río, Cementos Boyacá, Colclinker, Compañía Colombiana Automotriz, Icollantas, Monomeros Colombo-Venezolanos, Propal, Sofasa*— among others have been leading firms near the center of Colombia's entrepreneurial development. Hence, *privatization* has been a traditional financial instrument for the case of IFI and makes it different from other privatization programs in Latin America because in this case firms in most cases were mixed capital enterprises rather than *state-owned* enterprises.

The CONPES document 2378 of 1988 sped up the privatization program of IFI enterprises. In that sense, the policy focused on the transfer of assets and left off the Institute's new investments. By December of 1987, the *Institute* had capital shares in 45 manufacturing and non-manufacturing enterprises. Thirty of them were operating and the others had already begun a liquidation process. In addition, there were investments in six ongoing projects.[6] The privatization program defined three steps: i) the selection criteria, ii) the stock assessment, and iii) the method of sale. The selection criteria was to sell equity shares of all operating enterprises that were not subject to special legal procedures and ongoing projects that had not started commercial operations after 3 years of initial disbursements.[7] The stock assessment process sought to determine the commercial value of the firm's net assets and the single stock price. The assessment studies took into account several parameters such as company cash flow present value, asset benchmarking, asset- book values, stock exchange prices, and the reposition and liquidation costs. In addition, all stocks were listed into the domestic stock exchange markets as well as at the *National Stock Registry Office* to provide transparency in the

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[6]   It is important to highlight that there were important transfer of assets to private sector before the privation program of the nineties. One example was *Icollantas* were IFI sold its equity shares in 1980 and 1985. The Institute in 1994 participated in a 20% share of USD 60 million company's capitalization.

[7]   The special legal procedures refers to the following cases: i) companies with property shares from two or more public institutions, ii) companies with direct investments from foreign government agencies, and iii) companies with ongoing settlement processes with their lenders. The second case applied at that time to *Monomeros* because the Venezuelan government is still a company's shareholder. For details, see DNP (1988) *op. cit.*

process. This element facilitated the purchase of equities from the public and contributed to property democratization.

Regarding the method of sale the *Institute* used several bidding procedures such as private offers to current shareholders, public bids, domestic stock exchange, and preferential offer to the so-called "*solidarity*" sector, which is formed mainly by company's retirement employees and union workers. From May 1986 to December 1997 there were 38 privatization contracts of the IFI enterprises. Table 2 displays the summary of the IFI's sale program. Three comments are worth mentioning. First, in all cases the share of IFI in the firm's net worth were less than one half. This implied that the *Institute* never set management policies. Moreover, the partnership of IFI has been oriented since the beginning to promote technology transfers and to enhance an entrepreneurial base.

Second, the data suggests that the selling process was successful in the sense that stocks' selling prices were in all cases greater or equal to the pre-privatization stock nominal price.

However, there is no evidence to ascertain if fixed assets were correctly valued before privatization. Third, the accumulated sale was 300 million US dollars, which reflects that government involvement in manufacturing was very small by the end of the eighties. For instance, such amount represents less than 10% of the privatized value in Colombia's power sector during 1996-1997, or the sale of the Mexican Telecom Company [*TELMEX*] in 1990.

3.2 Privatization in Natural Gas and Gasoline Distribution

The privatization program in natural gas transportation and distribution industry as well as gasoline distribution was centered in the Colombian Petroleum Company —ECOPETROL—[8] selling of equity shares of its investment portfolio. Privatization was narrowed to the sale of those assets that were not directly related with crude oil exploration, transportation, and refinement. ECOPETROL's main investments were located in complementary industries such as natural gas transportation and distribution, gasoline stations, pipelines, thermal gas-based power plants, and other investments in non-oil businesses.[9] Table 3 depicts a summary of ECOPETROL divesture process until mid 1999.

Three comments are worth mentioning. First, the share of ECOPETROL in the privatized companies was except for Gas Natural, less than 50% at the privatization date. This case, similar to IFI enterprises implied that firms were not directly subordinated to ECOPETROL guidelines and managing policies. Moreover, those companies were independent in their investment expansion

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[8]   Empresa Colombiana de Petróleos.
[9]   For instance, by March 1993 ECOPETROL had equity shares in three domestic investment banks [Corficaldas, Corfinorte, Corfinanza], one power utility [ESSA], one fertilizer plant [FERTICOL], and one promoting enterprise [Artesanías de Colombia]. For details, see DNP (1993, op. cit.)

Table 2
IFI - Privatization Program 1986-1997

Sector	Firm	Date	Num. Stocks	IFI Share %	Stock Nominal Value $	Stock Sale Value $	Total Sale Mill $	Total Sale Mill USD	Selling Method
Fishing	COPESCOL	Jul-91	147,000	49.0%	1,000	6,505	956.2	1.5	Public Bid
Manuf	EMPACA S.A.	May-86	357,440	29.2%	10	150	53.6	0.3	Public Bid
Manuf	SUCROMILES S.A.	May-86	102,709	15.6%	100	2,400	246.5	1.3	Public Bid
Manuf	VIKINGOS S.A.	Jul-86	7,049,250	35.5%	10	16	112.8	0.6	Domestic Stock Market
Manuf	UNICA S.A.	Mar-88	1,108,273	3.4%	10	95	105.3	0.4	Domestic Stock Market
Manuf	FORJASCOL S.A.	Dec-88	ASSETS				1,699.8	5.7	Public Offer
Manuf	SOFASA	Feb-89	1,085,648	49.8%	1,000	18,362	19,935.0	52.1	Public Offer
Manuf	CICOLSA	Mar-90	140,000	17.4%	100	100	14.0	0.0	Private Offer
Manuf	AICSA S.A.	Apr-90	1,321,920	49.0%	10	144	190.5	0.4	Public Offer
Manuf	ING RISARALDA S.A.	Jul-90	2,307,868	11.7%	100	421	972.4	1.9	Public Offer
Manuf	PAPELCOL S.A.	Aug-90	ASSETS				16,218.2	32.3	Public Offer
Manuf	COLCLINKER S.A.	Oct-90	118,107	15.7%	1,000	16,160	1,908.6	3.8	Private Offer
Manuf	RIOCLARO S.A.	Dec-90	5,081,585	10.3%	100	430	2,185.1	4.4	Domestic Stock Market
Manuf	C.C.A.	Dec-90	505,055	0.0%	0	0	0.0	0.0	Private Offer
Manuf	COSEDA	Jun-91	200,000	20.0%	1,000	1,277	255.3	0.4	Private Offer
Manuf	ASTIVAR	Aug-91	46,500	31.0%	100	2,800	130.2	0.2	Private Offer
Manuf	TEXPINAL	Sep-91	22,089,534	32.4%	5	160	3,534.3	5.6	Private Offer
Manuf	PROVICA	Sep-91	47,160	13.2%	1,000	1,414	66.7	0.1	Private Offer
Manuf	CONASTIL	Jan-92	1,013,828	59.9%	1,000	1,000	1,013.8	1.5	Private Offer
Manuf	FERTICOL	Apr-92	129,028	0.7%	10	10	1.3	0.0	Preferencial Offer
Manuf	PENNWALT	Nov-92	7,739,517	40.7%	10	158	1,222.8	1.8	Private Offer
Manuf	FATEXTOL	Feb-93	240,001	16.0%	1,000	2,250	540.0	0.8	Domestic Stock Market
Manuf	FRIGOPESCA	Dec-94	5,708,109	47.4%	100	440	2,511.6	3.2	Public Bid
Manuf	INTELSA	Apr-95	7,853	15.7%	1,500	16,500	129.6	0.2	Public Offer
Manuf	COSECHAR	Oct-95	11,954	1.4%	500	695	8.3	0.0	Public Offer
Manuf	QUIBI S.A.	Apr-96	12,847,611	20.7%	10	45	578.1	0.6	Public Offer
Manuf	CERRO MATOSO	Feb-97	5,512,803	47.7%	100	28,264	155,813.9	150.3	Pref Offer/Public Bid
Manuf	NITROVEN	Dec-97	30,000	10.3%	1,000	702,933	21,088.0	20.3	Pref Offer/Public Bid
Mining	FOSFONORTE S.A.	Jan-89	691	1.1%	1,000	1,250	0.9	0.0	Private Offer
Mining	FOSFOBOYACA S.A.	Feb-90	9,000	6.4%	1,000	1,000	9.0	0.0	Private Offer
Mining	PROCARBON	Sep-91	35,160	0.1%	100	270	9.5	0.0	Domestic Stock Market
Mining	PRODESAL	Oct-91	2,351,174	11.6%	100	921	2,164.4	3.5	Domestic Stock Market
Services	PROHOTELES S.A.	May-86	1,105,201	10.8%	10	39	43.1	0.2	Domestic Stock Market
Services	CIAC S.A.	Mar-89	103,709	0.5%	10	38	3.9	0.0	Private Offer
Services	COLAR LTDA.	Aug-89	ASSETS				100.0	0.3	Public Offer
Services	CORFERIAS S.A.	Oct-89	4,239,005	5.6%	10	65	275.5	0.7	Private Offer
Services	CORFIDESARROLLO	Sep-93	15,183,107	16.1%	100	217	3,294.7	4.8	Domestic Stock Market
Services	COKOSILK S.A.	Jan-97	1,269,546	16.2%	690	690	876.0	0.8	Pref Offer/Public Bid
					Manufacturing		230,536	288	
					Mining		2,184	3	
					Services		4,593	7	
					Fishing		956	2	
					Total Accumulated (Millions)			**300**	

Source: IFI- Requested Files, Dager (1999)
Notes: After 1995 all privatization contracts were subject to Law 226/1995
CCA: equity shares seized by Banco Colombia's trust fund since 1986

plans, and company wages policy was set independently from ECOPETROL.[10] Second, privatization until mid-1999 was explained by three sales. The most important sale was *Gas Natural* in May 1997 where the second bid to the strategic private investors was successful. The sale price was three times greater than the bid base price. The bid followed a simultaneous *first price auction* within the three stock markets of the country.[11] Third, the gasoline network represented by the TERPEL

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[10]   ECOPETROL workers union historically has been one of the most influential and political strongest in the country.

[11]   For details, see Ecopetrol's press release of June 6 1997. According to such bulletin there was a tight competition between the winner (Gas Natural-Spain) and British Petroleum, Amoco, Empresas Publicas de Medellin (EPM), and France Gas.

stations was the first privatization sale after the CONPES document 2648 of 1993 was approved. TERPEL was traditionally the competitor of private retailers. Thus, this transfer implied that gasoline retail distribution became a 100% privately-owned but regulated industry, in contrast to other oil producers in Latin America such as Ecuador, Mexico, and Venezuela where gasoline distribution is still an industry vertically integrated with the state oil company.

TABLE 3

ECOPETROL Privatization Program by June 1999 - (USD and Units)

Company/Name	Activity	Share Before Priv %	Assess. Price $USD	Number Stocks Sold	Sale Price Solid. $USD	Sale Price Private $USD	Priv. Date	Selling Method
Gas Companies								
Gas Natural	Transp. Distrib.	60.6	5.85	9,088,711	5.85	17.46	1997	Pref-Offer Stock Market
Colgas	Distrib.	16.2	0.08	12,267,411	0.08		On Going Sale	Pref-Offer Stock Market
Promigas	Transp.	28.8	2.46	16,954,441	2.46	2.95	1997	Pref-Offer Stock Market
Invercolsa	Distrib.	24.8	0.06		0.06		On going Sale	Pref-Offer Stock Market
Surtigas	Distrib.	15.4	0.22				No sale	
Gases Guajira	Transp. Distrib.	6.2	n.a				No Sale	
Gasoline Companies								
Terpel Sabana	Distrib.	40.0		640,000		8.34	1993	Direct Offer
Terpel Bucaramanga S.A.	Distrib.	36.1		1,882,322		9.78	1993	Stock Market
Terpel del Centro S.A.	Distrib.	49.7		46,993,690		0.28	1993	Stock Market
Terpel Sur S.A.	Distrib.	45.6		262,290		8.27	1993	Stock Market
Terpel Norte S.A.	Distrib.	18.0		2,290,105		0.90	1993	Stock Market

Notes: After 1995 all privatizations were subject to Law 226; Ecopetrol stopped the sale of Iversolsa in 2000. Colgas has not been sold by 2001
Sources: Ecopetrol- Planning Office Requested Files; Decree 829/1999; DNP (1993, 1997)

3.3 Privatization in the Power Sector

The regulatory reform in Colombia's electricity supply industry (ESI) is supported by the *Electric Law* (Law 143) and by the *Domiciliary Public Services Law* (Law 142) of July 1994. The 1994 reform has been the most important and comprehensive since 1967 because it changed the structure of a vertically integrated industry. The new regulatory institutions in turn started to operate one year later The core elements of the reform followed the schemes adopted in the

Great Britain concerning the separation of power activities and markets, the setting up of an electricity spot market, and the development of long-term contract market for electricity.[12]

Privatization arose therefore as one instrument for promoting market competition and industry restructuring. Thus, it became a complementary policy within a broad deregulatory context. Table 4 describes the selling process, which had two phases until 1998. The first one was the 1996-1997 privatization round focused in the selling of thermal plants and hydroelectric stations. The sales went up to USD 3,900 millions. This represented a 50% transfer of overall system generating capacity. The most important transaction was the sale of 48% of Bogotá Power Company's net worth, which included also the transfer of the local distribution network and the regional grid. The buyers were two holdings leaded by ENDESA and CHILECTRA, which are Chile's largest power generators. The second phase of the privatization program took place in 1998 and focused in the capitalization and sale of the CORELCA holding, which covers Colombia's Atlantic Northern region.

The restructuring implied the holding division in several independent companies according to power activity: generation, transmission and distribution. The national grid company ISA bought 65% of the new transmission company equity share. On the other hand, a holding formed by American and Venezuelan utilities purchased 65% equity share of the two distribution utilities founded after CORELCA's restructuring. Both transactions added up USD 1,160 millions.[13]

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[12]   The national grid company *Interconexión Eléctrica* S.A (ISA), was founded in 1967. By that time, the sectoral developed view was to consolidate ISA as the largest nationwide power generator and transporter of bulk electricity following the vertically integrated natural monopoly model. For more details, see The World Bank (1991). A complete description of the regulatory reform in Colombia's power sector is in Pombo (2001b) and ISA reports. Historically, Colombia's power sector is divided in five regional markets: Bogotá Power Company (EEB); The Atlantic Coast Regional Electric Corporation (CORELCA), Public Enterprises of Medellin (EPM), Public Enterprises of Cali and the Cauca Valley Corporation (EMCALI and CVC), and the Power Colombian Institute (ICEL). So far, only two out of five power distribution networks has been already privatized. Nevertheless, one has to keep in mind that the city of Bogotá stills as the largest shareholder of CODENSA; the power distribution utility founded after EEB divestiture. Therefore, EPM, EMCALI, and ICEL still, as public utilities, covering 70% of the geographical areas that belong to the National Interconnected System. Hence, privatization and entry competition still a pending and unfinished task for local power distribution.

[13]   A complete description of the regulatory reform in Colombia's power sector is in Pombo (2001b) and ISA reports. Historically, Colombia's power sector is divided in five regional markets: Bogotá Power Company (EEB), CORELCA, Public Enterprises of Medellin (EPM), Public Enterprises of Cali and the Cauca Valley Corporation (EMCALI and CVC), and the Power Colombian Institute (ICEL). So far, only two out of five power distribution networks has been already privatized. Nevertheless, one has to keep in mind that the city of Bogotá stills as the largest shareholder of CODENSA; the power distribution utility founded after EEB divestiture. Therefore, EPM, EMCALI, and ICEL still, as public utilities, covering 70% of the geographical areas that belong to the National Interconnected System. Thus, privatization and entry competition still a pending and unfinished task for local power distribution.

TABLE 4

PRIVATIZATION IN THE POWER SECTOR

Utility/Plant/ Hydroelectric	Capacity MW	Type	Transaction USD Mill.	Seller	Buyer	Networth Share %	Investor Origin
Betania	500	Hydro	497	ICEL	ENDESA	100	Chile
Chivor	1,000	Hydro	645	ISA	CHILGENER	100	Chile
Tasajero	150	Thermal-Coal	30	ICEL	Cooperative - Sector	58	Colombia
TermoCartagena	180	Thermal-Coal	15	Corelca	Electricidad-Caracas	15	Venezuela
					Cooperative - Sector	85	Colombia
EPSA-Gen	772	Hydro	535	CVC	Houston Industries/	56	United States
	210	Thermal-Gas					
EPSA-Distrib					Electricidad-Caracas		Venezuela
EEB-Gen	2,312	Hydro	810	EEB	Capital-Energia Holding[1] (EMGESA)	48.5	Chile-Spain
	104	Thermal-Coal					
EEB-Distrib			1,085	EEB	Luz-Bogota Holding[2] (CODENSA)	48.5	Chile-Spain
EEB-Trans.			141	EEB	Capital-Energia Holding[1]	5.5	Chile-Spain
			141	EEB	Luz-Bogota Holding[2] (EEB-Head Quaters)	5.5	Chile-Spain
CORELCA Privatization							
ElectroCosta-Distrib and				CORELCA	Houston Inc - Electricidad Caracas	65	USA-Ven
ElectroCaribe-Distrib			980	CORELCA	Houston Inc - Electricidad Caracas	65	USA-Ven
Transelca-Transm			180.5	CORELCA	ISA	65	Colombia
Total Generation	5,228		2,532				
Total Distribution			2,065				
Total Transmission			462.5				
Total Privatization			**5,060**				

Notes: EEB = Empresa de Energía de Bogota; EPSA = Empresa del Pacifico S.A (former CVC); CVC = Corporación Autónoma del Cauca; ICEL = Instituto Colombiano de Energía Eléctrica; CORELCA = Corporación Eléctrica de la Costa Atlántica; ISA = Interconexión Eléctrica S.A.
1/: Capital Energía = ENDESA (Chile) + ENDESA-Desarrollo (Spain)
2/: Luz Bogota = CHILECTRA (Chile) + ENERSIS (Chile) + ENDESA-Desarrollo (Spain)
Sources: MME (1996) and (1998) Reports to the Congress; ISA reports (1998, 1999), DNP (2001).

The coming section will focus on the performance analysis for the privatized firms in manufacturing and power utilities in order to provide an assessment for privatization and economic deregulation policies in these two sectors where their assets transfers counts for 90% of the total privatization sales in the real sector until mid 1999.

IV. THE PERFORMANCE ANALYSIS

The present section studies firm performance within a sample of former IFI manufacturing enterprises and the thermal power plants that were subject to privatization, restructured or were new entrants because of the new regulation. The approach follows the general framework of Meggisson *et. al.* (1994) and Lopez de Silanes (1999) *et. al.*, but it departs from them in the specific methodology regarding the measurement of the performance variables by firm. This study relies

on the measurements of efficiency, market power, technology, and profitability indicators following standard methodologies in industrial economics based on a combination of physical and financial series extracted from datasets that follow a statistical protocol. For instance, technical efficiency proxies rely on non-parametric measurements derived from growth accounting decomposition or best practice frontiers using physical input and output series. These methodologies are *technically better* than financial ratios indicators derived from accounting data.

Grouping financial statements data across firms might have several biases because statements are influenced by the current tax, depreciation and subsidies regimes. The problem gets worse if data come from highly inflationary economies where adjustments for inflation are a common accounting practice. For example, if one takes the asset book value as proxy of capital stock it will overstate any measurement of capital productivity. The value of fixed assets is already affected by the accounting depreciation rate, which by far exceeds any economic depreciation rate. For that reason in industrial economics it is common to assume lower depreciation rates reflecting the real replacement consumption of capital equipment and their technical useful life benchmark. Similar problems are found for the other indicators. Hence, one must keep some caveats on the results based on solely financial data.

4.1 Styled facts and changes in performance in manufacturing

The study of privatized firms in manufacturing consists of 30 former IFI enterprises that have records at DANE's Annual Manufacturing Survey [*Encuesta Anual Manufacturera (EAM)*]. These enterprises were at some point either publicly owned or mixed capital companies, where IFI was a founder partner. Nineteen of such firms started commercial operations between the fifties and mid seventies. This means that incumbent plants are the dominating ones within the sample. For instance, the sample has the larger steel mills, tires and tubes, pulp and paper, and the basic industrial chemicals plants. On the other hand, twenty-one firms were part of the 1986-1997 IFI's transfer program, accounting for 75% of total accumulated privatization sales. Four of them are exiting firms that were liquidated after 1992. The reminding firms are cases in which companies were either transferred to the private sector before 1987 or the sale was postponed for strategic reasons.[14] The dataset is an unbalanced panel that records individual information since 1974 to 1998. Hence, the panel allows an analysis by market dynamics tracking down data by firm according to entry and exit flows. That feature makes the study sample appealing because of the robustness and length of the dataset in contrast to the datasets used in other studies on privatization, which at most have available time series with three or four observations before and after privatization [Meggison & Netter (2001)].[15]

Table 5 presents a summary of the basic variables for the IFI sample and their weight into total manufacturing before and after the privatization. Without any doubt the sample constitutes

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14   Appendix 2 lists the sample firms. We could access to the EAM dataset at plant level thanks to the *technical cooperation agreement* between the University and DANE [*Departamento Administrativo Nacional de Estadística*]. All the information was processed within DANE's headquarters.

15   The Meggison & Netter (2001) paper is a comprehensive review on privatization studies. The paper provides a summary of the sample, study period and methodology of each reviewed case study. See Appendix 3 for a brief description of the EAM dataset.

a representative selection of firms within Colombia's manufacturing. For instance, they account for 5% of industry's value added, 3% of industry's employment, and most importantly, they represent 20% of the total capital stock as well as power consumption of total manufacturing. They are larger capital-intensive plants.

TABLE 5

IFI-SAMPLE AND TOTAL MANUFACTURING

Summary of the Basic Variables Pre and Post privatization periods

Averages (USD at 1995 prices and Units)

Variable	Pre-Privatization 1974-1989		Post Privatization 1990-1998			
	IFI-sample	IND	IFI-Sample	IND	(1)/(2)	(3)/(4)
Gross Output (Mill)	1,203	20,145	1,751	31,052	6.0	5.6
Value Added (Mill)	497	9,030	697	13,495	5.5	5.2
Total Employment	20,631	495,404	15,806	622,594	4.2	2.5
Gross Investment (Mill)	127	956	92	1,372	13.2	6.7
Capital Stock (Mill)	2,016	9,679	2,934	14,450	20.8	20.3
Number of Plants	25	6,356	27	7,475		
Monthly Per-capita Compensation	904	451	1,134	506		
Consumption of Electricity (GWh per year)	1,060	4,953	1,594	8,299	21.4	19.2

Source: Own estimations based on EAM-DANE

The study of the IFI sample seeks to analyze changes in economic performance before and after privatization. Without loss of generality the post-privatization period in Colombia matches with the economic openness policy of the nineties. In fact, thirty out of thirty-seven IFI privatization contracts took place after March 1990. The analysis relies on the measurement of six broad indicators of performance and strategic competition: i) efficiency and productivity, ii) profitability, iii) scale economies, iv) industry concentration, v) assets and investment, iv) employment and wages, and vi) total output.

The proxies are measured first at firm level and then they are weighted grouped by economic usage classification —durable and non-durable consumer, intermediate and capital goods— with the purpose of presenting general trends for the pre-privatization and post-privatization periods. Most proxies are relative ratios to ISIC-specific or to total manufacturing. Therefore, the indicators are already *industry-adjusted* or *controlled by groups*. For incumbent firms the *pre-privatization* period is 1974-1989. For entrants, the time series start with the first recorded observation, which in most cases coincides with the startup year of commercial operations. The sample has four exiting firms, which shut down operations within the privatization period [1990-1998]. The length of the dataset allows assuming that in most cases firms have had enough time to complete restructuring a processes after

privatization. One fact needs a further comment. The dataset is clean for measuring errors. This bias comes from samples where there are few observations before privatization. It is a well-known fact that financial records might be tampered with in order to make the selling effective and by this way understate or overstate the gains of privatization. Other source of that bias is the case when SOEs are capitalized before privatization with the purpose of speeding up the selling.[16] Hence, outliers are easily detected and controlled with other variable trends within a time series context.[17]

The analysis continues as follows. First, general trends are displayed for each type of indicators. Second, testing the null of no changes in proxy's mean and median before and after privatization evaluates changes in performance for the sample of privatized firms. One starting question is what happened with productive efficiency [Table 6]. Total factor productivity growth for the IFI sample follows closely the cycle for total manufacturing [Figure 1]. The slowdown of the nineteen eighties is more drastic for the IFI sample, which shows on average a negative growth in TFP [-1.04%].

The drastic drop in capital productivity where investment rates were not compensated with a sustained growth in domestic demand explains the productivity cycle. This was particularly severe within the intermediate goods plants. Labor productivity in turn increased more than proportionally for the IFI firms in contrasts to total manufacturing, partially offsetting the fall in capital productivity. On average, the index of labor productivity rose 58% in its level after 1990. This implies that plant restructuring took place after privatization. Moreover, the sample's labor productivity relative to total manufacturing rose from 1.6 times before privatization to 2.2 times on average during the nineties [Figure 2]. In sum, the above elements are beneath the modest recovery in TFP for IFI firms [1.38%] as well as in total manufacturing [1.26%].

Is there anything to say about the direction of plant restructuring? IFI plants are on average 4.7 times more capital-intensive than total manufacturing. For the privatization period this number increased to 8.4 times [Table 7]. Hence, IFI plants invested more or experienced sharper adjustment of their payrolls. It seems that both things happened simultaneously. Except for producers of durable consumer goods all other firms in the sample kept the pace in their investments in machinery and equipment. Plant size got reduced moving on average from 11.6 times before privatization to 7.4 times after it. Thus, firms followed a strategy toward reducing their excess capacity and, rationalize capital spending.

Output scale increased significantly within producers of capital goods. Their scale of operations got 38 times larger than the average within the capital goods industry during the nineties. Producers of consumer goods doubled their scale relative to their competitors, and basic materials kept constant. These results suggest that part of productivity gains were due to *size effects* rather than a pure cost diminishing technical change. Regarding labor input the layoffs bore more on workers than technicians and administrative employees. Moreover, the cut was located within the producers of basic materials. In other cases, there were *normal* adjustments or even increases in payroll.[18]

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[16]   According to Laporta and López-de-Silanes (1999) paper this happened in Mexico when government tried to initiate several restructuring processes.

[17]   Appendix 2 summarizes the methodology in the construction of the basic variables, the performance indicators and sources.

[18]   This fact was also noticed in Megginson's 1994 cross-country study.

TABLE 6

EFFICIENCY AND INVESTMENT RELATED PERFORMANCE INDICATORS
## IFI SAMPLE AND TOTAL MANUFACTURING

Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98	Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98
EFFICIENCY					
I. Total Factor Productivity Growth (%)			IV. Investment Rate (%)		
IFI-SAMPLE			IFI-SAMPLE		
Non-Durable Consumer Goods	-3.25%	4.59%	Non-Durable Consumer Goods	21.52%	16.64%
Durable Consumer Goods	-1.33%	1.15%	Durable Consumer Goods	5.61%	5.03%
Intermediate Goods	-0.52%	0.83%	Intermediate Goods	23.43%	14.38%
Capital Goods	0.48%	0.54%	Capital Goods	11.85%	6.27%
Total-IFI	-1.04%	1.38%	Total-IFI	21.02%	12.67%
Total Manufacturing /1	0.12%	1.26%	Total Manufacturing	10.66%	10.36%
II. Partial Capital Productivity (1974=100)			V. Value Added Growth (%)		
IFI-SAMPLE			IFI-SAMPLE		
Non-Durable Consumer Goods	29.6	14.6	Non-Durable Consumer Goods	9.72%	8.78%
Durable Consumer Goods	74.6	27.8	Durable Consumer Goods	-0.10%	9.06%
Intermediate Goods	47.7	20.0	Intermediate Goods	5.34%	-4.42%
Capital Goods	69.4	83.2	Capital Goods	2.64%	1.39%
Total-IFI	46.2	21.9	Total-IFI	4.90%	-2.62%
Total Manufacturing	96.3	95.6	Total Manufacturing	3.82%	3.04%
III. Partial Labor Productivity (1974=100)					
IFI-SAMPLE					
Non-Durable Consumer Goods	69.0	103.9			
Durable Consumer Goods	99.1	167.0			
Intermediate Goods	143.6	231.6			
Capital Goods	88.8	142.5			
Total-IFI	127.1	200.9			
Total Manufacturing	115.7	138.3			

Methodology: TFPg = Changes in Translog Indices of TFP for IFI sample and Manufacturing and corrected for changes in inputs' efficiency. Aggregate Inputs follow a Translog specification.
Notes: 1/ refers to 1990-1995.
Source: Own measurements based on EAM-DANE.

Abril de 2002

FIGURE 1

TRANSLOG INDICES OF TOTAL FACTOR PRODUCTIVITY
## IFI FIRMS AND TOTAL MANUFACTURING (1974=100)
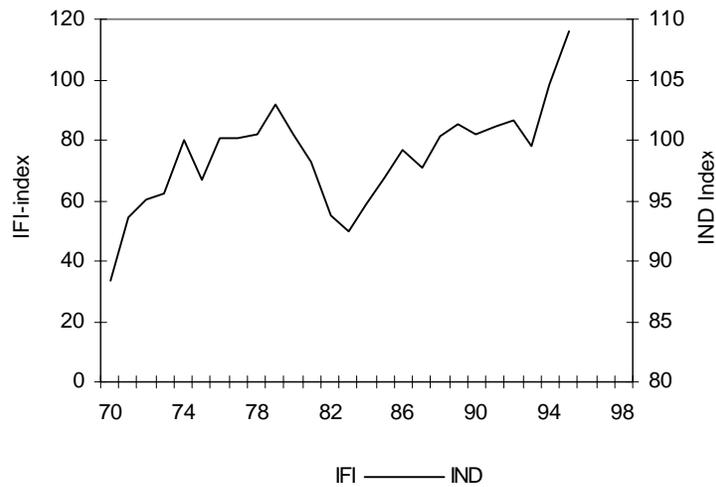
Source: Own estimation based on DANE-EAM

FIGURE 2

PARTIAL PRODUCTIVITY LABOR INDICES AND RELATIVE LABOR PRODUCTIVITY
IFI-SAMPLE AND TOTAL MANUFACTURING
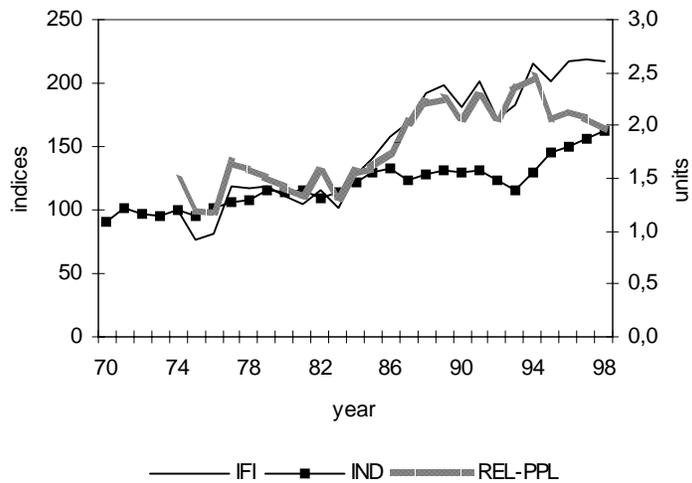
Source: Own estimation based on DANE-EAM

TABLE 7

IFI SAMPLE AND TOTAL MANUFACTURING

EMPLOYMENT AND PLANT'S TECHNOLOGY RELATED VARIABLES

Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98	Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98
I. Employment by Occupational Category			V. Relative Output Scale		
IFI-SAMPLE			IFI-SAMPLE		
Workers	14,678	10,944	Non-Durable Consumer Goods	1.66	3.82
Administrative Employees	4,640	3,890	Durable Consumer Goods	2.19	3.94
Technicians	1,312	972	Intermediate Goods	11.73	11.38
			Capital Goods	26.26	38.23
II Total Employment by Type of Industry			Total-IFI	13.18	14.64
IFI-SAMPLE			VI. Relative Capital-Labor ratios		
Non-Durable Consumer Goods	1,242	1,798			
Durable Consumer Goods	311	372	IFI-SAMPLE		
Intermediate Goods	16,415	11,103	Non-Durable Consumer Goods	1.41	1.69
Capital Goods	2,663	2,533	Durable Consumer Goods	0.43	1.70
Total-IFI	20,631	15,806	Intermediate Goods	4.14	7.71
			Capital Goods	1.03	1.38
Total Manufacturing	495,404	622,515	Total-IFI	4.70	8.36
III. Relative Compensation by Ocupational Category			VII Embodied Investment Rate (%)		
IFI-SAMPLE			IFI-SAMPLE		
Workers	1.87	2.50	Non-Durable Consumer Goods	62.0%	76.5%
Employees 1/	1.85	2.32	Durable Consumer Goods	87.5%	30.1%
			Intermediate Goods	71.8%	84.7%
IV. Relative Plant Size			Capital Goods	70.4%	65.7%
			Total-IFI	69.6%	80.4%
IFI-SAMPLE					
Non-Durable Consumer Goods	5.57	4.95	Total Manufacturing	68.2%	71.2%
Durable Consumer Goods	5.26	2.73			
Intermediate Goods	11.37	7.29			
Capital Goods	7.87	8.78			
Total-IFI	11.52	7.26			

Source: Own estimations based on DANE-EAM
Notes: 1/ Include technicians; relative indicators are ratios between the proxy for the IFI sample with respect to economic usage classification group or total manufacturing proxy.

Employment cuts were too small relative to other international experiences. The Mexican privatization payrolls in manufacturing were halved according to Lopez de Silanes (1999), while the privatization of British Telecom implied more than 5,000 layoffs, the same number than the IFI sample. Finally, the relative compensation —wages and social benefits— increased in 33% for workers and 25% for employees after privatization, which is explained by the sharp increase in labor productivity. Profitability shows a decreasing trend for IFI firms as well as total manufacturing [Figure 3]. Excepting the producers of durable consumer goods, IFI plants have been profit-

able enterprises before and after privatization according to their Lerner index. On average, the profit rate was 9% above the market real deposit rate before privatization. Afterwards it has been 6% covering their opportunity cost [Table 8]. Contrasting with the markup coefficient for total manufacturing and type of industry according to economic usage classification, one sees that IFI firms were more profitable than their competitors during the nineties except again, for the case of durable consumer goods. Such pattern contrasts with the findings in other studies. For instance, Mexican SOEs were highly unprofitable [-30%] before privatization [López de Silanes (1999)].

FIGURE 3

IFI SAMPLE AND TOTAL MANUFACTURING - MARKUP AND REAL DEPOSIT RATES
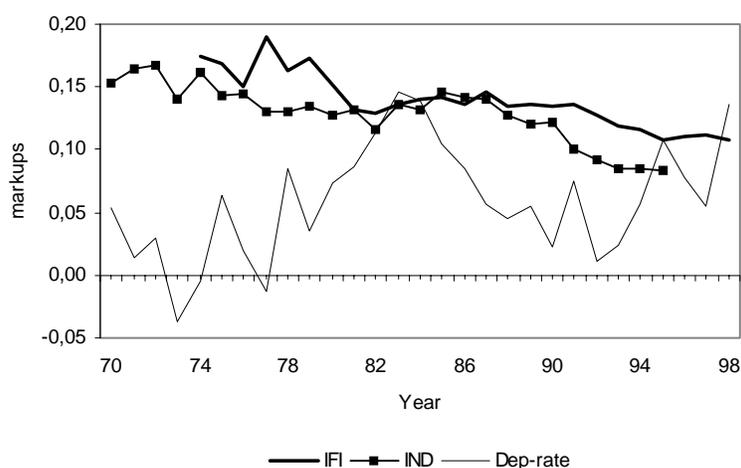
Source: Banco de la República and own estimations based on DANE-EAM

Besides the falling trend there is a convergence in the markup rates during the nineties across industry groups as Table 8 suggests. This behavior is partly explained by the tariff reduction that came with the economic openness program. For instance, intermediate goods industries were highly protected until the mid-eighties having a positive correlation with their markup level. Thus, the firm's market power has diminished because deregulation made entry a credible threat, while exposure to foreign competition disciplined domestic markets.

The gross margin rate is a proxy for plant working capital. Except for capital goods, IFI firms are more constrained due to a payroll structure that makes per-capita wages greater than their competitors. One reason for such inflexibility is the existence of labor union convention clauses. Most former IFI firms, traditionally, have had well-functioning labor unions. After privatization, IFI firms close the gap in this indicator showing that they were able to partially ease such constraint through the renegotiation of wage targeting clauses.[19]

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[19] The 1990 labor market reform [Law 50] eliminated   wage rigidities such as the retroactive severance system, and the mandatory reinstatement regime for workers with more than 10 years in payroll. For details of the reforms of the nineties see Montenegro (1995).

The changes in performance within IFI firms are tested by means of the Mann-Whitney (1947) rank-sum test. The idea from the statistical point of view is to consider privatization applied to matched (unmatched) samples as an experiment and test the null if the *treatment* was effective.

TABLE 8
IFI SAMPLE AND TOTAL MANUFACTURING - PROFITABILITY AND MARKET POWER

Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98	Indicator/Industry	Pre-Priv 74-89	Post-Priv 90-98
I. Market Share (%)			III. Relative Gross Margin Rate		
IFI-SAMPLE	5.9%	5.7%	IFI-SAMPLE	0.85	0.95
Non-Durable Consumer Goods	0.5%	1.0%	Non-Durable Consumer Goods	0.66	0.86
Durable Consumer Goods	0.2%	0.3%	Durable Consumer Goods	0.78	0.81
Intermediate Goods	10.6%	8.7%	Intermediate Goods	0.84	0.94
Capital Goods	12.0%	15.4%	Capital Goods	1.24	1.14
II. Lerner Index (%) 1/			IV. Herfindal Concentration Indices		
IFI-SAMPLE	15.0%	11.9%	TOTAL MANUFACTURING	0.0835	0.0624
Non-Durable Consumer Goods	24.1%	13.9%	Non-Durable Consumer Goods	0.0927	0.0763
Durable Consumer Goods	3.1%	1.4%	Durable Consumer Goods	0.0539	0.0510
Intermediate Goods	15.3%	12.9%	Intermediate Goods	0.1149	0.0833
Capital Goods	19.1%	17.2%	Capital Goods	0.0401	0.0226
			V. Rel. per-capita compensation total employment		
TOTAL MANUFACTURING /2	13.5%	9.5%			
Non-Durable Consumer Goods	10.3%	8.5%	IFI-SAMPLE	1.88	2.37
Durable Consumer Goods	6.0%	5.7%	Non-Durable Consumer Goods	0.93	1.04
Intermediate Goods	21.2%	14.2%	Durable Consumer Goods	1.29	1.65
Capital Goods	7.2%	4.1%	Intermediate Goods	1.73	2.22
			Capital Goods	1.72	2.80
			VI. Real Deposit Rate	6.8%	6.3%

Sources: Own estimations based on DANE-EAM; Demand Price elasticities by ISIC Group from Pombo (1999);
Deposit rates: 1970-1979 [Faimboin (1991)]; 1980-1998: Banco República
Notes: 1/: IFI Lerner Indices based on Domestic Supply [Y + M] by ISIC group specific
2/: Markup Indices = Herfindal / Demand price elasticity; refers to average for the 1990-1995 period

This test is non-parametric because data is ordered or counts for events that belong to individuals from different groups.[20] The test relies on changes in medians rather than means because there is no need for assuming symmetry. If medians differ, then rejecting the null indicates that population medians come from different distributions. Hence, the experiment is effective if the observed change is statistically robust and matches with the expected one. The number of usable observations (N), in this case matches up with the dimension of sample size, that is, the number of firms

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[20]   See Sprent & Smeeton (2001) for further explanation on tests for two independent samples.

times number of observed years before and after the privatization periods. Thus, the *experiment* is repeated *m* times before privatization and *k* times after it for each individual.[21]

The interpretation of the results is not straightforward because one has to analyze two forces behind the tests. On one side, testing differences in sample means and assuming equal variances shows the direction of privatization effects. On the other side, by testing for differences in medians one is evaluating a change in the distribution shape, which may or may not coincide with the direction of the change in means. For instance, increases in the sample mean with a negative change in the median show that overalls variation might be explained for few individuals in the sample. Thus, privatization effects are not equally distributed or might have opposite results across firms.

Taking into account the above caveats, Table 9 summarizes the basic results applied to IFI sample. The outcome reinforces the stylized facts up to a certain point. Nine out of twenty-one variables showed the expected relationship in the mean change during the privatization period. Nevertheless, only seven of them are statistically significant. The tests on profitability variables show that IFI firms increased their *gross margin rate* relative to their competitors but overall markups decreased as in all over manufacturing. However, IFI firms still are more profitable despite the closing gap: the mean (median) is 1.93 (1.39) times relative to ISIC group during the nineties.

The tests on efficiency variables indicate that the *relative TFP indices* increased the mean 20% while medians fell in 2 %. On average, IFI firms increased 21% the mean of TFP translog indices after privatization. On the other hand, taking the differences with respect to ISIC specific in TFP growth rates show an opposite variation. IFI's TFP growth was 3% above ISIC average during the 1974-1989 period. In the nineties, it dropped to -0.1%, which indicates a productivity convergence within industry groups. Thus, lower markups with increases in productivity suggest that IFI firms followed pro-competitive strategies after privatization. This also implies the lower industry concentration indices tested by means of changes in market share. Another feature is that investment did not jump after privatization. In fact, the relative investment rates fell from 2.5 to 2.0 times the rate observed in ISIC averages.[22]

Regarding output, IFI firms were able to generate new economies of scale since the mean of output scale increased in 1.5 times relative to ISIC average between periods. The relative compensation rates showed the opposite change with the expected one. The mean (median) rose 0.35 (0.17) points relative to ISIC average during the privatization period. Finally, the tests for changes in performance on the other variables were not conclusive.

In sum, the stylized facts as well as the tests on the industry-adjusted changes in performance indicate that IFI firms followed pro-cyclical trends relative to overall behavior in manufacturing. Thus, there was no asymmetric performance of these companies in contrast to their private peers. Part of the explanation for this is that IFI firms were mixed-capital enterprises and followed profit maximizing pricing rules rather than pursuing second best prices or net transfers through subsidized sale prices. As a result, management strategies followed private sector bench-

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[21]   The size of m depends of firm's entry date as well as k for the exit one. Taking averages before and after privatization such as Megginson (1994), reduces running the experiment only once.
[22]   This finding is similar to the case of Mexico [Lopez de Silanes (1999)].

marks although tariff policy favored at some point and for some cases, their dominant position within domestic markets. The *supporter* role of IFI made it a non-principal shareholder but a strategic one for firm capitalization. Accordingly, the *Institute* never had the intention of setting company's management policies.

Table 9
IFI-Firms: Industry-Adjusted Changes in Performance
Sample of Privatized Firms - Mann-Whitney Rank Sum and T-tests

Variable	N 74-89	N 90-98	Mean 74-89	Mean 90-98	Median 74-89	Median 90-98	Mean Change	Median Change	t-stat change Mean	Z-stat change Median	% of Firms Improved Performance	Expected Relationship
Profitability												
Relative Gross Margin	394	227	0.1903	1.2814	1.0222	0.9206	1.0911	-0.1016	-1.233 **	3.624 *	46	Increase
Lerner Index (Domestic Supply)	394	227	0.1482	0.1275	0.0663	0.1015	-0.0207	0.0351	1.588 *	1.070	28	Increase
Relative Lerner Index	394	227	2.1805	1.9358	1.4161	1.3984	-0.2448	-0.0178	1.352 **	0.200	54	Increase
Efficiency												
Relative Partial Labor Productivity	394	227	1.32	1.38	1.07	1.02	0.0641	-0.0469	-0.759	0.983	42	Increase
Relative Partial Capital Productivity	393	227	8.68	7.20	1.73	0.99	-1.4841	-0.7469	0.854	2.722 *	42	Increase
Translog Index of TFP (I1974 = 100)	448	231	116.58	140.39	98.49	81.89	23.81	-16.61	-2.777 *	3.089 *	42	Increase
Relative Translog Index of TFP	391	158	1.4082	1.6089	1.0431	1.0263	0.2006	-0.0169	-1.656 *	-0.212	46	Increase
Adjusted TFP Growth	366	158	0.0308	-0.0098	0.0105	-0.0173	-0.0406	-0.0278	1.656 *	1.664 **	36	Increase
Industry Concentration												
Market Share	394	227	0.1354	0.1082	0.0735	0.0793	-0.0272	0.0058	2.502 *	1.323	32	Decrease
Relative Market Share	394	227	0.1969	0.1501	0.0519	0.0633	-0.0468	0.0114	2.353 *	0.822	36	Decrease
Scale Economies												
Plant Size	394	227	5.58	6.27	3.64	2.96	0.6810	-0.6822	-0.932	0.590	53	Decrease
Plant Scale	394	227	6.31	7.85	3.38	2.67	1.5324	-0.7033	-1.815 *	-0.463	46	Increase
Relative Capital-Labor Ratio	393	227	4.91	4.15	0.6744	0.9659	-0.7618	0.7699	0.770	-2.119 *	50	Increase
Assets and Investment												
Gross Investment Rate - I/VA	394	227	0.8470	0.1753	0.0608	0.0516	-0.6717	-0.0092	1.012	2.409 *	21	Increase
Relative Gross Investment Rate	396	230	2.5585	2.0300	0.6322	0.3659	-0.5285	-0.2663	0.440	3.066 *	43	Increase
Relative Embodied Investment Rate	389	223	1.6134	1.1934	1.0176	0.9737	-0.4200	-0.0439	0.887	1.544	50	Increase
Labor												
Log workers	389	224	5.62	5.50	5.87	5.63	-0.1253	-0.2445	1.027	1.576	42	Decrease
Log Administrative Employees	394	222	4.53	4.56	4.71	4.54	0.0342	-0.1732	-0.341	0.331	64	Decrease
Log Technicians	354	221	3.04	2.89	3.00	2.75	-0.1536	-0.2430	1.338 **	1.122	46	Increase
Wages												
Relative compensation rate total empl	394	227	1.07	1.41	1.07	1.24	0.3489	0.1698	-7.440 *	-5.660	85	Decrease
Output												
Log Real Gross Output (1995 USD)	394	227	16.69	17.07	16.89	17.48	0.3767	0.5897	-2.607 *	-2.741	71	Increase

Methodology: Ranksum test of changes in proxy's medians = proxy t-k and t+k; with t = 1990 for every i and k = number of observed records before and after privatization. Meggison's (1994) methodology = proxy average t-k, and t+ k with k = 3 years of every privatized firm i. T-test H0: mean (0) - mean (1) = 0
Notes: *: Significant at size of 0.05; **: Significant at size of 0.1
Maximum sample size = n x t; where n = number of firms and t = number of recorded years, that is Pre-privatization period: 1974-1989 = 28 x 16 = 480 and Post-privatization: 1990-1998: 28 x 9 = 270.
The dataset excludes two firms that did no have recorded data before 1991.

4.2 PERFORMANCE ANALYSIS IN THE POWER SECTOR

The ex-post performance analysis in the power sector must take into account the effects of the 1994 reform on firm entry, market competition, and efficiency gains. In that sense, the analysis focuses on the pattern of key variables that are aggregated at sectoral level, and then it concentrates in direct measures of profitability by the privatized larger power utilities and productive efficiency for thermal generation. The reform has induced, without loss of generality, the following results: i) new investment in thermal generating capacity, ii) privatization and the new regulation led to a balanced competition between public and private generators, iii) a decrease in electricity wholesale prices, and iv) a new composition of electricity demand toward non-regulated users.

Regarding investment in new capacity, the new regulation has used two instruments to incentive market entry. One is the designing of capacity charges by which the regulator guarantees a minimum return on the installed capacity. The second instrument is the *power purchase agreements* (PPAs). These are long term contracts through which generators hedge against unexpected changes in demand and distributors from system's constraints. One type of PPA initially implemented in Colombia is to *pay what is generated*, which implies an advance purchase of plant capacity. Most of thermal generators are marginal producers whose objective is to generate at system's hedge. In fact, the thermal park had 63 plants with an effective capacity of 3,800 MW in 1998, which represent a 32% share. Among them 21 started commercial operations after 1993 and 16 are privately owned. This is not a coincidence since the government had already undertaken an emergency expansion plan to overcome the 1992 power crisis.[23]

Figure 4 displays the evolution of thermal capacity and generation during the nineties, and it clearly shows the sharp increase in the thermal capacity, which doubled in seven years. A second fact is that the ratio of power generation to available capacity ratio shows an improvement after the reform. Clearly, the 1992-1993 and 1997 periods match with the bad hydrology and the *el niño* cycle but there is a difference between them. In 1992 there was a rationing of about 16% of the power demand and by June 1993, when the power rationing was over, power generation to available capacity ratio was over 0,8, reflecting the insufficiency of the thermal park in backing the system. In contrast, such ratio was 0,35 when the second *el niño* ended by June 1998. In sum, fixed investment in thermal generation has played a central role in improving system reliability as well as promoting market entry in power generation.

The second point concerns ownership composition. The reform has induced to a balanced distribution of the power generating capacity between public and private utilities. Public utilities count for 42% of total capacity while private and mixed capital utilities hold a 58% share. The largest generator has 21% of market share [Table 10].[24] This outcome contrasts with the initial

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[23] An analysis of the 1992 blackout is in Pombo (2001b) op cit. The official version of the blackout causes and policy measures is in the 1993 Ministry of Mining report to the Congress.

[24] The National Interconnected System was formed by 33 hydro centrals plus 63 thermal plants distributed among 26 power companies in 1998. EMGESA the largest generator was founded after the Bogotá Power Company Divestiture. On the other hand, no single power generator can have more than ¼ of system's generating capacity (Law 143).

divestiture in the UK where the CEGB was broken into a duopoly for non-nuclear generation, and in Chile where the three larger power generators control 85% of the market.

FIGURE 4

THERMAL CAPACITY VS. GENERATION (GWH)
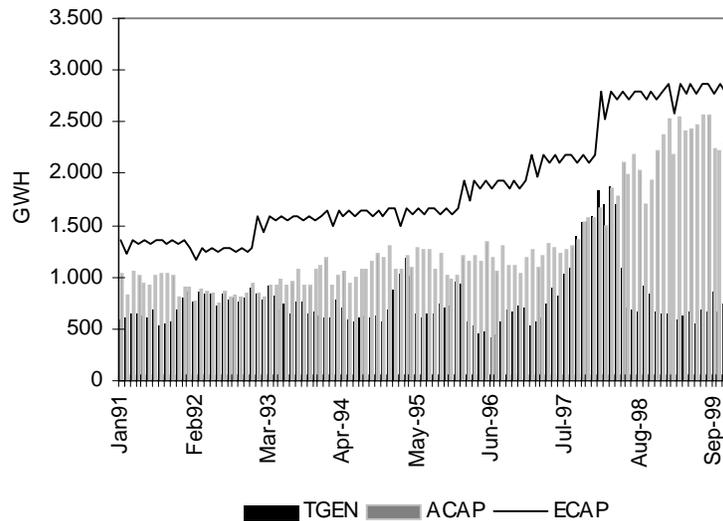
Source: ISA Reports
Notes: ACAP: Available Capacity; ECAP: Effective Capacity

Regarding prices and commercial electricity demand, Table 11 summarizes the main variables of the electricity market. Two facts are noticeable. First, the evolution of electricity spot prices suggests that buyers —*power distributors*— have effectively hedged against Pool price volatility [Figure 5]. Contract real prices have dropped 42% from 1996 to 2000. Such outcome is important since contracts have a 75% market share of bulk electricity. Other important outcome is that market deregulation has sharply increased the number of non-regulated users, most of which them are large industrial and commercial clients. In that direction the definition for large customer has changed over time. It began with a minimum individual consumption of 2.5 MW/month and has gradually decreased. The current level is at 0.1 MW/month implying that non-regulated demand doubles during the analyzed period.

Concerning firm performance, two exercises are carried out. The first one concerns the measurement of productive efficiency at plant-level for a sample of thermal plants. Fifty-five plants that belong to the interconnected system have made up the thermal park since 1995. Nonetheless, just 32 units were active, having a permanent or temporal production within a specific year. Because of the changes in the statistical sources, the dataset was divided in two samples since 1988. The first sample records on average 33 thermal plants from 1988-1994 that is the pre-reform years. The second one records 32 thermal units for the post-reform years (1995-2000).

TABLE 10

COLOMBIA EFFECTIVE POWER GENERATING CAPACITY
BY PLANT OWNERSHIP STRUCTURE 1998

Power-Utility Name	Ownership	Capacity			
		Hydro MW	Thermal MW	Total MW	Share %
EMGESA	Mixed	2,274.8	220.0	2,494.8	20.7
EPM	Public	1,708.0	300.0	2,008.0	16.6
ISAGEN	Public	1,410.0	193.0	1,603.0	13.3
CHIVOR S.A.	Private	1,000.0		1,000.0	8.3
EPSA	Mixed	772.0	210.0	982.0	8.1
TEBSA	Private		877.0	877.0	7.3
CORELCA	Public		626.0	626.0	5.2
CHB	Private	540.0		540.0	4.5
Others 1/		431.8	1,513.0	1,944.8	16.1
Total Private		1,614.0	1,851.0	3,465.0	28.7
Total Public		3,475.8	1,658.0	5,133.8	42.5
Total Mixed		3,046.8	430.0	3,476.8	28.8
Total		8,136.6	3,939.0	12,075.6	100.0

Notes: 1/ Includes 17 additional power plant generators: 6 private, 1 mixed, and 11 public utilities.
Source ISA (1998)Source: 1998 ISA Report

TABLE 11

MARKET EFFICIENCY VARIABLES - ANNUAL AVERAGES
(USD AT DEC 1998 PRICES, GWH, UNITS)

Date	Mean Spot Price US$/KWh	Mean PPAs Price US$/KWh	Spot price Index Dic98=100	PPAs price Index Dic98=100	Attended Demand GWh	Non Regulated Demand GWh	Regulated Demand GWh	Non Regulated Demand Share	Non Regulated Users Number
Dec-96	0.0086	0.0349	54.1	125.3	3,543.1	457.3	2,869.7	0.1374	18.0
Dec-97	0.0680	0.0323	425.6	115.8	3,650.9	452.3	2,963.3	0.1330	100.5
Dec-98	0.0283	0.0285	176.8	102.3	3,595.5	649.0	2,810.4	0.1876	692.0
Dec-99	0.0159	0.0220	99.4	78.9	3,466.1	686.3	2,662.8	0.2050	906.3
Dec-00	0.0215	0.0202	134.8	72.7	3,422.6	865.1	2,566.9	0.2522	2,471.0

Sources: MEM-ISA and ISA-Reports
Notes: Value series in USD deflated by USA CPI

FIGURE 5

SPOT AND CONTRACT REAL PRICE INDICES (DEC 1998 = 100)
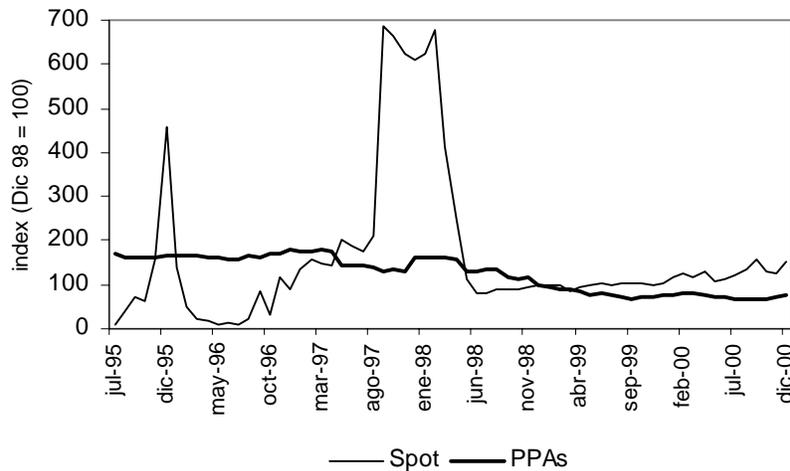
Source: ISA-MEM
Notes: PPA: Purchase Power Agreement

The measurement of *Data Envelope Analysis* (DEA) efficiency scores needs information of inputs and output by thermal unit. Plant inputs are capital (or capacity in MW), labor (number of employees), and fuel consumption (coal, gas, fuel oil, and diesel oil). All fuels need a common measure unit, such as BTUs or T-Calories.[25] Output by turn is given in millions of KWh (GWh). Information for power generation, consumption by type of fuel and capacity at plant-level is available by crossing the different datasets before and after 1994.

Labor input is not directly observable for most units. Two reasons explain that problem. One is that before privatization thermal units were vertically integrated to power utilities, thus payroll series were recorded following accounting criteria. Power companies kept labor records to fulfill the needs of their financial statements. Second, there was no regulator requesting information by power activity. Labor statistics after 1996 have improved sharply since the regulator *Superintency of Domiciliary Public Services* is in charge of the SIVICO database. Labor series by power-company are broken by occupational categories, sectoral activities (i.e. generation, transmission, and distribution), and by type of power generation. In addition, after privatization the sold plants became new utilities. This allowed making direct inferences of labor input (number of employees) by thermal substations. Fixed coefficients of labor to capacity were assumed based on the information sent by power generators in order to complete labor series before 1995.[26]

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[25] The basic conversion factors are: 1 kWh = 3,412.1 BTUs; 1 GWh = 0.86 T-Calories; 1 MW of Capacity = 1000 KWh.

[26] Appendix 4 describes the methodology and the contents of the power sector databases. The request of labor series was done through the Colombian Power Generator Association (ACOLGEN). SIVICO stands for *Sistema de Vigilacia y Control.*

Table 12 displays the main results of the efficiency frontier measurement exercise. The most important result is that the efficient units before the reform are no longer the most efficient after the reform. This suggest that there was a downward shift in the efficiency frontier implying an *efficiency gain* due to entry and new gas-based and combined cycle technologies. In fact, TEBSA, the largest thermal generator in the country as well as the other newer plants built since 1993 exhibit efficiency scores close to 1.

The profitability exercise focused on the privatized power utilities of the Bogotá Power Company, the former regional holdings of CORELCA and CVC. Privatization sales in the former focused on the regional power distribution utilities, while the latter included the generators stations that supply electricity for the city of Cali. The control group is *Empresas Publicas de Medellin*, historically has been the most efficient utility and is municipal owned enterprise.[27] The dataset comes several sources that have recorded the main accounts of utilities income and balance statements.[28] The holding structure before privatization was kept in order to chain the series after divestitures. The results are summarized in Table 13. The most striking result is that all profitability indicators either adjusted and non-adjusted fell after the regulatory reform. Six out of eight are statistical significant according to the tests on structural change in indicator means and medians.

What explains such trends? To provide a common answer is not possible just looking data from the financial statements because one has to keep perspective of the market deregulation. Three elements, at least, played a central role. One was that privatized utilities have dropped their final tariffs after 1995. Moreover, they have converged to EPM's final user tariffs. The relative tariff dropped from 1.7 to 1.04 after the reform. On the spending side, there was a sharp increase in the financial costs during the first half of the nineties. The four regional markets had on average a 90% real increase relative to the average of the 80s. Bogotá Power Company faced most part of the indebtedness burden because of the over-costs generated by the five-years delay in the startup of the Guavio hydro.[29] Last, the value of inter-firm bulk electricity real purchases increased in 110% on average after the reform relative to the first half of the 90s. The high spot prices during the 1997-1998 *niño* explain such increase in operative costs. Besides, the regulatory commission forced power companies to undertake further internal capitalization in order to strengthen their net worth and financial leverage. Hence, the above elements squeezed utilities gross and net profits.

The next section turns attention to modeling efficiency and profitability as function of plant characteristics, ownership structure, and regulatory policy variables for the former IFI firms and the sample of thermal plants with the purpose to shed light on the determinants of those performance variables.

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27 An indicator for utility efficiency is the index of power losses. See Pombo (2001b) for details in the trend of such indicator since 1970 by power holding.
28 See appendix 4 for details.
29 The *Guavio* hydro is the largest in the country with 1600 MW of capacity.

TABLE 12
DEA EFFICIENCY-SCORES
Before and After the Regulatory Reform

DMU	Plant Name	Plant Startup	Owner-ship	Cap MW	Score before	Score after	Score1 before	Score1 after	Relative Effic.	Relative Effic.1
1	Barranca1	1982	Public	13	78.59%	59.32%	78.59%	79.39%	decrease	increase
2	Barranca2	1982	Public	13	72.03%	59.32%	74.48%	77.02%	decrease	increase
3	Barranca3	1972	Public	66	87.98%	64.04%	87.98%	82.11%	decrease	decrease
4	Barranca4	1983	Public	32	66.25%	61.18%	66.25%	81.10%	decrease	increase
5	Barranca5	1983	Public	21	70.23%	61.76%	70.23%	82.17%	decrease	increase
6	Bquilla1	1980	Public	58	92.11%	.	91.39%	.	.	
7	Bquilla3	1980	Private	66	100.00%	66.24%	100.00%	71.56%	decrease	decrease
8	Bquilla4	1980	Private	69	96.99%	74.39%	98.03%	100.00%	decrease	increase
9	Cartagena1	1980	Private	66	86.77%	64.28%	100.00%	74.47%	decrease	decrease
10	Cartagena2	1980	Private	54	79.32%	65.15%	74.37%	82.74%	decrease	increase
11	Cartagena3	1980	Private	67	87.12%	68.15%	86.03%	82.45%	decrease	decrease
12	Chinu4	1982	Public	14	42.42%	.	70.97%	.	.	
13	Cospique1	1960	Public	4	90.86%	.	100.00%	.	.	
14	Cospique2	1960	Public	4	72.77%	.	100.00%	.	.	
15	Cospique3	1967	Public	8	100.00%	.	97.22%	.	.	
16	Cospique4	1966	Public	9	100.00%	.	77.91%	.	.	
17	Cospique5	1965	Public	12	44.87%	.	85.84%	.	.	
18	flores1	**1993**	Private	152	98.81%	100.00%	98.81%	100.00%	increase	increase
19	Guajira1	1987	Public	160	100.00%	85.63%	100.00%	77.43%	decrease	decrease
20	Guajira2	1987	Public	160	100.00%	83.74%	100.00%	89.15%	decrease	decrease
21	Paipa 1	1963	Public	31	40.48%	49.77%	32.08%	88.59%	increase	increase
22	Paipa 2	1975	Public	74	73.07%	37.94%	47.55%	78.91%	decrease	increase
23	Paipa3	1978	Public	74	63.31%	41.54%	38.74%	77.35%	decrease	increase
24	Palenque 3-4	1972	Public	15	87.80%	45.86%	100.00%	80.11%	decrease	decrease
25	Palenque5	1985	Public	21	67.06%	.	67.06%	.	.	
26	Proeléctrica1	**1993**	Private	46	99.93%	96.95%	99.93%	88.57%	decrease	decrease
27	Proeléctrica2	**1993**	Private	46	100.00%	96.95%	100.00%	96.54%	decrease	decrease
28	Tasajero	1985	Private	163	100.00%	67.55%	100.00%	82.41%	decrease	decrease
29	Tibú1	1965	Public	6	16.69%	.	31.57%	.	.	
30	Tibú2	1965	Public	6	16.32%	.	80.26%	.	.	
31	Zipa2-3	1976	Mixed	104	49.04%	88.88%	42.13%	67.21%	increase	increase
32	ZIPA3	1976	Mixed	66	.	22.35%	.	80.21%	.	
33	Zipa4	1981	Mixed	66	46.26%	18.79%	46.01%	67.97%	decrease	increase
34	Zipa5	1985	Mixed	66	26.92%	32.13%	30.42%	86.55%	increase	increase
35	Flores2	**1996**	Private	100	.	91.99%	.	92.05%	.	
36	Flores3	**1998**	Private	152	.	100.00%	.	100.00%	.	
37	Merilectrica	**1998**	Private	157	.	78.87%	.	92.73%	.	
38	TebsaB1	**1998**	Private	768	.	100.00%	.	91.41%	.	
39	Termocentro1	**1997**	Public	99	.	91.60%	.	100.00%	.	
40	dorada1	**1997**	Public	52	.	25.54%	.	80.10%	.	
41	Sierra1	**1998**	Public	150	.	14.42%	.	85.64%	.	
42	Termovalle1	**1998**	Private	214	.	82.37%	.	88.58%	.	
						Total Decrease (plants)		**19**	**10**		
						Share Capacity		**36.1%**	**24.3%**		

Sources: Own Estimations based on EMS 1.3 software written by Holger Scheel (2000)
Notes: Input1: Capacity in MW; Input2: Labor in Number of Employees; Input3: Fuels, standardized in T-Calories; Periods: Before Privatization 1988-1994; After Privatization: 1995-2000; Input-Output variables are annual averages; Score Assumptions: CRTS, No weights, Input-Oriented; Score1 Assumptions: CRTS, No weights, Input-Oriented, Capacity corrected by short run unavailability index = MW * [1-SRUI] or capacity utilization (after 1994).

Abril de 2002

TABLE 13
COLOMBIA-POWER SECTOR
NON-ADJUSTED AND INDUSTRY-ADJUSTED CHANGES IN PERFORMANCE
Sample of Privatized Power Utilities and Public Enterprises of Medellin
Mann-Whitney Rank Sum and T-tests

Variable	N 83-94	N 95-99	Mean 83-94	Mean 95-99	Median 83-94	Median 95-99	Mean Change	Median Change	t-stat Change Mean	Z-stat change Median	Expected Relation-ship
Profitability Indicators (Non-Adjusted)											
Operating Income/Sales	48	20	0.3208	0.1891	0.3587	0.2262	-0.1317	-0.1325	3.0930 *	2.410 *	Increase
Net Income/Sales	48	20	0.1382	0.0882	0.1992	0.0998	-0.0500	-0.0995	0.6926	0.794	Increase
Operating Income/PPE	48	20	0.0562	0.0288	0.0556	0.0397	-0.0273	-0.0159	3.0597 *	2.544 *	Increase
Operating Income/ Net-Worth	48	20	0.0997	0.0463	0.0958	0.0463	-0.0534	-0.0495	3.1554 *	3.876 *	Increase
Profitability Indicators (Industry-Adjusted)											
Opertaing Income/Sales	36	15	0.7122	0.4088	0.82639	0.61091	-0.3034	-0.2155	2.3078 *	1.757 **	Increase
Net Income/Sales	36	15	0.1677	0.0504	0.19492	-0.0076	-0.1173	-0.2025	0.3405	0.537	Increase
Operating Income/PPE	36	15	0.7458	0.3206	0.69331	0.40368	-0.4252	-0.2896	2.0175 *	2.233 *	Increase
Operating Income/ Net-Worth	36	15	0.7647	0.3152	0.75588	0.37294	-0.4495	-0.3829	1.9958 **	1.736 **	Increase
Mean Tariff	26	6	1.7088	1.0469	1.42132	1.02959	-0.6619	-0.3917	2.0318 *	1.977 *	decrease

Sources: FEN and SSPD
Notes: * = significant at size of 0.05; ** = significant at size of 0.1
PPE = Fixed Assets Value corrected by CPI; Adjusted indicators are controlled by Public Enterprises of Medellín Power Utilities: 1) CORELCA Holding = 7 Regional Power Distribution Companies + 1 Regional Transmission Grid + 5 generator plants; 2) EEB = Bogotá Power Company; 3) CVC = Corporación Autónoma del Valle del Cauca (Empresa del Pacífico SA after 1994); 4) EPM = Empresas Publicas de Medellín

V. THE ECONOMETRIC ANALYSIS

5.1 IFI MANUFACTURING PLANTS

This section analyzes the role plant characteristics, foreign trade variables, and privatization played in determining firm privatization outcomes for the sample of the IFI firms. The econometric analysis focuses on two key performance variables: plant profitability rates (Lerner indices) and the translog indices of total factor productivity (TFP) as a proxy of technical change. In that sense, the econometric exercise therefore searches to shed light regarding plant efficiency and markups determinants as well as to evaluate the significance of privatization within the model.

The dataset is an unbalanced panel for 28 IFI firms that records information for the 1974-1998 period. The estimating equation follows the baseline pooled regression model

$$performance_{it} = (\beta_0 + \alpha_i) + \mathbf{X_{it}B} + \mathbf{Z_{it}}\Lambda + \varepsilon_{it} \qquad (1)$$

where i = 1, ..., n is the number of individuals; t = 1,2,...,T is the number of observations in each panel; X = firm's characteristics variables; and Z = ISIC-specific variables. Equation (1) allows running several types of regression models according to specific assumptions on the residual variance-covariance matrices and individual effects (α_i). In particular, the estimations relax the assumptions of *constant variance* across panels, the non-existence of individual effects, and instrument for endogeneity on right hand side variables.

Plant characteristic variables are related to technology structures, labor composition, and the firm's market positioning actions. One expected result is that technology-related variables have a positive impact on profitability gains. In that sense, plant size, operative scale, quality of raw materials, capital intensity and relative labor productivity result in lower average costs that represent productivity gains due to new economies of scale. Plant payroll composition will reflect quality in labor input. Thus, technicians should lead overall plant labor productivity because skilled workers are more dynamic and generate productivity spillovers. Administrative employees in turn may generate inflexibilities that end up punishing profitability. Market positioning variables are those actions that strengthen a firm's market share. The firms' signals are investment rates, the usage of technological licenses, and product differentiation tactics such as advertising. These actions may persuade rivals to soften competition and adopt collusive prices but on the other hand, the competitors' best response might include hardening competition and setting dumping prices. Hence, there is no expected sign.

Industry specific variables are mostly related to foreign trade. Three main variables are used in the estimating equations: nominal tariffs, effective protection rates, and Grubel and Lloyd (1975) indices. The latter is a proxy for trade in differentiated goods.[30] Protectionism increases domestic profitability through entry deterrence. Intraindustry trade, in contrast, implies trade in similar goods that makes entry a credible threat driving sale prices to second best prices.[31] Hence, profitability decreases. Table 14 displays the main results regarding the markup determinants, which call for several comments. First, in all cases, the firm's market share is the robust determinant.[32] This is consistent with the observation that economic openness reduced the firm's market power and by this way decreased markups rates. Estimations show that a 10% decrease in market share will reduce profitability by 9%. Second, the foreign trade variables are robust regressors and show the expected sign. On average, an increase in 10% in the effective protection rate will rise markups by 4%. In contrast, if intraindustry trade indices rise 10%, markups will decrease on average 3%. This finding is important from the perspective of strategic trade policy. Competition through similar goods forces firms to undertake further specialization strategies to promote efficiency gains in order to compensate the reduction in the markup rates. Third, plant size and productive efficiency are important sources of profitability gains. IFI firms are on average seven times larger than their competitors. As a result the observed gains in TFP partially offset the falling trend in firm's markup. On

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[30]   See Pombo (2001) for a specific study on intraindustry trade and technology applied to the case of Colombia.

[31]   This idea is similar to the competition behind *contestabilility* where firms apply the hit and run strategy in order to capture profits. However, in this case there are significant sunk costs. For theoretical details, see Baumol, Panzar and Willing (1988) and Baumol (1982). The game theoretical explanation is in Shy (1995).

[32]   This finding contrast the results of López de Silanes [1999]. One possible reason is the manner that profitability is measured. In our case it relied on direct measures of firm output share relative to ISIC specific group and parametric estimates of demand elasticities rather than financial indicators.

average, if TFP indices raise 10 points they will induce a change of between 0.005 and 0.02 points in markup rates. Fourth, privatization shows a consistent sign. Privatization induced a 1.2% increase in profit rates [Eq. 3]. Finally, the foreign investment dummy has the opposite sign. In the context of the IFI sample this result is not surprising since some firms are located in formerly highly protected industries that kept lower efficiency levels with respect to parent firms and international standards.[33]

The econometric results on productive efficiency are displayed in Table 15. Five comments are worth mentioning. First, plant characteristics are relevant for TFP indices. All equations show that plant labor productivity, licensing and number of technicians have positive effects. On average, an increase of 10% in partial labor productivity relative to ISIC specific group raises TFP by 3.2%. The effect of licensing is the largest. If plants expand by 1% their technological licensing spending relative to their value added, this will boost productivity between 5.5 to 8.2 times. This finding is consistent with previous results for total manufacturing, and calls attention to the effectiveness on a short-run basis of using patented licenses for improving productivity rather than engaging in direct R&D spending.[34] The number of technicians is a proxy for labor input quality. A 10% increase on this variable will improve productivity by 1.12%.

Second, the equation included two variables to capture demand effects on TFP measured either by the growth in value added or the log-value of firm's ISIC specific group. The sign matches with the expected one, which is consistent with the traditional hypothesis derived from *Verdoom law* by which growth and productivity are constrained by effective demand. The impact of aggregate demand is two-fold: domestic and exports demand induce growth and improve productivity by learning. This in turn leads to improvements in price competitiveness that will induce higher rates in effective demand [Dixon & Thirlwall (1975)].[35]

Third, privatization had a positive effect on productivity where it caused an increase ranging from 0.27 to 0.50 points on TFP indices. Fourth, the scale and the relative capital partial productivity coefficients had a negative impact on productivity. The interpretation of this result is not straightforward. The losses in capital productivity due to over-investment suggest that IFI firms adjusted capital spending in order to close gaps to industry benchmarks. Fifth, profitability rates exhibit the opposite effect on TFP, which is not consistent with the self *investment-financing* hypothesis of endogenous growth models [Romer (1990), Barro & Sala-I-Martin (1995)]. In particular, one should expect a positive impact since larger profitability rates ease the self financing of capital equipment and firm's R&D spending. However, after controlling for fixed effects the expected sign is recovered. The within regression coefficients show that a 10% increase in markups will improve TFP by 13 %. The above result suggests that allowing fixed effects for modeling productivity is a better econometric specification.

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[33] The automobile assembly industry is the textbook example. Colombian consumers paid for twenty years a protection premium up to 100% relative to international prices.

[34] For details see Pombo (1999). This study highlights two key technology policy issues. First, based on the results of DNP's technological survey, panel regressions showed an inverse relation between TFP growth rates with respect to qualitative information about plant's R&D infrastructure such as laboratories, prototypes designing and pilot plants. Second, the effect of getting patented licenses multiples TFP from 1.2 to 1.8 times.

[35] Notice that the possible *simultaneity* bias which arises from running TFP against value added growth is avoided —partially— here because value added growth refers to overall industry specific group.

TABLE 14
IFI - EX-POST PERFORMANCE DETERMINANTS
POOLED, FIXED EFFECTS AND INSTRUMENTAL VARIABLE REGRESSIONS
DEPENDENT VARIABLE: LERNER INDEX

Independent Variables	Pooled OLS[1] Eq 1	Panel FGLS Eq 2	Panel FGLS Eq 3	Within FE Eq 4	Pooled 2SLS[1] Eq 5	FE+IV Eq 6
Market share	0.87511 (0.0470)	0.93178 (0.0263)	0.92644 (0.0255)	0.89314 (0.0305)	0.96415 (0.0311)	0.94587 (0.0341)
Relative partial productivity of labor	0.01948 (0.0039)	0.00854 (0.0017)	0.00893 (0.0016)	0.01080 (0.0024)	- -	- -
Translog Index TFP	0.00006 (0.00003)*	0.00012 (0.00001)	0.00010 (0.00001)	0.00007 (0.00004)	0.00034 (0.00011)	0.00015 (0.00006)*
Size	0.00120 (0.0006)	0.00076 (0.0002)	0.00094 (0.0002)	- -	- -	- -
Human Capital	-0.022627 (0.0054)	- -	- -	- -	- -	- -
Grubel and Lloyd Index	-0.05208 (0.0160)	-0.02803 (0.0079)	-0.03854 (0.0084)	-0.01699 (0.0094)	-0.04000 (0.0156)	-0.01823 (0.0095)
Effective protection	- -	0.03808 (0.0055)	0.04326 (0.0059)	0.03372 (0.0079)	0.08776 (0.0136)	0.03285 (0.0080)
Dummy privatization	- -	- -	0.01251 (0.0029)	- -	- -	- -
Dummy foreign investment	- -	- -	-0.01444 (0.0031)	- -	- -	- -
Constant	0.008408	-0.022806	-0.021430	-0.003917	-0.047047	-0.001628
Regression Statistics						
R2	0.6315			0.6699	0.6249	0.6245
Num of groups		28	28	28		28
Num Obs	613	621	621	621	620	621
Obs per Group: Min		13	13	13		13
Max		25	25	25		25
F-test	116.03 [0.0000]			238.69 [0.0000]	145.15 [0.0000]	235.16 [0.0000]
Wald-Chi2(k-1)		2741 [0.0000]	2932 [0.0000]			
F-test for all $\mu_i = 0$				93.6 [0.0000]		
Heteroscedasticity tests						
Cook-Weisberg	267.79 [0.0000]					
White	293.58 [0.0000]					
Variance Matrix Residuals						
Homocedastic panels	yes	no	no	yes	yes	yes
Instrumental Variables	no	no	no	no	yes	yes
RHS Endogenous Variables					TFP	TFP
Other Equations in System	TFP=F(pplrel,scale,KLrel)					

Notes: 1:/ White-Hubert robust heteroscedastic standard errors; std errors appear in parentheses; and p-values in square brackets. All series are described in the Appendix 2. All regression coefficients are significant at size of 0.05, otherwise stated. *: Significant at size of 0.1; ** statistically non-significant.

Abril de 2002

Table 15

IFI firms - Ex-post Performance Determinants
Pooled, Fixed Effects and Instrumental Variable Regressions
Dependent Variable: Translog Index of TFP

Independent Variables	Pooled OLS[1] Eq 1	Panel FGLS Eq 2	Panel FGLS Eq 3	Within FE Eq 4	Pooled 2SLS[1] Eq 5	Pooled 2SLS[1] Eq 6	FE+IV Eq 7
Relative partial productivity of labor	0.3803	0.3633	0.3295	0.2219	0.4811	0.4503	0.2384
	(0.0598)	(0.0321)	(0.0318)	(0.0248)	(0.0769)	(0.0727)	(0.0223)
Relative partial productivity of capital	-0.0094	-0.0049	-0.0050	-	-0.0103	-0.0092	-
	(0.0017)	(0.001)	(0.0009)	-	(0.0019)	(0.002)	-
Demand Growth [ISIC-specific]	0.2011	0.0812	0.0977	-	0.1915	0.1722	-
	(0.0782)	(0.0457)*	(0.0444)	-	(0.0783)	(0.0791)	-
Scale	-0.0316	-0.0190	-0.0175	-0.0136	-0.0262	-0.0247	-0.0185
	(0.0043)	(0.0023)	(0.0023)	(0.0038)	(0.0045)	(0.0045)	(0.0035)
Licencing	7.9312	7.9246	8.1922	-	5.3740	4.4938	-
	(1.9463)	(1.3614)	(1.4664)	-	(2.1096)	(2.0138)	-
Relative Compensation	-0.3283	-0.1031	-0.1135	0.9975	-0.2392	-0.2480	-
	(0.0943)	(0.0424)	(0.0432)	(0.0371)	(0.1125)	(0.1083)	-
Advertising Coefficient	-2.2255	-1.6442	-1.4812	-	-2.2842	-2.2048	-
	(0.5537)	(0.4407)	(0.4422)	-	(0.5543)	(0.5207)	-
Log Tecnicians	0.1152	0.1019	0.0778	0.1418	0.1875	0.1840	0.1071
	(0.0324)	(0.0176)	(0.0163)	(0.0262)	(0.0353)	(0.0354)	(0.0215)
Privatization Dummy	0.3626	0.5253	-	-	0.2700	0.2757	-
	(0.1073)	(0.0438)	-	-	(0.1118)	(0.1112)	-
Lerner Index	-	-0.4968	-0.4130	1.3185	-2.1912	-2.0258	1.3116
	-	(0.1570)	(0.1502)	(0.2899)	(0.4225)	(0.4223)	(0.3626)
Log Value Added [ISIC-specific]	-	-	-	0.3308	-	-	0.2702
	-	-	-	(0.0462)	-	-	(0.0412)
Relative Capital Labor ratio	-	-	-	-	-	0.0107	-0.0339
	-	-	-	-	-	(0.0061)	(0.0040)
	-	-	-	-	-	-	-
Constant	0.9934	0.614	0.7227	-5.7045	0.8739	0.8563	-4.3417
Regression Statistics							
R2	0.1954			0.2708	0.1663	0.2940	0.4747
Num of groups		28	28	28			28
Num Obs	554	554	554	575	554	564	476
Obs per Group: Min		4	4	5			5
Max		24	24	25			25
F-test	22.9			40.25	20.7	85.1	54.93
	[0.0000]			[0.0000]	[0.0000]	[0.0000]	[0.0000]
Wald-Chi2(k-1)		289.6	296.4				
		[0.0000]	[0.0000]				
F-test for all ! !ᵢ = 0				142.5			
				[0.0000]			
Heteroscedasticity tests							
Cook-Weisberg	73.51						
	[0.0000]						
Breuch-Pagan LM stat	158.9						
	[0.0000]						
Variance Matrix Residuals							
Homocedastic panels	yes	no	no	yes	yes	yes	yes
Instrumental Variables	no	no	no	no	yes	yes	yes
RHS Endogenous Variables					Lerner	Lerner	Lerner
Other Equations in System	Lerner = F(mshare, grubel, efepro)						

Notes: 1:/ White-Hubert robust heteroscedastic standard errors; std errors appear in parentheses, and p-values in square brackets. All series are described in the Appendix 2. All regression coefficients are significant at size of 0.05, otherwise stated. *: Significant at size of 0.1; ** statistically non-significant; TFP indices at starting year t = 1; Demand Growth = change in ISIC specific Value Added.

5.2 POWER PLANTS: STATISTICAL ANALYSIS OF EFFICIENCY SCORES

This section reports the results of an econometric analysis of thermal power plants DEA efficiency scores. The exercise follows a *limited dependent variable model* because the dependent variable under analysis is censored by construction. It takes positive values and is bounded at 1.00; thus, the efficient plants will record an efficiency score $-y_{it}-$ of one. Otherwise, $0 \leq y_{it} < 1$. The sample might be also *truncated* because there is knowledge of independent variables if only y_{it} is observed. This is particularly important for marginal power producers when the thermal plants are shutdown because of maintenance, transmission, and generation constraints by which there is no dispatch. The baseline *censored-model* follows a linear specification:

$$y_{it} = \begin{cases} \mathbf{x'_{it}B} + e_{it} & 0 < Y_{it} \leq 1 \\ 0 & otherwise \end{cases} \tag{2}$$

and the residuals are I.I.D following a normal distribution with zero mean and constant variance.

Equation (2) models efficiency scores as function of plant characteristics, ownership structure, and regulatory related policy dummies. Plant characteristics include plant age, capital labor ratio, technology type, and load factor. Controlling by the load factor indicates how marginal a given producer is.[36] A dummy that records all private plants with ones captures ownership. The regulatory dummy tries to capture the effect of large customer definition. Thus, for each plant such dummy takes a value of one after 1998 when the lower limit for large clients was set in 0.5 MW/month that implied a jump from 100 to 900 non-regulated users on average. The dataset includes all observed records from each one of the 32 active thermal plants during the 1995 to 2000 period. Therefore, the dataset is a time series cross-section unbalanced panel with 166 observations. Table 16 displays the parameter estimates from the Tobit analysis. The efficiency scores in the first two equations are input-oriented measurements under the assumption of CRTS convex technology. In the third equation efficiency scores take into account the adjustment in capital input by capacity utilization. Such adjustment normalizes plant capacity by load factor, which means that all producers are treated as if they were out of peak generators.

The reading of those results is the following. First, the equations exhibit high goodness of fit reported by the R^2 of the OLS regressions.[37] In particular, the overall effect of the plant characteristics, ownership structure, and regulatory the policy dummy explain 90% of the efficiency scores

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[36]   The definition of load factor for this exercise is: $LF = \dfrac{GWh}{K * (365 * 24)/1000} = \dfrac{GWh}{K * 8.76}$

[37]   In general, the variables included in the Tobit regressions are robust. Residuals are homoscedastic according to the reported OLS tests. The residuals are not normal, which is associated with the distribution Kurtosis. The distribution of the residuals is symmetric.

once capital input is already adjusted by capacity utilization, and explains 78% when in the assumption of constant returns to scale is relaxed. Second, technology dummies are robust and statistically significant in all equations. This implies that new gas-based technologies improve system efficiency, since they save on fuel consumption. Entrants played a central role in this particular issue. Third, the load factor is positively related, meaning that there is an effective reduction in the power losses associated with the frequent and costly plant start-ups. However, the squared is negatively related, showing that there are decreasing returns to scale at plant full plant capacity.

Fourth, plant age is negatively related, meaning that older plants loose relative efficiency. Nonetheless, there are positive learning effects that partially offset plant aging given by the squared of age variable. For instance, the accumulated efficiency loss after 10 years is 17%, but the learning effect represents a 4.5% efficiency gain. Fifth, regulatory policy has had positive effects. The regression coefficients indicate an overall efficiency gain of 2.7%. Sixth the exercise is not conclusive regarding if there are structural differences in productive efficiency due to ownership. The private ownership dummy turned out not significant once capital input is corrected by capacity utilization and the assumption of constant returns to scale is relaxed [Equation 3]. This result goes to the same direction that other studies have found. The study of Pollit (1995) reports regression coefficients statically non-significant for his ownership dummy. Those regressions are based on a cross-section dataset of 768 thermal power plants for 14 countries.

VI. CONCLUDING REMARKS

This paper has given an overview of the privatization program in Colombia gathering detail information in a comprehensive way that put this process in context within the global economic deregulation and market promotion competition strategy. In that sense, the paper offers for first time a complete description of the privatization experience of the nineties, and also the first in providing empirical evidence based on an ex-post performance evaluation for the privatized plants. The paper has explored in deep the cases of IFI manufacturing enterprises and power plants. These sectors account for 95% of the privatization sales, which without doubt make the results comprehensive in terms of the overall effects of privatization on firm performance.

The study showed several interesting results. First, IFI firms followed the cycles and trends of their private competitors across the manufacturing industry. This was proved through the study measurement of twenty-five indicators of economic performance. The productivity slowdown of the eighties hit these enterprises harder because they are among the largest capital-intensive plants. During the nineties these firms underwent to sharp restructuring processes. The large increase in labor productivity and the adjustment in plant size led to a modest recovery of plant total factor productivity. The evolution of firm market power and profitability rates indicate that firms are pricing more competitive and still adjusting to the global economic deregulation and foreign competition. This study has unbiased measurements because the sample includes firms where IFI equity was totally transferred to private sector, liquidated firms and enterprises where the IFI is still a strategic shareholder. Privatization was important as a complementary mechanism that facilitated and speed up plant industrial restructuring. This observation is supported in econometric results where the privatization dummy turned out to be a robust determinant for markup coefficients and the Translog indices of total factor productivity.

TABLE 16
TOBIT REGRESSIONS - LONGITUDINAL DATA
THERMAL PLANTS - EFFICIENCY SCORES (1995-2000)
DEPENDENT VARIABLE: INPUT-ORIENTED EFFICIENCY SCORES

	Pooled Tobit Eq 1	Pooled Tobit Eq 2	Pooled Tobit Eq 3
Dependent Variable	Score1	Score1	Score2
Independent Variables			
Adjusted Capacity	-0.0004		
	(0.0002)*		
Age	-0.0155	-0.0175	-0.0170
	(0.0018)	(0.0018)	(0.0029)
Age-squared	0.0004	0.0005	0.0005
	(6E-04)	(6E-05)	(9.4E-05)
Load Factor	0.4169	0.3700	0.1577
	(0.0445)	(0.031)	(0.049)
Load Factor-squared	-5.1005	-4.5298	
	(1.207)	(1.125)	
Capital-Labor ratio	0.0010		
	(0.0006)**		
Dummy Gas	0.3653	0.3704	0.4170
	(0.0118)	(0.0122)	(0.023)
Dummy Combine Cycle	0.1431		
	(0.0923)**		
Dummy Private Ownership	0.0323		
	(0.0116)		
Dummy Public Ownership		-0.0423	
		(0.0117)	
Dummy Regional Market			-0.0494
			(0.0258)*
Dummy Regulatory Policy	0.0201	0.0229	0.0382
	(0.0108)*	(0.0112)	(0.1762)
Constant	0.4098	0.4593	0.4869
Sigma	0.0660	0.0691	0.1095
Regression Statistics			
R2-OLS	0.9104	0.9074	0.7791
Uncensored Obs	155	156	152
Censored Obs	7	10	10
LR~Chi(k-1)	377.3	379.5	225.5
	[0.0000]	[0.0000]	[0.0000]
Tests Residuals			
Cook-Weisberg -OLS	0.00	0.04	1.83
	[0.9924]	[0.8445]	[0.1756]
Breuch Pagan -OLS	6.87		
	[0.4416]		
Ramsey-RESET - OLS	1.83	0.59	0.99
	[0.1439]	[0.6225]	[0.4009]
swilk -OLS	4.99	4.67	3.35
	[0.0000]	[0.0000]	[0.0004]

Notes: Std errors appear in parentheses, and p-values in square brackets; All regression coefficients are significant at size of 0.05, otherwise stated; *: Significant at size of 0.1; ** statistically non-significant; Efficiency Scores dataset 1995-2000; Assumptions: Score 1: CRTS, No weights, Input-Oriented, Convex Technology Capital Input corrected by utilization rates; Score 2: Non-DRTS, No weights, Input Oriented, Convex Technology Capital Input corrected by utilization rates.

The analysis for the power sector also has important results. The general trends of electricity contract prices, the evolution of plant entry in thermal generation, and the increasing share of non-regulated users into the commercial demand suggest that the regulatory reform has been effective in promoting market competition and system efficiency. The measurement of efficiency scores at plant-level showed that there were important efficiency gains after the reform because the new plants in thermal generation are gas-based with combining cycle technologies. The regulatory policy has had positive effects on plant efficiency. The increasing number of non-regulated users has led generators to offer more competitive prices in order to ensure generation on contract bases. Last, the relation between ownership and efficiency is not conclusive for thermal generation once the assumption of constant returns to scale technology is relaxed and capital input is adjusted by capacity utilization. This result is in accordance to the findings in international studies on performance and ownership in electric utilities.

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APPENDIX 1
CONCESSIONS INFRASTRUCTURE PROJECTS WITH ONGOING PRIVATE INVESTMENT BY 1998

Proyect Name		Ownership	Proyect Name		Ownership
I. Roads	Km		**III. Water and Sanitation**		
Armenia-Pereira-Manizale	98	Public-Concession	ACUACAR-Cartagena		Mixed-Capital
Barranquilla-Cienaga	60	Public-Concession			
Bogota-Facatativa	41	Public-Concession	Triple A-Bquilla		Public-Concession
Bogota-Villavicencio	120	Public-Concession			
Buga-Tulua-Paila	120	Public-Concession	Sta Marta		
Carreteras Meta	238	Public-Concession	Metro-Agua		Public-Concession
Cartagena-Barranquilla	112	Public-Concession			
Cortijo-Vino	31	Public-Concession	TIBITOC Plant for		Public-Concession
Espinal Neiva	150	Public-Concession	water treatment		
Medellin-RioNegro	195	Public-Concession	Bogota Water Company		
Patios-Guasca	53	Public-Concession			
Sta-Marta Paraguanchon	170	Public-Concession	**IV. Railroads**	KMs	
			Atlantic Line - cargo	965	Mixed-Capital
total	1388				
II. Gas-Pipelines	Km		**V. Maritime Ports**	Number	
				Contracts	Public-Concession
Sebastopol-Medellin	149	Public-Concession		15	and Private
Barranca-B/manga	59	Public-Concession	**VI. Telecomunications**		
Sur - Huila	193	Private			
Mariquita-Cali	340	Private	Mobile Phones Companies		
Huila- Tolima	120	Private	COMCEL		Mixed
			CELCARIBE		Mixed
Total	861		OCCEL		Mixed
			CELUMOVIL		Private
III. Airports			CELUMOVIL COSTA		Private
			COCELCO		Private
Bogota - Second Track	1	Public-Concession			
Barranquilla - Aereopuerto del Caribe S.A	1	Public-Concession			
Cartagena-Airport	1	Public-Concession			

Sources: Faimboin et al (2001); Bonilla et al (2000); Conpes documents: 2648/1993; 2775/1995; 2928/1997 Law 37 of 1993

Notes: Excludes power sector. Concession Contracts are either Build Operative Maintain Transfer (BOMT) or Rehabilitation Operative Maintain Transfer (ROMT).

APPENDIX 2
LIST OF IFI ENTERPRISES IN THE STUDY SAMPLE

Num	Name	Startup	ISIC4	ISIC-name
1	ACERIAS PAZ DEL RIO	1947	3710	Iron and Steel basic industries
2	AICSA	1977	3845	Manufacture of aircraft
3	ALCALIS - BETANIA	1951	3511	Basic industrial chemicals except fertilizers
4	ALCALIS-MAMONAL	1967	3511	Basic industrial chemicals except fertilizers
5	ASTIVAR	1974	3841	Ships buildings and repairing
6	CATSA	1978	3116	Grain mill products
7	CCA	1974	3843	Manufacture of motor vehicles
8	CEMENTOS BOYACA	1955	3523	Cement, lime and plaster
9	CEMENTOS RIOCLARO	1986	3692	Cement, lime and plaster
10	CERRO MATOSO	1979	3722	Recovery and founding of tin and nickel
11	COLCLINKER	1974	3692	Cement, lime and plaster
12	CONASTIL	1969	3841	Ships buildings and repairing
13	EMPAQUES DEL CAUCA S A	1965	3211	Spinning, weaving and finishing textiles
14	FATEXTOL	1988	3220	Wearing apparel
15	FEDERALTEX SA	1987	3211	Spinning, weaving and finishing textiles
16	FERTICOL	1966	3511	Fertilizers and pesticides
17	FRIGOPESCA SA	1978	3114	Canning, processing of fish, crustacean
18	ICOLLANTAS	1942	3551	Tire and tube industries
19	INGENIO RISARALDA	1978	3118	Sugar, factorie4s and refinements
20	INTELSA SA	1979	3832	Manufacture of radio, tv, and telecom eq.
21	MONOMEROS SA	1967	3512	Fertilizers and pesticides
22	PENWALT	1967	3512	Fertilizers and pesticides
23	PROPAL	1961	3411	Pulp, paper and paperboard
24	QUIBI	1968	3522	Manufacture of drugs and medicines
25	SIMESA	1938	3710	Iron and Steel basic industries
26	SOFASA	1969	3843	Manufacture of motor vehicles
27	SUCROMILES	1973	3511	Basic industrial chemicals except fertilizers
28	TEJIDOS UNICA	1953	3216	Weaving and cotton manufactures
29	TEXPINAL	1973	3211	Spinning, weaving and finishing textiles
30	VIKINGOS DE COLOMBIA S A	1968	3114	Canning, processing of fish, crustacean

Source: DANE-Industrial Directory, IFI-Investment Department

APPENDIX 3
PERFORMANCE INDICATORS: DEFINITIONS AND METHODOLOGY

The EAM is in practice a Census of manufactures for medium and large enterprises. The EAM has had three methodological changes: i) 1970-1991, ii) 1992-1993, and iii) 1994 to date. The changes have been addressed toward: i) the inclusion or exclusion of variables within chapters; ii) the addition or suppression of new information across chapters; iii) the modification in the format or variables classification criteria; and iv) the rescaling of the sample cohorts.

Some specific examples are the changes of the payroll classification, the inclusion of temporal workers after 1987, the exclusion of direct exports as a component of firm's sales, the elimination of the direct taxes variables after 1991, the redefinition of large enterprise according to number employees, and the addition of new components for fixed investment after 1992, among many others.

Despite of the format modifications, the survey has kept the basic variables and structure across time. The database clean up process took a two-step procedure. First, we worked with the basic variables of the 1970-1991 survey. Second, all basic series were overlapped and chained keeping the original definitions of the older survey.[38] The manufacturing survey offers five types of variables:

1. *Identification variables*: location (blue-park district), ISIC-specific group, firm's legal capital structure, and size classification.

2. *Labor variables*: wages, benefits, permanent and temporal employees, administrative employees, workers, technicians, and gender statistics.

3. *Output-related variables*: gross output, value added, intermediate consumption components, industrial expenditures, and inventories of final products and raw materials.

4. *Financial-related variables*: fixed assets investment, accounting depreciation, sales, marketing spending, paid royalties, and other general expenditures variables.

5. Consumption, generation, and sales of electricity.

The survey recorded data for 133 variables form 1970 to 1991. , The survey recorded 380 variables during the years of 1992 and 1993. From 1994 to date, the survey works with 200 variables. Without any doubt, the 1992-1993 period is the problematic one because the Survey included information no comparable with previous data. However, the core variables were recorded.

A.2 THE INDICATORS

The EAM database allows measuring the following set of plant characteristics and performance indicators for each one of the IFI's companies.

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[38] The main problem of the above methodological changes was the modification in the basic plant ID variable from 1991 to 1992, and 1993. This is troubleshooting if one wants to track the information at plant level. We ran a cross matching program throughout plant commercial names, recorded at the industrial directories, and generated an *identification key* for the ID variables in the 1991-1992 and 1992-1993 Surveys.

1. Fixed capital stock series by type of depreciable assets.

$$k_0 = \frac{IB_0}{g + \delta}$$ Initial capital formula

where: g: The historic growth rate of the fixed assets gross investment series; δ: Economic depreciation rate; IB_0: Gross investment at initial date

Having K_0, the capital stock series are generated using the perpetual inventory method

$$k_t = k_{t-1}(1 - \delta) + I_t$$

Depreciation rates are taken from Pombo (1999).

2. Productivity Indicators. These are the partial and total factor productivity for firm i

$$\frac{VA_i}{K_i} = \text{partial capital productivity}$$

$$\frac{VA_i}{L_i} = \text{partial labor productivity 1}$$

where: L = total number of permanent employees,

$$\frac{VA_i}{Wor\ker s_i} = \text{partial labor productivity 2}$$

The TFP indices follow the measurement of Solow's residual using a translog technology specification, which allows for changes of inputs' efficiency [Griliches & Jorgenson (1967)].

$$TFP_{t-1,t} = \ln \frac{Y_t}{Y_{t-1}} - \frac{1}{2} \sum_{i=1}^{n} (S_{it} + S_{it-1}) \cdot (\ln x_{it} - \ln x_{it-1})$$

Aggregate inputs follow a translog specification in their components. Thus, under CRTS the translog index for capital, labor and intermediate materials is

$$LnX_t = \frac{1}{2} \cdot \sum_{i=1}^{n} (S_{it} - S_{it-1}) \cdot (\ln x_{it} - \ln x_{it-1})$$

where: S_{it} represents the expenditure share of each component of input **X** observed at time *t*, and x_{it} denotes de quantity of each component *i* in **X** at time *T*.

4. $\frac{K_i}{L_i} = \text{capital intensity 1.}$

$$\frac{K_i}{Wor\ker s_i} = \text{capital intensity 2}$$

5. $\dfrac{TotalWorkers_{ij}}{AverageWorkers_{j}} = $ firm size 1

$\dfrac{L_{ij}}{AvgL_{j}} = $ firm size 2; where L = permanent employment

where j denotes ISIC-specific group.

The following indicators are ratios; therefore, they can be estimated through nominal-value series

6. $\dfrac{IRM_{i}}{DRM_{i}} = $ quality in intermediate consumption

where IRMC = imported raw material; DRM = domestic row materials

7. $\dfrac{SB_{i}}{W_{i}} = $ Hiring cost; where SB = social benefits and W = wages

8. $\dfrac{Technicians_{i}}{Workers_{i}} = $ Human Capital indicator by firm i.

9. $\dfrac{W_{i}}{VA_{i}} = $ Wage rate

$\dfrac{W_{i} + SB_{i}}{VA_{i}} = $ Compensation rate; where SB = social benefits

10. $\dfrac{Adv_{i}}{VA_{i}} = $ Advertising rate. This is a indicator for product differentiation, where Adv = advertising and promotional spending.

11. $\dfrac{Roy_{i}}{VA_{i}} = $ Licensing indicator, where Roy = paid royalties

12. $\dfrac{Y_{ij}}{\overline{Y}_{j}} = $ output-scale indicator; where Y-bar is the average output of ISIC-group j.

13. $\dfrac{I_{i}}{Y_{i}} = $ gross investment rate

$$\frac{IME_i}{Y_i} = \text{machinery \& equipment investment rate}$$

IME_i/I_i = embodied investment rate

14. Industrial concentration indices.

$$CR_4 = \frac{\sum_{i=1}^{4} Y_{ij}}{\sum_{i=1}^{n} Y_{ij}}$$

where the numerator stands for the four-largest plants in ISIC-group j.

$$Herfindal_j = \sum_{i=1}^{n} s_{ij}^2$$

where s denotes firm's i market share in ISIC-group j.

15. $\dfrac{Exports_j}{TotalSales_j}$ = export orientation coefficient ISIC-group j

16. $IIT_j = 1 - \dfrac{|Xj - Mj|}{(Xj + Mj)}$ = Grubel and Lloyd intraindustry trade index by ISIC-group j.

17. Profitability indicators

$$\frac{VA_i - W_i}{VA_i} = \text{gross margin rate}$$

$L_i = \dfrac{\alpha_i}{\varepsilon}$ = Lerner index (price-cost margin) for firm i

where α_i = firm's market share, and = the demand elasticity. Demand elasticities are taken from Pombo (1999).

APPENDIX 4
THE POWER SECTOR DATASETS

At present, the power sector statistics in Colombia are split among the following institutions:

i) The National Grid Company (Interconexión Eléctrica S.A); ii) the Mining and Energetic Planning Unit (UPME); iii) the Electricity and Gas Regulatory Commission (CREG); iii) the National Planning Department (DNP); and iv) the Superintendency of Domiciliary Public Services (SSPD). As a result, each source has a different format and contents.

The information is sorted out either by plant, utilities, regional electricity markets, regional geographical provinces, or simply at a countrywide aggregate level. The Table A4.1 describes the contents of the collected datasets.

TABLE A4.1
COLOMBIA - POWER SECTOR STATISTICS - DATASETS DESCRIPTION

SIVICO 1997-1999	The following data available by utility level:
	Financial Statements
Source: SSPD	- Income statement
	- Balance sheet
	Labor Statistics
	- number of employees by sector's activity
	- number of employees by occupational category
	- number of employees by type of generation
	Market composition by type of users
	- consumption
	- invoicing
	- number of subscribers
	- average tariffs by users
	Results and Performance control process indicators
	- quality service indicators
	- spending & indebtedness indicators
ISA-Reports (1995-1999)	**Operative Reports of the National Interconnected System**
	- Hydrology
	- Grid Constraints
	- Generation
	- Demand
	- Available effective capacity
	The Electricity Spot Market Report
	- Pool's prices & contacts
	- Total traded amount (GWh)
	- Pool's marginal supply prices by type of generation

Table A4.1 (Cont.)

Colombia - **Power Sector Statistics** - **Datasets description**

SIEE 1970-1998	The Economic and Energetic Information System is a dataset that covers the Latin American Economies energetic statistics.
Source: OLADE	
	The SIEE sections are: - prices - demand and supply - energetic Equipment - environmental impact - economic + energetic indicators -world-wide energetic statistics
FEN 1983-1996	Power Sector Historical Financial Statistics. This dataset done by the Financiera Electrica Nacional (FEN), offers:
Source: FEN	- income statements - balance sheets
SINSE 1970-1994	The power sector national system is a comprehensive Database. The data is available by utility and regional market.
Source: MME	The SINSE chapters are - energetic balances - generation and Electricity Demand - number and type of subcribers - average tariffs by users

Besides the above datasets there were direct requests to ISA regarding the monthly indicators of the *el Mercado de Energia Mayorista* (MEM) since July 1995, and the *Thermal Park Dataset*. The crossing of information among ISA's thermal park dataset, SIVICO, and SINSE allowed collecting the input-output variables by thermal unit that are depict in table A4.2.

In order to make direct inferences of labor input by plant after 1996, a survey was carried out among the members of the Colombian Generators Association (ACOLGEN). The collected information allowed distinguishing benchmarks of capacity-labor ratios, which under normal assumptions of *putty-clay* technology that coefficient turns out a constant parameter. The data provided by the power utilities along with SIVICO allowed identifying the number of employees by thermal plants for the period 1996-1999 given the reported capacity per unit.

Table A4.2

Thermal Plants - Inputs and Output Variables

Sample	Variables	Sample	Variables
1988-1994	Generation (GWh)	1995-1999	Generation (GWh)
	Gross Capacity (MW)		Efective Capacity (MW)
	Net Capacity (MW)		Labor (Number employees)*
	Coal (tons)		Heat Rate
	Fueloil (gls)		
	Diesel-Oil (gls)		
	Gas (ft3)		

Sources: SINSE, ISA, SIVICO
Notes: * Since 1996. Labor information is recorded by power utility and industry activity: Generation, Transmission and Distribution (SIVICO).

The estimated benchmark labor to capacity ratios by occupational category for a base-technology thermal plant were:

0.036597 (Directives); 0.151852 (Administrative), and 0.527731(Operative)

For the 1988-1994 period the FEN books recorded some physical variables per power utility, among them the permanent employment series. Thus, the inference of labor series by the thermal units followed a constant distributing capacity assumption, that is:

Thermal Unit Labor (L1) = [Max Theoretical Thermal Plant Unit Capacity (GWh) / Utility Available Capacity (GWh)] * Utility total permanent employees

Other formulas were used in order to generate alternative labor series by thermal plants. One was based on power generation:

Thermal Unit Labor (L2) = [Thermal plant generation (GWh) / Utility Available Capacity in GWh] * Utility total permanent employees

Now an adjusted L2 series were generated under the assumption:

$$(\frac{L}{MW})_{Thermal} = (\frac{L}{MW})_{Hydro} /(1+x); \text{ where: } x = avg \frac{MgP_{hydro}}{MgP_{thermal}}; \text{ and}$$

Rationing Price: MgPhydro > MgPthermal = 1.8;

Without Rationing: MgPhydro < MgPthermal = 0.6

The above coefficients are observed parameters. L_1 and L_2 were used as the labor input series in the estimation of plant efficiency scores.

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