DAE Working Paper WP 0316

UNIVERSITY OF CAMBRIDGE
Department of Applied Economics

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Environmental Policy Research

CMI Working Paper 23

DAE Working Paper Series

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Welfare Impacts of Electricity Generation Sector Reform in the Philippines

Natsuko Toba*

Sidney Sussex College, University of Cambridge, Cambridge, CB2 3HU, UK

Abstract

This paper reports an empirical investigation into the welfare impacts of an introduction of private sector participation into the Philippines electricity generation sector, by liberalizing the market for independent power producers (IPPs) during the power crisis of 1990-1993. This study uses a social cost and benefit analysis. The main benefits came from IPPs, who contributed to resolving the crisis, and promoted economic and social development. Consumers and investors are net gainers, while the Government lost and there was an air pollution cost. The paper concludes that the reform with private sector participation increased social welfare.

JEL Classification: O10; D61; L50; L10; L94.
Key words: Electricity; Cost-benefit-analysis; Institutional change.

1. Introduction

Sector reform has been a major pillar of policy agendas across the world since 1980. Common reasons across all sectors are government failure and financial crisis, institutional failure, technological advancement and the globalisation of the world economy. The increasing private sector involvement in government activities such as infrastructure services, assumes that resources are better allocated through the market mechanism in a competitive and decentralized environment than through the highly centralized and bureaucratic decisions of government. There has been an ongoing debate on the superiority of performance between private and government owned enterprises. This paper reports a social cost and benefit analysis to contribute to this

* *Tel.*: +44 1223 359417.
Email address: nt212@cam.ac.uk (N. Toba).
The author wish to acknowledge her utmost appreciation to Ian Hodge, Michael Pollitt, David Newbery, Jon Stern, Preetum Domah and two anonymous referees. Participants at the Regulation seminar and the Land Economy seminar of the University of Cambridge also made valuable comments.

debate on the ownership effects on social welfare, focusing on the electricity generation sector in the Philippines.

This paper is organised as follows. Section 2 provides a brief background to the Philippines electricity sector. Section 3 briefly discusses the theoretical and empirical review surrounding the issue of ownership effects. Section 4 discusses the methodology used in this paper. Section 5 details the data. Section 6 describes the scenarios. In section 7 the results are presented and discussed. And the final section 8 concludes.

2. Background to the Philippines electricity sector

2.1 Generation Sector Profile

In 1999, the country's electric generation capacity was 12 GW, electricity generation was 40,745 GWh[1] and electricity consumption was 37,900GWh (US Energy Information Agency, 2002). In 1998, the electricity generation (41,192 GWh)[2] mix by fuel type was Oil based 47.01%, Imported coal 19.23%, Local coal 3.89%, Hydro 10.25%, Geothermal 19.57% and Natural gas 0.05%. In 1998, total installed capacity (11,788.6MW) by fuel type consisted of Oil based 48.15%, Imported coal 8.91%, Local coal 7.21%, Hydro 19.54%, Geothermal 16.17% and Natural gas 0.03%; of this total, small island grids shared only 1.47% (Oil based 1.46% and Hydro 0.02%) (Department of Energy (DOE) (of The Philippines), 1999). The Philippines has tried to reduce its dependence on fuel imports. The country's 8% of self supply of total energy mix in 1973 increased to over 40% by 1997. The only indigenous energy resource that merits significant investment is geothermal steam. The proportion of imported oil to total energy was reduced from 92% in 1973 to 50% in 1999 (DOE, 2000). The share of indigenous oil within the total energy mix was expected to increase from 0.11% in 1998 to 2.18% in 2009, contributed by the Malampaya off

[1] Consisted of (65% thermal, 19% hydro, 16% Geothermal, Solar, Wind, Wood, and Waste).
[2] International Energy Agency: Energy Balance of Non-OECD Countries, 1997-1998 (n.d.), in documents obtained from Japan Electric Power Information Center (JEPIC) (n.d.).

shore field (DOE, 1999, 2000). The average annual electricity generation growth from 1973 (10,910 GWh) to 2000 (40,700 GWh) was about 5.3%.[3]

2.2 Historical Context

Under the macroeconomic stabilization program of the mid 1980s introduced by President Aquino after the fall of the Marcos government, an overall public sector investment in the Philippines economy was cut back sharply. In 1986, the energy investment was only 30% of the 1979 level in constant prices. Furthermore, the government decided to mothball its one nuclear power plant which had received most of the recent investment and which had been designed to meet an increasing power demand. As a result, since 1988, the Philippines had experienced a major crisis in electricity supply due to generating capacity deficits, which greatly affected national economic and social development and stability. At the depths of the crisis in 1992-1993, brownouts averaging seven hours per day were common in many regions of the country, hurting industrial production and the development of new and commercial activities which were on course for recovery with the new government. In Luzon, brownouts occurred for 4-8 hours per day and in Mindanao, for up to 12 hours per day. These brownouts led to unemployment and economic loss, estimated at 1.5%of GDP per year by the World Bank[4] and at US$1-1.3 billion by the business community (in 1993 prices) (World Bank, 1993). Many essential services were jeopardized both directly and indirectly, as it not only caused a lack of electricity for reading, cooking or entertainment but also interrupted other key services that depended on electricity such as traffic management, pumped water and sewerage (World Bank, 1993, pp.2-3). The real annual GDP growth rate fell from 6.1% in 1989 to –0.99% in 1991 and was 0.72% in 1992 (DOE, 1999). With the stabilization of power situation in 1994, the economy posted the real annual GDP growth rate of 4.4% (DOE, 1999). The power crisis also stimulated the development of many inefficient and expensive self generators. To mitigate the shortages, some 1600 MW generation capacity of gensets is known to have been imported to the Philippines during 1993 (World Bank, 1994a, p.10).

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[3] Calculated from the data in 1973 from DOE (1999) and in 2000 from US Energy Information Agency (2002).

[4] Estimated by the World Bank (1993, p.2), using US 50 cent/KWh as the cost of unserved energy.

The main causes of this crisis were, inter alia; (i) rapid growth of electricity demand, (ii) mothballing of a completed nuclear plant without alternative generation capacity; (iii) the lack of Government equity infusion into the government-owned generation and transmission monopoly National Power Corporation (NPC) and the lack of a long-term debt instrument in the domestic financial system; (iv) inordinate delays in implementing new base load plants and in environmental clearances due to the public protests; (v) declining hydro power generation capacity; (vi) insufficient maintenance of ageing power plants causing frequent and prolonged outages; (vii) the recent new regulations standardizing (e.g., salary conditions, etc.) all the administration of Government agencies including NPC; and (viii) the recent politicised tariff adjustment process which constrained NPC's financial capability even further.

Ironically, the crisis followed the Government's substantial steps to strengthen NPC both operationally and financially. Moreover, because its existing capacity was considered sufficient to meet projected increases in demand through to about 1991, although NPC did have sufficient lead time to implement least cost additions to its generating capacity, it did not make use of the time to invest in its needed new capacity.

Just before the power crisis, the Government had promulgated Executive Order (EO) 215 of 10 July 1987 to end NPC's generation monopoly which was designated to accommodate the Philippines National Oil Company (PNOC), which could not sell the geothermal steam which it was developing to NPC because the Government's required royalty on this resource raised the cost of geothermal steam powered electricity well above that of coal and oil fired alternatives (World Bank, 1994a). As the power crisis deepened and private development came to be viewed as the only viable approach for quickly addressing the shortages, the Government developed a fully fledged plan for privatizing the power sector, by rewriting exclusionary laws, drafting new policies to support IPPs, streamlining clearance processes, restructuring the Government energy sector policy departments and regulatory agencies, and removing the constraints to broader participation of IPPs in Build-Operate-Transfer (BOT) and similar arrangements. In that context, it developed a legal framework to enable foreign investors to win and operate generating facilities.

The issuance of EO 215 laid the foundation for private sector participation in the Philippines (World Bank, 1994a). Rules and regulations, and Congressional endorsement, were given in 1989. It was subsequently legislated as Republic Act (RA) No. 6957, dated 9 July 1990 (World Bank, 1994a). The policy objectives of this act are to (i) recognize the indispensable role of the private sector for infrastructure development, and (ii) provide the most appropriate incentives to mobilize private resources for financing the construction, operation and maintenance of appropriate infrastructure projects, and freeing the Government from financing and undertaking such projects (World Bank, 1994a). Also, under the "Electric Power Crisis Act of 1993", the President granted special powers to solve the energy crisis, such as facilitation of tariff increases, acceleration of project approvals, and salary improvements for technical staff in the sector (World Bank, 1993).

Since the successful commissioning of the first IPP project (a 210 MW Hopewell Navotas gas turbine project) in 1991 that NPC contracted via a negotiated process, the Philippines has successfully attracted further private offers for power generation (e.g., about US$ 5 billion in 1994 prices in foreign investments between 1992 and March 1994) (World Bank 1994a) . NPC has continued to implement various types of scheme for IPPs, including BOT, Build-Own-Operate (BOO), Build-Transfer-Operate (BTO), Rehabilitate-Operate-Lease (ROL), Rehabilitate-Operate-Maintain (ROM) and Operate-Lease (OL) providing a total capacity in excess of 3500 MW and completing installation of 1300 MW by 1993 (World Bank, 1994a). Most of the early IPP projects were made via solicited and unsolicited proposals followed by negotiated arrangements, although competitive bidding procedures were introduced later. In 1997, IPP generation increased to 46.3 % of total generation or about 35 IPPs. By the end of 1996, the private sector had completed 3,270 MW of installed capacity on a mostly BOT or BOO basis. An additional 5,655 MW of power plant capacity had either been contracted or was under negotiation with the IPPs and was scheduled for completion between 1997 and 2004. The private sector had also become involved in the rehabilitation and operation of a number of NPC's power plants. As of 31 December 1996, private participation in the operation of power plants with a total installed capacity of 1,299 MW had been arranged under ROL and ROM contracts. In addition, the NPC Power Development Plan as of December 1996 had provided for distribution utilities such as Meralco to make arrangements with the IPPs for the construction of power plants with a total installed capacity of 11,274 MW (ADB, 1997).

The Government's introduction of private participation in the electricity sector was indeed a major success in ending the power crisis, and its approved IPP contracts have contributed to the improvement of the environment for foreign investment in the Philippines as a whole. To put an end to the crisis, "fast track" plants were constructed. Most of the "fast track" plants were gas turbines, which are characterized by the low capital cost, short construction period, and high operational costs typical of peaking facilities. However, for these additions to capacity to meet unmet demand, they were run at plant factors more appropriate for base load facilities. As these were the first investments by IPPs in the Philippines, the Government offered generous terms and favourable risk-sharing arrangements. Under power purchase agreements (PPAs) in these early projects, NPC assumed market, fuel supply, location, and foreign exchange risks, with the Government providing a performance undertaking on behalf of the NPC. Terms of PPA included Government guaranteed commercial obligations of NPC and off-take through take or pay provision, and substantive incentives to exceed that off-take and thereby run the facility as a base load or intermediate plant. Most of these early projects were undertaken at a time of relatively stable exchange rates. The sustainability of these PPAs tended to become vulnerable in case of major shocks such as the Asian financial crisis in 1997 as they lacked appropriate mitigating mechanisms and procedures in dealing with such circumstances (Stern, 2001).

In addition to the high cost of gas turbines whose direct operational costs were very high, payments were 90% or more based on capacity due to the high utilization factors to alleviate the power shortage. Thus, these high cost plants needed to be operated in very low utilization factors once appropriate base plants become commissioned. IPP plants were neither cheaper nor more fuel-efficient than NPC plants. This was justifiable since the "fast track" projects' reduction in power outages avoided large costs to the economy.

However, after the end of the power crisis, although later IPP projects became less expensive and regulation over them has improved, IPP contracts which are still unfavourable to NPC have been exacerbating the NPC's already chronically weak financial position. The regional economic crisis since 1997 especially hit NPC because a considerable proportion of payments to IPPs is denominated in foreign currency. The decreased energy demand due to the crisis meant that NPC had to run the IPP's costly plants at relatively high capacity utilization factors due to the take or pay contracts instead of running their own cheaper plants at higher capacity. As a result, the external balance of Government deteriorated to the extent that it could no longer continue to guarantee these projects. Although the electricity tariff settings to the distribution sector and its customers are highly politicised, involving multiple levels of cross subsidy, these prices had to be increased as a result. These developments in turn caused a further deterioration of the already financially and operationally weak distribution sector. The subsequent increasing oil prices and political turmoil after the crisis of 1997 put the Philippines electricity sector further into dire straits.

These trends toward increased private development in the power sector, taken together, indicated that a major transformation in the structure of the power sector had already taken place. While the Government was addressing many constraints to private sector led growth in this sector, little attention has been paid to ensuring that the resulting structural framework would serve the national interest.

The Government has been considering a further radical reform and the eventual privatization of the entire power sector for a few decades. Many proposals and studies have been made of alternative structural models for reform.[5] The present arrangements of the electric power sector are putting major financial, operational and institutional constraints on Government capacity to maintain a stable, efficient, and cost-effective sector. This was even further aggravated by the regional financial and the country's political crises since 1997. Introducing competitive electricity markets will lead to an improvement of governance related to additional supply capacity, a shift of the market risk to the private sector, removal of the heavy financial burden from the public sector, and a downward pressure on power tariffs. The Government

[5] For example, Stubbs and Macatangay (2002) analysed the British experience of electricity sector privatisation to provide lessons learnt for the Philippines.

expects that the resultant efficiency gains will enhance the export competitiveness of the country's industries.

The current partial privatization of the generation sector is incomplete with many problems as explained above. However, nobody has actually questioned and quantified the extent to which this was costly or beneficial to society as a whole. It would be useful to evaluate this partial privatization, so as to give some insight to the sector reform and total privatization still pending as well as to indicate useful lessons to be learnt.

3. Theoretical and empirical review on ownership effects

Pollitt (1997) discusses several approaches to examine differences in performance between private and government owned electricity enterprises, whose literature is dominated by direct comparisons of performance between private and government owned electric utilities (e.g., Pollitt, 1995). The approaches include analysis based on: (i) financial and physical indicators (e.g., Yarrow, 1992); ii) labour productivity or total factor productivity (TFP) (e.g., Haskel and Szymanski, 1992), and iii) frontier analysis (e.g., Burns and Weyman-Jones, 1994), such as data envelopment analysis. All these approaches are, however, partial approaches to welfare measurement.

The number of studies focused on welfare impacts is small compared to the other approaches. There are two studies on poverty and consumer impacts of the Philippines electricity sector reform (Asian Development Bank (ADB), 1998; Navigant, 2001). The poverty impacts assessment study assumes, inter alia, subsidy removal; National Power Corporation (NPC) will not retain all their employees; and competition will generate efficiency gains. The consumer impacts assessment analysed partial equilibrium effects as a short term assessment and general equilibrium effects as a long term assessment. The main assumptions adopted are subsidy removal and that price will reach a long-run marginal cost (LRMC) plus a universal levy of P0.23/KWh.[6] A study on Argentinean electricity sector reform also

[6] A universal charge through Electricity Regulatory Commission (ERC) is to be imposed to meet costs associated with missionary electrification, usage of indigenous resources, environmental cost, removal

analysed general equilibrium effects and efficiency gains were estimated based on a few years of data after the privatization of the electricity service utilities (Chisari et al., 1999). These studies analysed the welfare impacts of electricity sector reform but do not provide a pure measure of difference in performance between government owned and private electricity enterprises. This is because these studies did not analyse the differences in performance between privatized enterprises under the sector reform and the state owned enterprises going through the comparable sector reform. Social cost and benefit analyses of the electricity sector reform in Chile (Galal et al., 1994) and UK (Newbery and Pollitt, 1997; Domah and Pollitt, 2001) did analyse such difference. This social-cost-benefit-analysis (SCBA) basically designs a behavioural and cost model of an industry and simulates it over the post privatization period with and without the sundry changes attributed to the privatization. Thus a counterfactual scenario (viz., enterprise without divestiture) is constructed to serve as control group as opposed to an actual scenario (viz., enterprise with divestiture) as treatment group. We adapt this methodology.

Many theoretical and empirical studies conclude that while they support superior performance of private enterprises, ownership is not per se a major determinant of differences in efficiency and social welfare, as discussed in Pollitt (1995). The institutional changes associated with private sector participation/ownership could also affect the differences. We caution that, while frequent progress evaluations are necessary, the private sector participation/ownership phenomenon could be too recent to distinguish between the outcomes derived from the legacy of the past state ownership regime and those from the private sector participation/ownership.

4. The SCBA Methodology

Galal, et al. (1994) identify three main groups in society, viz., consumers, private producers, and government as their framework in assessing the impacts of privatization on the economy. A full social cost and benefit analysis can, in theory, address the impact on economic efficiency and equity. Our first objective is to

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of cross subsidies, and NPC's and distributors' stranded liabilities upon privatization (Government of the Philippines, 2001).

answer the question: *Does the cost of introducing IPPs warrant the current benefit gained by the society?* We shall then address the distributional aspect of the problem: Who gained and who lost in the process of private sector participation? The former question concerns the productive efficiency and environmental impacts of the IPP participation and the latter issues related to equity.

The general approach we take is to set up and compare two scenarios: NPC and IPP. Under the NPC scenario we make assumptions associated with NPC continuing to control the vast majority of new generation under public ownership. Under the IPP scenario we make various assumptions about the introduction of private sector participation in electricity generation. Comparison of these two scenarios (with associated sensitivity analysis) allows us to put a value on the policy of introducing IPPs into the Phillipines. In line with Galal et al (1994) can broadly think of the NPC scenario as involving continuing government operation and the IPP scenario as involving private operation.

We followed the fundamental methodology of Jones et al. (1990):

$$\Delta W = V_{sp} - V_{sg} + (\lambda_g - \lambda_p)Z, \text{ where} \quad (1)$$

ΔW = change in social welfare

V_{sp} = social value under private operation

V_{sg} = social value under continued government operation

λ_g = shadow multiplier on government funds

λ_p = shadow multiplier on private funds

Z = actual price at which sale is executed.

The given reform will increase social welfare if ΔW is positive.

Alternatively, the welfare change can be expressed as a distributional function as in equation (2) below, which is adapted from Galal et al. (1994):

$$\Delta W = \Delta S + \Delta \pi + \Delta G + \Delta L + \Delta E \quad (2)$$

where,

ΔS = change in consumer surplus and avoided cost

$\Delta \pi$ = change in private (investors') profit

ΔG = change in effects on government via income and tax

ΔL = change in effects on providers of inputs, of which labour is the most important

ΔE = change in externalities cost - effects on others arising from impacts on environment and natural resources, i.e., air pollution costs.

The above formula (2) defines the NPV of change in welfare as the sum of the NPV of changes in welfare for each of the groups directly (as in a partial equilibrium model) affected by the private sector participation in the generation sector. The resulting impact on social welfare is calculated firstly without giving social weights and then by giving two different sets of social weights taken from different sources. Social weights recognize a different social value of each monetary unit of consumption by each agent.

Before the estimation of distributional social welfare effects using the model postulated (2) above, the net welfare impact was estimated by constructing a model as follows:

$\Delta W = \Delta I + \Delta E + \Delta R$, where, (3)

ΔI = change in investment cost (capital, coal and oil)

ΔE = change in externalities cost (air pollution cost from oil and coal - different plant types, e.g., gas turbine, imported or domestic coal, and from geothermal, hydro, etc.)

ΔR = change in restructuring cost (controllable cost, avoided cost and privatization and subsidization cost).

The elements of the welfare functions in (2) and (3) are discussed in section 5 below.

5. Data

Our dataset covers the pre- and post-private participation periods over at least 5-10 years. All data are disaggregated and detailed as much as possible. Most of the data and information used for our SCBA were collected from a fieldwork study in the

Philippines, whereby a number of different locations were visited including: government agencies, non-governmental organizations (NGOs), international organizations, universities, and private companies. Data have also been collected from sources outside the Philippines.

We have data from 1988 up to 1997 (some are from 1983 and some are up to 2000). Based on these data, we made projections until 2010 although some projections go further than this time frame. Based on the data and documents, actual and counterfactual scenarios were constructed. We shall refer to the actual scenario as 'IPP scenario (the generation sector shared between NPC and IPPs)' and the counterfactual as 'NPC scenario (the generation sector continuing NPC monopoly)'.

5.1 Controllable cost

Generation is now shared between NPC and IPPs but transmission is still an NPC monopoly. Thus we firstly reconstructed the accounts of the generation and transmission sectors, for the actual IPP scenario, by consolidating the accounts of NPC and IPPs, and for the counterfactual NPC scenario, by estimating the 'would-have-been' NPC accounts without IPPs.

Efficiency gains are examined in terms of savings in controllable cost following Newbery and Pollitt (1997), whose cost includes such costs as manpower related cost, operating and maintenance cost including materials and services, but excludes costs of fuel, depreciation, depletion,[7] local government tax and provision of doubtful debts. The major data required and details to estimate controllable costs are presented in Table 1. It was estimated that NPC's controllable cost would have been about 14.6% higher than IPPs' if NPC plants had been constructed instead of IPPs during the crisis. NPC's controllable cost is assumed to decline, with the influence from the IPPs, as discussed later.

Table 1
Controllable cost of the Generation Sector

Items	Sources and Details
Controllable cost of the NPC	As NPC accounts include its transmission sector, we subtracted the

[7] Using up of mineral resources.

	transmission and distribution cost components including associated manpower related costs.
Controllable cost of IPPs	We obtained purchased power cost where this is identified separately in various unpublished documents of ADB, World Bank and the Energy Regulatory Board (ERB) to estimate controllable cost of IPP.
Controllable cost of the NPC plants which would have been constructed instead of the IPP plants	We used the data comparing BOT coal plants with NPC turn-key coal plants as reported by the World Bank in 1994 (World Bank, 1994b, Annex 21, p.1), and with a NPC coal plant called Masinloc (turn-key) from an ADB report of 1995 (ADB, 1995, app. 6, p.5).
NPC and IPP generated units (KWh)	We obtained NPC's unpublished data on the actual generation data for NPC operated plants and IPP operated plants owned privately and owned by NPC for 1990-1999.

5.2 Capital cost

Next, we estimated the capital costs for each type of plant, as presented in Table 2. It was found that, excluding interest charges, annual NPC project costs were lower than IPP project costs. Assuming that the time taken for construction of NPC projects is the same as that of IPP, annual NPC project cost is about 96% of that of IPP.[8] The reasons of the higher capital cost of IPP projects than NPC could be, due to the urgency to end the crisis, there were insufficient: (i) procurement time and procedures by NPC; (ii) time for the IPPs in specifying and costing equipment and technologies; and (iii) competition that may have inflated the project costs. Also, this could be because: (i) most of the projects used a project financing method (off-balance sheet, non-recourse or limited recourse financing) which is riskier and more expensive (e.g., high interest rates and debt proportion, and short term repayment period unmatched to the plant life) than corporate balance sheet financing (see Clifford Chance, n.d.); (ii) a lack of experience in project financing in the Philippines electricity sector might have taken even more preparation, transaction, adjustment and administrative costs; and (iii) the project cost data obtained may not include cost overruns. After the crisis, the above situations were improved. The prices and costs of post-crisis IPP project plants in the Philippines, are, on average, 12% lower than those of the initial IPP projects (World Bank, 1994a).

Table 2

[8] An interest rate on project cost is assumed to be 12% in the IPP scenario and 7% in the NPC scenario. From 1999, an interest rate of the IPP scenario at 9.5% is assumed to reflect increased competition and better negotiation of NPC for IPP contracts.

Capital costs for IPP and NPC projects

Items	Sources and Details
IPP project costs	IPP project cost estimates were based on the published and unpublished data from the Philippines National Oil Company's Energy Development Corporation (PNOC-EDC) (1998), Energy Regulatory Board (ERB) and World Bank reports, for data of a total of 34 IPP projects for 1990-2001. For those IPP projects for which cost data were unavailable, we used the average cost of similar types of plants constructed elsewhere.
NPC project costs	To supplement the very few available data from NPC annual reports and development plans and in making future projections, we took data from a Financial Times (FT) publication (Daniel, 1997). As many plants in the Philippines are constructed by international constructors, the use of such data was assumed to be appropriate in this study.

5.3 Fuel cost

Thirdly, we looked at the fuel cost as part of the examination of changes in investment cost. Power purchase agreements (PPAs) between NPC and IPPs require NPC to supply expensive diesel oil and less expensive bunker C oil to IPPs, regardless of the fluctuations of oil prices and exchange rates and their contribution to higher air pollution, which lead to distortion of the least cost dispatch. Based on an available data from NPC, the oil costs per KWh of land based and barge gas turbines are about 1.97 and 2.29 times higher than those of other oil based plants on average during 1993-1999 respectively. The cost of coal was calculated from data obtained from Asian Development Bank (ADB), which is an economic cost, viz., cost, insurance and freight (CIF) price only at $34.2/metric ton in 1995, adjusted by relative movements in World Bank commodity price projections until 2022, and from 2022 to 2034 which is the year of termination of the last plants concerned, at a constant 2022 price (ADB, 1995, p.41).

5.4 Avoided cost

The main benefit of partial restructuring of the generation sector is that IPPs solved the power crisis one year quicker than NPC alone could have done, due to financial and institutional constraints on NPC. This one year generation gap between the IPP and NPC scenarios is an economic cost to the society arising from power shortages, which would have delayed economic recovery and growth, and development one year further. This benefit is referred to as avoided cost, i.e., the cost to consumers in the absence of an adequate service, assuming that NPC would have been unable to complete similar projects during the shortage period. The avoided cost was derived from the World Bank estimation (in1994 prices: US$0. 43/KWh of lost output for 1991-1993 and US$0.28/KWh for 1994 onward) (World Bank, 1994a). This is derived from NPC's estimate of US$0.50/KWh in 1994 prices for the gross economic cost of outages that the NPC uses in its planning process. While further information and data on how the NPC and the World Bank arrived at these costs are not available, these estimates are quite conservative compared to other estimates for the Philippines and other countries (for review, e.g., Toba, 2002; Willis and Garrod, 1997). According to the World Bank, this was lower than the estimated outage cost in other developing countries, but it was consistent with the conditions predominant in the NPC's power system. This is because after a long period of unreliable service, consumers tended to be better prepared for outages and a large number of consumers have purchased a total of 1600 MW of generating sets as backup units during the crisis, thus reducing its impact. On average, this avoided cost was 6.8 times the NPC wholesale tariff and 4.0 times the retail tariff (Meralco's tariff) during 1990-1993 in real terms.[9]

From 1994 onwards, a normal situation after the end of crisis, on average, this avoided cost is 4.6 times the NPC wholesale tariff and 2.7 times the retail tariff (Meralco's tariff) during 1994-1997 in real terms. This is the cost of best alternative energy supply of NPC instead of more expensive electricity supply from IPPs, estimated as the cost of alternative NPC projects implemented under a turn-key modality for construction and operation (World Bank, 1994a, p.44). The power shortage in a normal situation would not have affected the society and economy so severely as minor brown and black outs occur in the Philippines even during the normal situation and people are get used to them. From 1998 onwards, enough capacity and NPC's capability to complete their projects on time were assumed so that there was no avoided cost.

5.5 Externality cost

[9] NPC tariffs are taken from NPC annual reports and retail tariffs are taken from Meralco annual reports.

Concurrently, there are externalities arising from plant and fuel use and investment. In order to be consistent within the context of social cost benefit analysis differences in the environmental impact between the NPC and IPP scenarios need to be evaluated. This is especially important because the introduction of IPPs had negative environmental impacts. Most obvious are the air pollution effects. Two different sets of air pollution data were used. Pollution Data 1 (CO_2, Particulates, SO_2 and NOx) estimate air pollution costs of different types of plants per KWh in the Philippines, which were estimated by Logarta (1994) at 1993 cost levels. Pollution Data 2, which were obtained from ADB, consist of CO_2 and NOx emission costs and have been used to estimate emission costs of diesel fuel, bunker fuel and coal plants in this analysis. Pollution Data 2 provide average annual global climate change damages from carbon emissions as 1992 US$/ton of carbon emissions (ADB, 1996, app. H, pp.224-225). The NOx impacts (Premature respiratory 70%, Adult chronic morbidity 10%, Material soiling 10%, Acute morbidity 5%, and Visibility reduction 5%) were reported as their indirect effects because NOx emissions can contribute to impacts caused by ozone and fine particulates, which are formed by the release and transformation of NOx emissions. Pollution Data 2 are chosen for the base analysis as they provide more information, and sensitivity analyses are performed using the other data set.

5.6 Privatization and subsidization cost

There are very limited data on the cost of privatization of NPC triggered by the introduction of IPPs. However, privatization and subsidization cost was documented in the income statements of NPC annual reports from 1996. This cost includes accelerated retirement benefits such as gratuity pay, terminal and accrued leaves, etc. and the expenses incurred by the Privatization and Restructuring External Office of NPC. This data was available until 1999. As projecting this cost is highly speculative, from 2000, an average cost of the available years was used for the projection ending in 2003.

5.7 Consumer surplus

Detailed unpublished electricity price data were obtained from NPC, Energy Regulatory Board (ERB), Meralco, World Bank and ADB to calculate consumer surplus. In 1995 automatic tariff adjustments on fuel and exchange rate fluctuations were implemented. Since1996, ERB allowed NPC and the distribution sector to make a partial adjustment to their prices to reflect the fluctuation of power purchase costs. Until these automatic tariff adjustments were introduced in 1995, the NPC scenario is assumed to have the same tariff as in the IPP scenario. From 1995, the counterfactual scenario's retail electricity prices were based on estimates of NPC's operating costs and the rates of return on assets that were obtained from its annual reports. Up to 1999 for which data were available, the actual rate of return was applied and from 2000 a rate of return of 8% on asset base (the percentage required in compliance with the World Bank and ADBs' loan covenant) was used.

5.8 Government benefits

Government benefits are represented by transfers to the Government. As a government owned corporation, NPC's net income was assumed to be a transfer to the Government. Under the NPC scenario, transfers were measured using an actual net income return on rate base obtained from NPC's annual reports. Where actual rates were not available, it was assumed a return of 3% would be earned on the rate base, following trends of the past data. Under the IPP scenario, an estimated corporate tax from IPPs was added in addition to an estimated NPC net income presented in its annual reports. Earlier IPPs had income tax holidays for the first 7 years of operation and thus it was assumed that IPPs would pay an income tax accordingly. It was assumed that from 2005, all IPPs would pay the tax.

5.9 Private benefits

Deriving from equation (2) in Section 4 on the SCBA Methodology, private (IPP) net benefits are the residual after subtracting the discounted consumer net benefits and government net benefits from total net benefits (ΔW) excluding externalities. Private profits are further allocated between foreign and domestic investors, assuming 75% of the profit goes to foreign investors and 25% to domestic investors, as most of the IPP projects are financed from foreign sources.

5.10 Employee benefits

Since 1996, NPC has been downsizing its workforce in preparation for privatization through the Special Disengagement Plan. NPC estimates that the proportion of casual workers with a college degree or vocational training is about 90%, and that they are likely to be able to find alternative employment. No data are available on IPP employees. Since the BOT Law of 1994 requires hiring of Philippines nationals where Philippines skills are available, any difference in the number of Philippines employees in the generation sector between the NPC and IPP scenarios would be insignificant. For these reasons, there was assumed to be no gain or loss for employees between the two scenarios.

6. Scenarios

In undertaking the analyses, we made a number of different assumptions. Here, we present the three most plausible cases, viz., Central case (our preference), Pro-IPP case, and Pro-NPC case. Further, electricity retail prices are assumed to equalize at two dates, i.e., 2010 and 2020 for each case.

Central case

Restructuring and private sector participation (R&P) had effects which it is instructive to keep separate. The direct impact was that IPPs contributed to the resolution of the Power Crisis. Based on the available information we assume that the private sector's efficiency and speedy fundraising process were effective in ending the crisis one year earlier than the NPC.

The second effect was on the efficiency with which plants and fuels were used to generate electricity. We assume that there would be differences in efficiency improvement between the NPC and IPP scenarios, as described in Table 3 and Figures 1-3 below. The plants operated by NPC were assumed to become more efficient due to the additional competitive pressures on NPC from the presence of IPPs, the influence from IPPs' efficient operation, the technology transfer from IPPs to NPC, and the privatization of NPC being scheduled (Government of the Philippines, 2001).

The third effect was that R&P prevented least cost generation and fuel mix. This is due to the power purchase agreements (PPAs) between NPC and IPPs, most of whose plants were expensive to operate such as gas turbine and diesel plants. Further, high margins were allowed to cover capital recovery costs incurred by IPPs. The patterns of generation dispatch, fuel use and investment were thus altered, generally increasing the costs of generating electricity. Also, presuming that there would be no more Government guarantees for later projects, it is assumed that the private sector would construct coal plants that would have cheaper capital cost, instead of hydro and geothermal plants which would have lower operation and air pollution costs. The final component of total effect is the impact of R&P on the environment – changes in fuel and plant type had a direct result in increasing emissions influencing climate change and human welfare.

Pro-IPP case

The only differences between the Central case and this Pro-IPP case are the assumptions of lower controllable cost and altered plant mix in the IPP scenario. The mix is assumed to be environmentally less damaging and less threatening to the country's energy security and foreign exchange exposure by making greater use of indigenous natural resources, reducing the Philippines' heavy dependency on oil imports. This is due to the assumptions of a highly effective regulatory regime to protect investors, competitive pressures from non-NPC's IPPs, more technology transfer from IPPs and development of financial systems making it easy to obtain a large capital with long term financial instruments, which is needed for more environmental friendly electricity generation such as hydro, geothermal or other new and renewable energies. Other assumptions remain the same as in the Central case.

Pro-NPC case

The Pro-NPC case assumes that the NPC scenario would have a lower controllable cost than in the other cases, and the same construction years and same commissioning year of rehabilitated and new plants as in the IPP scenario. Other assumptions remain the same as in the Central case. Detailed assumptions for each case are presented in

Table 3, followed by the differences in controllable cost between the NPC and IPP scenarios in the three cases presented in Figures 1-3.

Table 3
Assumptions for the three base cases

Shared Assumptions Annual electricity sales growth rate: 1999-2010 8.2%; 2010-2020 5%; 2020-2030 3%; 2030- 1%. Controllable cost in 1994: NPC new plant 14.5% higher than IPPs.
Central case: assumptions NPC scenario: 1995-2010, rehabilitated and new plants' controllable cost decreases by 1% p.a. due to efficiency improvement until 1997 and thereafter both efficiency improvement and fuel mix change away from oil to more hydro and geothermal instead of coal. 1998-2010, NPC's existing plants' controllable cost decreases by 0.5% p.a. One year delay in commissioning rehabilitated and new plants until 1999. IPP scenario: 1998-2010, rehabilitated and new plants' controllable cost decreases by 1% p.a. due to efficiency improvement and fuel mix change away from oil to coal. 1998-2010, NPC's existing plants' controllable cost decreases by 1% p.a. *Pro-IPP case: assumptions* Same as in the Central case, except in IPP scenario, 1998-2010, rehabilitated and new plants' controllable cost decreases by 1.5% p.a. due to efficiency improvement and fuel mix change away from oil to hydro and geothermal instead of coal. *Pro-NPC case: assumptions* NPC scenario: 1995-1997, rehabilitated and new plants' controllable cost decreases by 1% due to efficiency improvement and 1998-2010 by 1.5% p.a. due to efficiency improvement and fuel mix change away from oil to more hydro and geothermal instead of coal. No delay in commissioning rehabilitated and new plants. Both scenarios: 1998-2010, NPC's existing plants' controllable cost decreases by 0.5% p.a. Other assumptions remain the same as in the Central case.

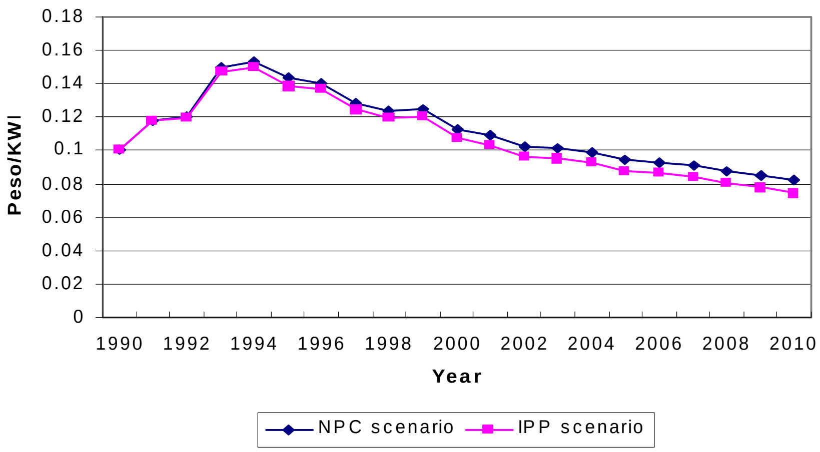

Fig. 1. Central case controllable cost (1988 prices)

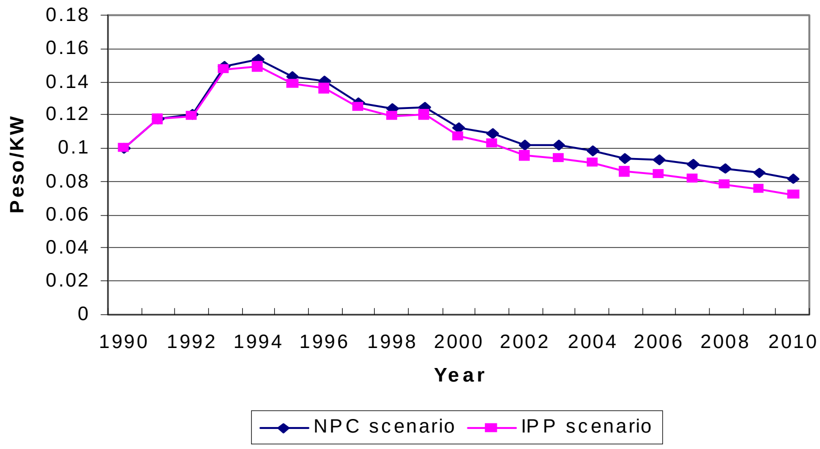

Fig. 2. Pro-IPP case controllable cost (1988 prices)

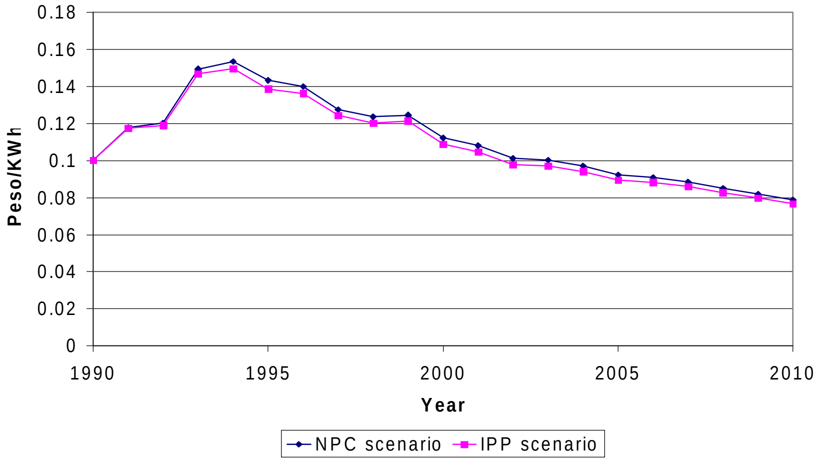

Fig. 3. Pro-NPC case controllable cost (1988 prices)

Each analysis used two public discount rates, viz., 15%, which is the normal real discount rate used for selecting public investments in the Philippines (World Bank, 1994b, Annex 21, p.1), and following Newbery and Pollitt (1997),10% for sensitivity analysis. All analyses were conducted in the 1988 peso prices and the base year of NPV is 2000. All the results were thus in 1988 peso prices but were converted to 1999 peso prices, and then 1999 US$ using nominal exchange rate (exchange rate US$1=P38.346 in 1999). All the analyses were undertaken once more using the Purchasing Power Parity (PPP) exchange rate (PPP exchange rate at US$1=9.96 in 1998) in converting the data whose original values were in US dollars as a sensitivity analysis.[10] Here, all the results are presented in US$ 1999 prices unless otherwise noted.

7. The Results

7.1 Total net benefits

The net impacts of R&P come from five sources – the investment including capital cost and fuel costs, the environmental cost, the efficiency gains in terms of reduced controllable cost and changes in plant use and mix, the avoided cost in quickly ending the Power Crisis, and the privatization and subsidization cost. These are separately quantified in Table 4.

The major sources of the net benefit of R&P were the avoided cost during the Power Crisis and the improvement in operating efficiency. The net benefit was equivalent to an NPV of US$10.4 billion in the Central case and an NPV of US$11.8 billion in the Pro-IPP case. These results may be compared with NPC's debts in 2001 of US$10 billion (2001 prices), 1999 net operating revenue of US$2.3 billion and net income of US$-155 million (1999 prices). The air pollution costs are significant. In the Pro-NPC case, the net benefit becomes negative however. This is an unlikely outcome because in practice NPC alone would not have been able to meet the required power demands. As is clearly noted in an official report (PNOC-EDC, 1998, p.7), the introduction of IPPs and Government assumptions of all risks were rational responses to the Power Crisis and the Government guarantees were justified against NPC's cost planning methodology and traditional financing options -- NPC estimated this as the least cost solution of the crisis. Actually, our assumption of one year delay of NPC's completion of new and rehabilitated plants were proved by the fact that over the past several years only minor generating plants were constructed by NPC and that NPC alone had no financial provision for constructing new plants and rehabilitation of

[10] Although no other country study comparable with our study exists so far to use our PPP exchange results, differences in the rate fluctuations between the official and PPP exchange rates could change the negative to positive results between the different exchange rates. Actually, both exchange rates did not follow the same trends in the Philippines during the 1990s. The official exchange rates fluctuated especially during the power crisis and at the Asian financial crisis of 1997, although in general, both exchange rates followed a positive linear path. Also, using both exchange rates might indicate the relative magnitude of different results.

deteriorated plants by NPC around the time of power crisis. IPPs proved that the private sector could mobilize funding faster than the government sector.

Table 4
Net Benefit of IPP participation (decimal points rounded)

In US$ billion (1999 prices) Discount rate 15%	Central	Pro-IPP	Pro-NPC
Investment cost			
Capital	-2.0	-2.2	-0.7
Oil	-0.6	-0.6	-0.7
Coal	-0.1		-0.1
Total investment cost savings	-2.6	-2.7	-1.5
Externality benefits			
Total pollution cost from Oil	-0.3	-0.3	-0.3
CO2 (climate change)	-0.2	-0.2	-0.2
NOx (human welfare)	-0.1	-0.1	-0.1
Total pollution cost from Coal	-1.5		-1.5
CO2 (climate change)	-1.1		-1.1
NOx (human welfare)	-0.3		-0.3
Total externality benefits	-1.7	-0.3	-1.7
Restructuring			
Controllable cost	0.4	0.5	0.2
Avoided cost	14.5	14.5	
Privatization & subsidization cost	-0.1	-0.1	-0.1
Total restructuring benefits	14.7	14.8	0.1
Total net benefits			
Excluding externalities and avoided cost	-2.3	-2.4	-1.4
Including externalities and avoided cost	10.4	11.8	-3.1

The contribution of avoided cost of US$14.5 billion in the Central and Pro-IPP case was very large. In our estimation of the Philippines, the ratio of avoided cost per capita to GDP per capita is about 19%, based on the 1999 data (World Bank, 2002a) of US$76.2 billion GDP (1999 prices) and 74.2 millions total population. The ratio of annual average avoided cost per capita to GDP per capita during 1991-1998 when the avoided costs were assumed and calculated, was 2.3% based on the 1999 data. However, this avoided cost may still a conservative measure, as according to Henisz and Zelner (2001), the loss due to the Power Crisis was estimated at US$20 billion by Private Finance International in 2000. This was not an avoided cost, but was a loss even with IPPs' additional generation. ADB (1998) reported that the Power Crisis was one of the main reasons for the decline in the country's GDP growth rate and that with the stabilization of the power situation the GDP growth rate increased.

7.2 The distributional impact

The resulting distributional impact from the net benefit exduding externalities on social welfare is shown in Table 5.

Table 5
Distributional benefit (decimal points rounded)

In US$ billion (1999 prices) Discount rate 15%	Central	Pro-IPP	Pro-NPC
Net benefit (excl. externalities)	12.1	12.1	-1.4
Case 1 prices converge in 2010			
Consumers	10.8	10.8	-3.7
Consumers Surplus	-3.7	-3.7	-3.7
Avoided cost	14.5	14.5	
Government	-1.5	-1.5	-1.1
After tax profit, of which:	2.8	2.8	3.4
Foreign 75%	2.1	2.1	2.6
Domestic 25%	0.7	0.7	0.9
Global Social welfare	12.1	12.1	-1.4
Domestic social welfare	10.0	10.0	-3.9
Case 2 prices converge in 2020			
Consumers	9.2	9.2	-5.2
Consumers Surplus	-5.2	-5.2	-5.2
Avoided cost	14.5	14.5	
Government	-1.5	-1.5	-1.1
After tax profits, of which:	4.4	4.4	5.0
Foreign 75%	3.3	3.3	3.7
Domestic 25%	1.1	1.1	1.2
Global social welfare	12.1	12.1	-1.4
Domestic social welfare	8.8	8.8	-5.1

Our results show that except in the Pro-NPC case, consumers most benefit, largely due to the avoided cost. We note that an inclusion of the avoided cost captures some general equilibrium effects. Foreign and domestic investors also benefit, with 75% of this benefit accruing to the foreign investors. While the Government is a loser, with possibilities of divestiture in the future and increased corporate income tax collection from IPPs, Government could gain more. The case 2 prices converge in 2020 is less favourable to consumers and more favourable to private investors than the case 1 prices converge in 2010, resulting in a decreased domestic social welfare. Our preferred assumptions are for the Central case with prices converging in 2010. This is because we anticipate that the Government would take appropriate measures such as a lifeline rate[11] to protect vulnerable consumers from higher tariff and because not defaulting on the even more expensive PPAs due to the Asian crisis of 1997 may have strengthened the credibility of the Philippines institutional frameworks, increasing investors' confidence in the Philippines investment environment that would attract more investors and thus promote cheaper, more competitive, and increased investment flows, supporting the further electricity sector reform and eventual benefits to the economy and welfare of the Philippines society. The resultant gain in global social welfare was equivalent to an NPV of US$12.1 billion and in domestic social welfare to an NPV of US$10 billion.

7.3 Sensitivity analyses

We have experimented with numerous sensitivity analyses for each of the three cases presented in Tables 4 and 5. Further variations of the Central case are presented in Tables 6 - 8. Tables 6 shows the sensitivity analysis of the net benefit.

The left hand side of the first panel shows the base case, with 15% public discount rate and using Pollution Data 2, as discussed above. From the second column to the fourth column, all the assumptions remain the same as in the base case except a few changes as follows. In the second column of the panel, a 10% discount rate was used. In the third columns, Pollution Data 1 were used. In the fourth column, we used Purchasing Power Parity (PPP) exchange rate in converting the data originally denominated in US dollars during the analyses, but when converting the final results from original peso result to US dollars, we used the nominal exchange rate.

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[11] Lifeline rate is a subsidized electricity price for lower income consumers for a certain block of electricity consumption. The Republic Act 9136 section 73 (Electric Power Industry Reforms Act of 2001) states that "a lifeline rate for the marginalized end-users shall be set by the Energy Regulatory Commission, which shall be exempted from the cross subsidy phase-out under this Act for a period of ten years, unless extended by law" (Government of the Philippines, 2001).

Change in discount rate to 10% from 15% makes noticeable differences in net benefits. Also, the use of different pollution data makes differences in externalities depending on valuation methods and coverage of impacts included. The use of PPP exchange rates makes significant differences in the outcomes, which could be very important for developing countries with a significant share of informal economy against formal economy such as the Philippines. To be conservative, we would still prefer the base case, because (i) the 15% discount rate is officially used by the Philippine government, (ii) the pollution data source 2 has more information on the data backgrounds and (iii) it is difficult to estimate accurate Purchasing Power Parity exchange rates with a reasonable confidence.

Table 6

Net Benefit of IPP participation Central case Sensitivity analyses (decimal points rounded)

In US$ billion (1999 prices)	1 (base) 15% d. r., pol. 2	2 10% dis. rate	3 Pol. 1	4 PPPex.
Investment cost				
Capital	-2.0	-1.1	-2.0	-0.6
Oil	-0.6	-0.6	-0.6	-0.6
Coal	-0.1	-0.2	-0.1	0.0
Total investment cost savings	-2.6	-1.8	-2.6	-1.2
Externality benefits				
Total cost from Oil	-0.3	-0.2	-0.3	-0.1
CO_2	-0.2	-0.2	-0.1	0.0
NOx	-0.1	-0.1	-0.1	0.0
Particulates			0.0	
SO_2			-0.1	
Total cost from Coal	-1.5	-2.8	-0.1	-0.4
CO_2	-1.1	-2.1	0.0	-0.3
NOx	-0.3	-0.6	-0.1	-0.1
Particulates			0.0	
SO_2			0.0	
Total externality benefits	-1.7	-3.0	-0.4	-0.4
Restructuring				
Controllable cost	0.4	0.6	0.4	0.3
Avoided cost	14.5	11.2	14.5	0.9
Privatization & subsidization cost	-0.1	-0.1	-0.1	-0.1
Total restructuring benefits	14.7	11.8	14.7	1.1
Total net benefits				
excl. externalities and avoided cost	-2.3	-1.3	-2.3	-0.9
incl. externalities and avoided cost	10.4	6.9	11.7	-0.5

The sensitivity analysis of the distributional benefit in Table 7 follows the same variations as above, except that there is no column on pollution data variation, as externalities are not included in the distributional benefit analysis. The overall comments are generally the same above and we still prefer the base case.

Table 7
Distributional Benefit Central Case Sensitivity Analysis (decimal points rounded)

In US$ billion (1999 prices)	Base case 15% discount rate	10% discount rate	PPP exchange
Net benefit (excl. extern.)	12.1	9.9	-0.1
Case 1 prices converge in 2010			
Consumers	10.8	7.6	-2.8
Consumers Surplus	-3.7	-3.7	-3.7
Avoided cost	14.5	11.2	0.9
Government	-1.5	-0.1	-1.5
After tax profit, of which:	2.8	2.5	4.2
Foreign 75%	2.1	1.9	3.2
Domestic 25%	0.7	0.6	1.1
Global social welfare	12.1	9.9	-0.1
Domestic social welfare	10.0	8.1	-3.2
Case 2 prices converge in 2020			
Consumers	9.2	5.3	-4.3
Consumers Surplus	-5.2	-5.9	-5.2
Avoided cost	14.5	11.2	0.9
Government	-1.5	-0.1	-1.5
After tax profit, of which:	4.4	4.8	5.8
Foreign 75%	3.3	3.6	4.3
Domestic 25%	1.1	1.2	1.4
Global social welfare	12.1	9.9	-0.1
Domestic social welfare	8.8	6.4	-4.4

The sensitivity analysis applying different social weights to the distributional benefit is presented in Table 8. The social weights set 1 (NP) was estimated based on the UK (Newbery and Pollitt, 1997), a developed economy, which was derived from a study by Newbery (1995). In the study, social weights of Hungary, a less developed and former communist economy, were also estimated and the estimates were not significantly different from those of the UK in the study. This suggests that the social weights of the Philippines also might not considerably differ from those of UK but this might still need verification. The social weights set 2 (B) was estimated based on the Philippines, but the original data was published in 1976 (Bruce, 1976, cited in Jones, et al., 1990), with our adjustments using the recent available data. Although the current Philippine economy has developed since 1976, we assume that the basic economic and social structure of the Philippines has not changed significantly, which is dominated by a small elite and has a large gap between the rich and poor. Thus, social weights set 2 could be still applicable to this analysis.

Table 8
Central case Distributional Benefits with social weights (decimal points rounded)

In US$ billions (1999 prices) Discount rate 15%	No social weights	Social weights 1 (NP)		Social weights 2 (B)	
Net benefit (excl. externalities)	12.1		12.1		12.1
Case 1 prices converge in 2010					
Consumers	10.8	0.975	10.5	0.33	3.6
Consumers Surplus	-3.7	0.975	-3.6	0.33	-1.2
Avoided cost	14.5	0.975	14.1	0.33	4.8
Government	-1.5	1	-1.5	1	-1.5
After tax profit, of which:	2.8	0.5	1.4	0.65	1.8
Foreign 75%	2.1	0.5	1.1	0.65	1.4
Domestic 25%	0.7	0.5	0.4	0.65	0.5
Global Social welfare	12.1		10.4		3.9
Domestic social welfare	10.0		9.4		2.5
Case 2 prices converge in 2020					
Consumers	9.2	0.975	9.0	0.33	3.1
Consumers Surplus	-5.2	0.975	-5.1	0.33	-1.7
Avoided cost	14.5	0.975	14.1	0.33	4.8
Government	-1.5	1	-1.5	1	-1.5
After tax profits, of which:	4.4	0.5	2.2	0.65	2.8
Foreign 75%	3.3	0.5	1.6	0.65	2.1
Domestic 25%	1.1	0.5	0.5	0.65	0.7
Global social welfare	12.1		9.7		4.4
Domestic social welfare	8.8		8.0		2.3

The social weights set 1 regards the values of public money and input as the same as the printed value of currency by weighting as 1; the value of money to consumer as consisting of half consumption (its weight as 0.95) and half inputs to production (its weight as 1) by weighting as 0.975; and the value of private investors' money as half the printed value of currency by weighting as 0.5 assuming private investors are wealthier. On the other hand, social weights set 2 was estimated in a much broader and extended scope. This considers multiplier effects of public and private investments into the Philippine economy, by putting more weight on public (its weight as 3) and private investors' (its weight as 1.94) money than the printed value of currency. The money of the consumers is valued as the same as the printed value of currency. A questionable issue in determining social weights set 2 is whether private investors' money, especially that of global investors, would be reinvested into the Philippine economy. If, for example, global investors reinvest into the US, the social weight could have a different value.

To compare the results from different sets of social weights, we need to choose the same numeraire among them. Since we evaluate welfare impacts from the point of view of the Government as policy decision maker, we chose the Government as numeraire. Accordingly, social weights set 2 was adjusted (i.e., changed the social weights of Government to 1, consumers to 0.33 and private investors to 0.65) . The results show the significantly different results depending on the sources of social weights with different assumptions. Compared to the results without social weights, the use of social weights set 1 makes social welfare lower and the private benefit is reduced by half. In contrast, the use of social weights set 2 significantly reduces social welfare compared to the unweighted results -- consumers' benefit is reduced to one third, and private benefit decreases to about two third. It should be noted however, if we choose consumers as numeraire, compared to the unweighted results, global social welfare with the use of social weights set 2 does not change so significantly, being reduced by a small amount to become US$11.8 billion and domestic social welfare decreases to US$7.6 billion (for example, in the Case 1 prices converge in 2010) -- Government loses three times more and private investors gain about a little less than two times. Due to the uncertainties in estimating values of the social weights above, we still prefer the conservative results without social weights.

These tables illustrate that the choice of discount rate, the choice and use of exchange rates, the choice of emission values and the choice of social weights can change the estimated benefit and cost dramatically. This alerts us to the need to be careful in making assumptions and choosing data and in interpreting the results. Choice of which of the results to be preferred seems to depend on the assumptions, scope, coverage and time span of the social welfare impacts that the decision maker has in mind.

8. Conclusions

We have estimated the cost and benefit from the introduction of IPPs in the Philippines, making various assumptions about what might have happened had IPPs not been introduced in the generation sector and what might happen in the future. We found that the main gains came from two sources. One is the avoided cost during the Power Crisis, which promoted economic growth and social development and may have even saved lives by restoring vital social services such as water and sanitation. The other is the efficiency gains in generation, arising from the additional competitive pressures on NPC from the presence of IPPs, the IPPs' efficient operation and technology transfer to NPC, and the privatization of NPC under preparation (Government of the Philippines, 2001). Only about one quarter of the total private investors' gain is transferred to the domestic investors, as most of the investors are assumed to be foreigners. Further sensitivity analyses indicate the need for some caution in choosing data and making assumptions.

We conclude that the Philippines' partial electricity sector reform through IPPs was a good option available considering all the circumstances at that time such as the Power Crisis and the limitation of institutional backgrounds, including the regulatory capabilities and the financial system. This fact is proved by our social-cost benefit analysis which indicates that consumers were large net gainers. Our analysis, of course, does not imply that introduction of IPPs is the only solution to power shortages in developing countries. It may well have been the case that freeing up NPC from financial constraints, without IPPs, would have been equally successful. As with all real world analyses of the impact of liberalisation it is impossible to distinguish between impacts of the various elements of a reform when the elements are introduced simultaneously. However we can still use social cost benefit analysis to suggest that the reform package as compared with a business-as-usual scenario was successful.

Can electricity sector reform and private sector participation/ownership increase social welfare? Based on our analyses of the Philippines electricity generation sector, our answer would be affirmative. We believe that this could be true in other economies, especially in those experiencing a large capacity shortage, because private enterprises could mobilize funding and could deliver faster, and could be more efficient than government owned enterprises. As many as 2.5 billion people in the world are estimated to still remain without access to modern energy supplies (World Bank, 2002b). This could mean that a significant capacity shortage in the world continues and private enterprises could contribute to filling the gap of unmet demand for electricity and thereby prompting the global economic and social development and welfare.

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