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Donor Policies, Industry Structure, and the Global Allocation of Electrification Aid, 1970-2001*

William J. Hausman
College of William and Mary

John L. Neufeld
University of North Carolina, Greensboro

Till Schreiber
College of William and Mary

College of William and Mary
Department of Economics
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Contact information: William J. Hausman, Department of Economics,College of William & Mary, Williamsburg, VA 23188 USA. E-mail: wjhaus@wm.edu.

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Abstract

Access to electricity is widely recognized as an essential element of economic development. This paper uses a comprehensive dataset on electrification aid projects to quantify and model the determinants of multilateral and bilateral electrification aid in the last three decades of the 20th century. Total annual electrification aid fluctuated substantially over the period. While multilateral and bilateral donors were relatively concentrated, aid recipients were widely dispersed. Our major finding is that electrification aid by the 1990s had moved marginally toward poorer countries, except for those in Africa, and toward countries with better governance structures and ones that had restructured their electric power sector. This likely reflected the liberalization and privatization policies affecting the industry from the mid-1980s on.

JEL Codes: L94, N70, N80, O13

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William J. Hausman
Department of Economics
College of William and Mary
Williamsburg, VA 23187-8795
wjhaus@wm.edu

John L. Neufeld
Department of Economics
University of North Carolina, Greensboro
Greensboro, NC 27412
john_neufeld@uncg.edu

Till Schreiber
Department of Economics
College of William and Mary
Williamsburg, VA 23187-8795
txschr@wm.edu

Introduction

The most salient economic characteristic of the electric utility industry has been its extraordinary capital intensity. This means that attracting outside financing has been essential; new projects, or expansion of existing systems, could not be financed from retained earnings. From the earliest days of the industry in the 1880s to contemporary times, the necessity of raising an adequate supply of new capital has been a central concern and constant necessity for all electric utilities. This has been especially difficult in areas of the world that are relatively poor and under served.[1] From the 1880s to the 1930s multinational enterprises, initially led by the major electrical equipment manufacturers (particularly the large U.S. and German firms such as General Electric, Westinghouse, Siemens, and Allgemeine Elektrizitäts Gesellschaft), then followed by electric utility holding companies and a wide variety of other intermediaries, raised a substantial amount of capital to invest in electric utilities in the developing and less developed areas of the world, including colonial dependencies. These were areas where domestic capital simply was inadequate to finance electric utilities, even in the largest cities. Multinational enterprises and international finance played a crucial role in expanding access to electric power in urban areas around the world in the late nineteenth and early twentieth centuries. But these sources of capital were not sustained through the political and economic difficulties of the middle decades of the twentieth century.[2]

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[1] The International Energy Agency estimates that the world will need to add about 4,530 gigawatts of capacity by 2030, representing cumulative investments of $13.6 trillion. A majority of these investments will be in developing countries. International Energy Agency, *World Energy Outlook 2008,* p. 139.

[2] For elaboration, see Hausman, Hertner, and Wilkins, *Global Electrification*, pp. 190-261.

The Great Depression of the 1930s and World War II, among their other effects, seriously disrupted the flow of international capital to the electric utility industry, which nevertheless retained a voracious appetite for finance. Furthermore, by the late 1940s electricity was widely recognized as a necessity of modern life rather than a luxury, and foreign ownership of such an essential service frequently was viewed skeptically by political decision makers. Tensions among owners, especially foreign owners, customers, workers, and governments, at the local, regional, and national levels, grew worse over time. Although there were exceptions in a few countries, new *foreign* capital stopped flowing to the industry, and existing foreign capital either was voluntarily withdrawn (through domestic purchases or government buy-outs) or confiscated (through nationalizations). Almost all electric utilities in every part of the world by the mid-1970s had become "domestic" firms; that is, they became owned by domestic investors or by governments.[3]

But even as electric utilities became almost entirely domestic in the post-World War II era, the need for a constant supply of additional capital did not abate. Infrastructure had to be rebuilt in the aftermath of the war, and attracting capital remained an especially serious problem in less developed and developing countries, including what became former colonies. Several institutions (the World Bank, most prominently) were created in the aftermath of the war to begin dealing with this problem. These were multilateral organizations, with the more developed countries, particularly the United States, contributing (or using their credit to guarantee) the bulk of capital made available. Over time, other multilateral development agencies were created. In addition, after the recovery from World War II, governments in developed countries began contributing to

[3] Hausman, Hertner, and Wilkins, *Global Electrification*, pp. 31-33, 233-61.

electrical infrastructure investment by providing a substantial amount of bilateral aid. Sometimes this aid was related to Cold War policies.[4]

Just as large domestic, often government-owned, electric utilities in developing and less developed countries became the norm, the political winds shifted again. Beginning in the 1980s and accelerating in the 1990s, a privatization, liberalization, and restructuring movement, part of the so-called "Washington Consensus," gained world-wide momentum.[5] Private foreign capital was once again welcomed, and private multinational enterprise investment in the electric utility sector revived.[6] Many of the multilateral aid agencies created in the post-World War II era welcomed and fostered this development since it offered new and potentially productive outlets for their lending.[7] But the privatization, liberalization, and restructuring movement turned out not to be a panacea after all. According to a 2003 World Bank working paper, "The optimism of the mid-1990s has now been replaced by widespread pessimism. Annual investment flows to private infrastructure projects in developing countries are down,"[8] and the first years of the twenty-first century, according to a 2006 World Bank publication, have come to be viewed as "a period of disappointment with private sector participation in infrastructure in the developing world." [9]

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[4] Easterly and Pfutze, Where does the money go, p. 31, lists 32 contemporary bilateral aid agencies and 17 multilateral aid agencies.

[5] This frequently has been referred to as a "deregulation" movement. However, in the electric utility sector, there never were intentions to completely deregulate all segments of the industry. At best, only partial deregulation was sought. See MacAvoy, *The Unsustainable Costs*, pp. 24-34. On the "Washington Consensus," see Williamson, Democracy; and Gore, The rise and fall.

[6] Hausman, Hertner, and Wilkins, *Global Electrification*, ch. 7.

[7] Manibog, Dominquez, and Wegner, *Power for Development*, Besant-Jones *Reforming Power Markets*.

[8] Harris, Private Participation, p. 6.

[9] World Bank, *Infrastructure at the Crossroads*.

We focus here on global multilateral and bilateral electrification aid in the last half of the twentieth century, with emphasis on the period from 1970 to 2001, where data are most readily available. We document trends in the level of aid and identify the largest donors and recipients of such aid. Finally, we estimate an econometric model to explain the pattern of electrification aid across countries and time. The data on which this paper is based come from the Project-Level Aid Database (PLAID), an ambitious endeavor "to collect and standardize data on every individual assistance project committed since 1970."[10] Aid projects include grants, mixed loans and grants, loans at discretionary rates from multilateral organizations, loans or loan guarantees at market rates, technical assistance, and sector aid program transfers in cash or in kind. A search of the several hundred thousand observations in the database resulted in the identification of 3,745 electrification aid projects between 1970 and 2001.[11] All figures and tables in this paper are constructed from this database.

Total Electrification Aid

Figure 1 presents the aggregate annual amounts of electrification aid from 1970-2001 in constant (2000) U.S. dollars. The graph reveals the erratic fluctuations of annual aid support from the early 1970s to the late 1990s, and highlights the severe reduction of support, to levels not seen in real terms since the mid-1970s, at the end of the period.

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[10] Hicks, et al., *Greening Aid*, pp. 265-67. PLAID covers approximately 90 percent of development aid projects from 1970-2000. Military aid, private long-term capital, and foreign direct investment are excluded, as is aid from the former Soviet Union. The data rely heavily on the Organization for Economic Cooperation and Development's Creditor Reporting System but uniquely also contains data collected from donor sources. The project has received funding from the Bill & Melinda Gates Foundation and the William and Flora Hewlett Foundation.

[11] We searched for and checked every entry where "elect" appeared in project description fields. If a single project received aid in two periods, it was counted in both of those periods. We assume that any projects we missed using this procedure are randomly distributed.

Some of the decline in aid in those years was made up with private investment, but it is clear that annual bilateral and multilateral electrification aid has been erratic.[12] Still, bilateral and multilateral aid was an important mechanism for funding electrification projects in the post-World War II era, and it certainly will continue to be important in the future.[13] It is worth trying to explain the historical pattern of this aid.

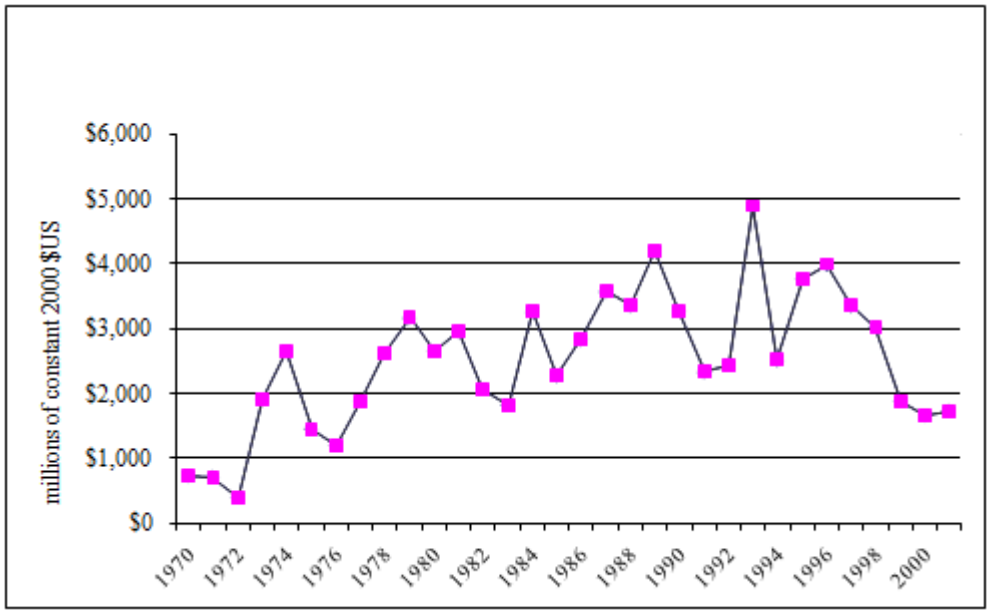

Figure 1. Total Multilateral and Bilateral Electrification Aid, 1970-2001.
Source: Project-level Aid Database.

Multilateral Electrification Aid and the Role of World Bank Policy Shifts

Table 1 lists the largest multilateral aid agencies in order of their cumulative support for identified 1970-2001 electrification projects. Multilateral agency aid was

[12] Power sector private investment in developing countries rose gradually during the 1990s, peaked in 1997 at over $40 billion, and fell off erratically to 2002, at which point it was less than $5 billion. International Energy Agency, *World Energy Investment Outlook*, p. 369.
[13] By way of putting electrification aid in quantitative perspective, the roughly $80 billion of constant dollar aid from 1970-2001 paled in comparison to the total assets of, for example, Électricité de France, the second largest electric power company in the world, which were €242 billion (over $300 billion) at the end of 2009. EDF Group, Management Report, 2009, February 10, 2010.

highly concentrated. The three largest organizations, the World Bank group, the Inter-American Development Bank group, and the Asian Development Bank group, together contributed over 95% of total electrification aid by multilateral organizations. Since it is the largest overall development organization, and one whose policies set trends, a brief look at the history of the World Bank will shed light on trends in infrastructure (particularly electrification) development aid.

Table 1. Multilateral organizations with year founded, and cumulative electrification aid, 1970-2001 (millions of constant 2000 US dollars)

Inter-American Development Bank (IDB) - 1959	$14,780
Int'l Bank for Reconstruction and Development - World Bank (IBRD) - 1945	12,117
International Finance Corp. - World Bank group (IFC) - 1956	2,345
Asian Development Fund - Asian Development Bank group (ADF) - 1974	1,982
International Development Association - World Bank group (IDA) - 1960	1,144
European Investment Bank (EIB) - 1958	633
Asian Development Bank (ADB) - 1966	384
European Bank for Reconstruction and Development (EBRD) - 1990	348
Global Environmental Facility (GEF) - 1990	197
Caribbean Development Bank (CDB) - 1969	67
Multilateral Investment Guaranty Agency- World Bank group (MIGA) - 1988	35
Nordic Investment Bank (NIB) - 1976	27
Nordic Development Fund (NDF) - 1989	21
Inter-American Investment Corporation - IDB group - 1986	19
Multilateral Investment Fund - IDB group - 1993	12
Total	$34,111

Source: Project-Level Aid Database

The World Bank, (officially the International Bank for Reconstruction and Development (IBRD), led the way in providing infrastructure investments in the aftermath of World War II. Articles of Agreement for the Bank and for the International Monetary Fund (IMF) were drawn up in July 1944 at Bretton Woods, New Hampshire.[14] They became effective at the end of December 1945 when 28 governments signed the

[14] James, *International Monetary Cooperation*, pp. 27-57.

Articles in Washington, D.C. According to Alec Cairncross, the main but somewhat delicate task of the Bank was "to stimulate and support foreign investment" but "not to supersede it."[15] It took nearly a year and a half to get the Bank organized, and its first loan was a $250 million ($1.9 billion in 2000 dollars) reconstruction loan to Credit National of France in May 1947. Reconstruction loans to the Netherlands, Denmark, and Luxembourg followed. The first explicit development loans for electrification by the Bank were made in March 1948 to two government-owned Chilean utilities, $13.5 million ($96 million 2000 dollars) to Fomento and $2.5 million ($18 million 2000 dollars) to Endesa.[16]

The primary purposes of the World Bank, as specified in its charter, were to assist in the recovery of devastated European economies and to support the economic development of poorer member countries. The Bank initially focused on the first obligation, but it gradually switched its attention to the second.[17] Bank loans were sovereign obligations: "The IBRD makes loans either to a member country or governmental authorities or enterprises in the territories of member countries. A loan that is not made directly to the member country must be guaranteed by the member country."[18] The Bank's development loans initially were made primarily to middle-income countries, because of their ability to pay, rather than poor countries. To address this situation a second component of the World Bank, the International Development Association (IDA) was created in 1960 to make subsidized loans and grants (interest-free credits) to a group of countries, primarily in Africa and South Asia, with very low per-

[15] Cairncross, *The International Bank*, pp. 5, 27.
[16] World Bank, History.
[17] Alacevich, *The Political Economy of the World Bank*, pp. 2, 11.
[18] World Bank, IBRD Financial Products.

capita GDP. Although the IBRD and IDA still maintain separate accounts, they operate as a single agency with a shared staff and policies. The "World Bank group" gained three other components that are smaller and have greater administrative separation. The International Finance Corporation (IFC), created in 1956, invests in private sector institutions, the Multilateral Investment Guarantee Agency (MIGA), created in 1988, insures private investors against expropriation and other risks in developing countries, and the International Centre for the Settlement of Investment Disputes (ICSID), created in 1966, provides facilities for the settlement and arbitration of international investment disputes between member countries and individual investors.[19] The Bank also developed technical and administrative expertise and devoted significant resources to research on development issues. In addition to its lending functions, the Bank has taken positions, and advised countries, on the relationship between public policies and economic development.[20] The positions and policies of the World Bank have changed, sometimes rather dramatically, over time.

World Bank policy changes toward electrification aid have been driven largely by developments in three areas: 1) changes in knowledge and opinion about how an aid agency can best foster economic development; 2) changes in the willingness of private lenders to provide funds to developing country governments and private companies; and 3) changes in theories about the best institutional structure for public utilities. This last factor has been particularly applicable to Bank support for electric power projects.[21] As the World Bank's *Global Monitoring Report 2007* stated, "All [international financial

[19] Salda, *Historical Dictionary*; Miller-Adams, *The World Bank*; Gilbert and Vines, *The World Bank*.
[20] Gilbert and Vines, *The World Bank*.
[21] Barnett, Aid donor policies.

institutions] are constantly adapting their strategies to respond to new demands and the changing external environment….The World Bank and the regional development banks have devoted considerable attention to clarifying roles and determining priorities."[22]

During its first 25 years, the Bank was primarily engaged in identifying and funding specific projects where the expected economic return exceeded the project's cost. These were projects unable to secure private funds because the project duration was too long or because the risk premium required by private lenders made the interest rate on borrowed funds uneconomically high. These frequently were large infrastructure projects, including hydroelectric and other power infrastructure projects. In this mode, the Bank played a role very similar to a commercial bank operating in an area of capital market imperfections.[23]

Between 1949 and 1982 the World Bank committed a total of $17.8 billion to 413 electric power projects in 86 countries. This represented 17% of its total commitments, exceeded only by the Bank's lending to agriculture (25%) and transportation (18%). Of these commitments, 39% went to Asian countries and 37% to Latin American countries, with the remainder scattered in other countries around the world.[24] The need for this type of aid was perceived to be so obvious by the early 1980s that the Bank did not feel that it had to explain itself: "Since electric power is a universal requirement for economic development, no special explanation is needed for the wide spread of the Bank's power lending."[25] The Bank also was not as prescriptive as it would become later regarding the structure of the industry. In the early 1980s it believed that there were "no generally

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[22] World Bank, *Global Monitoring Report*, p. 187.
[23] Gilbert and Vines, *The World Bank*, pp. 14-15; Barnett, Aid donor policies.
[24] Collier, *Developing Electric Power,* p. 19.
[25] Ibid.

agreed best methods of organizing a country's power sector."[26] The Bank soon would change its view.

The creation of the IDA in 1960 signaled a major shift in Bank policy away from traditional banking toward being more of a development agency. This change in emphasis was accelerated during the presidency of Robert McNamara (1968-1981). McNamara not only envisioned the Bank as a development agency, but also wanted the Bank to focus more specifically on alleviating poverty. The traditional activities of the Bank had become increasingly subject to criticism. One criticism was that the funds provided by the Bank were fungible by the recipient country and in effect were not used for designated projects. Critics also claimed that the Bank's activities actually aggravated income disparities in recipient countries and possibly resulted in an absolute decline of the well-being of the poorest in the population. Finally, there began to be vigorous complaints about some of the effects of the Bank's projects, particularly the Bank was accused of being environmentally insensitive.[27]

The oil shocks and subsequent inflation of the 1970s had a profound effect on Bank policies, as well as on the capital-intensive electric utility industry. The Bank in 1980 began offering structural loans designed to enable countries that had embarked on policy reforms to handle current account deficits. This was part of a movement from support for individual projects to country-oriented lending.[28] During this time, as private sector funds to developing country governments dried up, the Bank became increasingly involved in preventing sovereign default by helping countries restructure their debt by

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[26] Collier, *Developing Electric Power*, p. 12.
[27] Gilbert and Vines, *The World Bank*, pp. 196-209; Nielson and Tierney, Delegation to international organizations; Hoag and Öhman, Turning water into power.
[28] Milobsky and Galambos, The McNamara Bank.

lending the countries money to pay interest. Importantly, these loans generally came with strings attached requiring recipient countries to adopt micro-economic reforms. At this time electricity was being provided in most developing and less developed countries by government-owned monopolies. The power sectors accounted for a large (up to one-third) share of public investment, and they accounted for a significant proportion of public debt. In the 1980s the Bank was providing about 7% of the financing for power investments in developing countries, and it also aided these countries in obtaining additional financing for power projects. The Bank's conditions encouraged countries to adopt marginal-cost pricing, employ least-cost planning techniques, insulate management from political pressures, use competitive international bidding, and adopt international accounting standards, among others. A few countries became ineligible for future financing because of their failure to implement these standards. The Bank, by the end of the 1980s, clearly had joined the side of the advocates of privatization and restructuring of the electric utility sector. As one policy paper stated, "The Bank will aggressively pursue the commercialization and corporatization of, and private sector participation in, developing-country power sectors."[29] While the Bank led the way, these policies were adopted by other multilateral aid organizations. The Inter-American Development Bank (IDB), for example, created a Private Sector Development Program in 1990.[30]

Private international investment, including direct foreign investment, private debt, and portfolio equity investment, soared in the 1990s. A number of middle-income countries, the so-called "emerging markets," benefitted and experienced rapid economic

[29] World Bank, *The World Bank's Role*.
[30] Tussie, *The Inter-American Development Bank*; Inter-American Development Bank, Historical Milestones.

growth.[31] The level of private funds supporting infrastructure projects also grew, reaching 53% of total infrastructure investment in developing countries. Some now began to question whether the capital market failures that justified the Bank's original support for these activities still existed, and the Bank's relative support for all infrastructure projects, including energy projects, declined during the second half of the decade. Then, in 1997, the emerging markets in Asia experienced a financial collapse, and new private investments, including infrastructure investments, were suddenly and sharply reduced. The largest reductions came in private debt and portfolio equity investments; foreign direct investment abruptly leveled off but did not decline.[32] All types of foreign investment rebounded in 2002-03, but World Bank energy infrastructure projects continued to decline as a percent of the Bank's total commitments.[33]

What we have demonstrated in this historical sketch is that during the period 1970-2000 there were considerable fluctuations in the Bank's, and other multilateral lenders, practices and policies.[34] The question we address is: can we find evidence of this in the electrification aid data? Is there evidence that the money followed the policies?

Bilateral Aid Donors

In addition to multilateral aid organizations, bilateral electrification aid also played an important role in the post-World War II era. In fact, cumulative bilateral aid exceeded multilateral aid by almost 40%. Table 2 lists the largest bilateral donors from

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[31] World Bank, *Global Monitoring Report*.
[32] World Bank, *Infrastructure*, p. 4; World Bank, *Global Monitoring Report*, p. 196.
[33] World Bank, *Infrastructure*, pp. 4-5.
[34] Deaton, Instruments, p. 437 is critical of the Bank's "failure to learn from its own projects….Past development practice is seen as a succession of fads, with one supposed magic bullet replacing another—from planning to infrastructure to human capital to structural adjustment to health and social capital to the environment and back to infrastructure—a process that seems not to be guided by progressive learning."

1970 to 2001, with cumulative aid in constant 2000 U.S. dollars and aid per capita based on 1990 population. Bilateral aid provision was highly concentrated, with the top seven donors contributing over 90% of total bilateral aid. Japan was by far the largest donor, contributing over 40% of bilateral electrification aid, encompassing 419 projects in 59 countries.[35] Japan, however, was only the second largest donor on a per capita basis. The largest bilateral aid donor in terms of aid per person was Norway. If every country on the list had contributed the same amount of electrification aid per capita as Norway, total aid would have been three times as large, or almost $150 billion. European nations also contributed substantially. The United States, which was a major donor to multilateral agencies, was fifth on the list of bilateral donors. For the United States, some of this aid was based on the lessons of European reconstruction and emanated from the Cold War conflict:

> US government involvement in Asian electricity grew out of postwar reconstruction. The rebuilding of war-damaged electrical grids in Europe reflected the prevailing Keynesian consensus that government should direct investment in essential infrastructure. … The success of the state-led approach in European recovery shaped American thinking as it turned toward promoting economic development in the former colonial world as a bulwark against communism.[36]

The Soviet Union, although not represented in the data, also provided assistance to developing countries, mostly in the form of technical aid, but also in support of nuclear

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[35] Rudner, Japanese official development assistance, discusses Japanese aid policies up to the late 1980s. The vast majority of Japan's electrification aid from 1970-2000 went to other Asian countries although Japan supported several large projects in Peru in the 1990s.

[36] Williams and Dubash, Asian electricity reform. The largest recipient of US aid in all three decades (1970-1999) was Egypt. Several large projects preceded the Camp David accords, which also are given credit for stimulating aid to Egypt. Deaton, Instruments, p. 434. In the 1970s the Philippines was the second largest recipient, followed by India. In the 1980s the second and third largest recipients were Pakistan and Bangladesh. US bilateral aid dropped off precipitously in the 1990s.

power plants in some nations.[37] With the collapse of the Soviet Union there has been less political pressure for this type of bilateral aid. For example, the US Congressional Research Service noted that aid to Africa had peaked in the mid-1980s due to "the global competition with the Soviet Union" but that in 1995 "substantial reductions in aid to Africa had been anticipated, as many questioned the importance of Africa to U.S. national security interests in the post-Cold War era."[38] On the other hand, this freed donors to pursue other objectives when distributing their aid, including the general well-being of less developed nations.

Table 2. Bilateral donors, with cumulative electrification aid (millions of constant 2000 US dollars), and aid per capita, 1970-2001

	Total $	$ per person, 1990 population
Japan	$20,485	$166
W. Germany	8,099	102
France	4,052	71
Canada	2,714	98
United States	2,617	10
UK	2,504	44
Italy	2,020	36
Sweden	1,022	119
Norway	811	191
Spain	595	15
Denmark	517	101
Austria	362	47
Netherlands	325	22
Finland	269	54
Australia	172	10
Belgium	118	12
Switzerland	82	12
New Zealand	6	2
Ireland	<1	<1
Total	$46,770	60

Source: Project-Level Aid Database

[37] Guan-Fu, Soviet aid; Benjamin-Alvarado and Belkin, Cuba's nuclear power program.
[38] Copson, Africa. Total foreign official development assistance to Africa actually peaked in 1990, fell dramatically to 2000, but has since rebounded. See Abegaz, Multilateral development.

The Largest Aid Recipients and Largest Projects

Table 3 lists the top twenty-four total aid recipients in the period 1970-2001, along with aid per capita. Electrification aid is naturally spread more evenly among recipients than among donors, with the top 24 countries receiving about 75% of the total. The largest total recipients of aid tended to be the countries with the largest populations, but otherwise they are spread around the world. In terms of aid per capita, there are two Asian and two South American countries at the top of the list. It is noteworthy but not surprising that Sub-Saharan Africa, the area with some of the poorest countries in the world, has only two countries on the list. The same factors that inhibit bilateral or multilateral aid (including lack of income to service debt, meager resources, and rampant corruption in government-owned enterprises) almost certainly also inhibit direct foreign investment, making progress toward development all the more difficult.

Figure 2. Itumbiara hydroelectric project on Paranaiba River in Brazil.
Notes: 2,080 MW project funded in part by World Bank. Brazil was the largest recipient of electrification aid in the world, 1970-2001.
Source: http://web.worldbank.org/external/projects/

Table 3. Largest recipients of electrification aid (millions of constant 2000 US dollars), and aid per capita, 1970-2001

	total	$ per person, 1990 population
Brazil	$5,761	$38.1
India	5,421	6.4
China	4,849	4.3
Indonesia	4,769	25.4
Pakistan	4,058	35.6
Colombia	3,906	118.9
Thailand	3,687	66.6
Argentina	3,308	100.2
Egypt	2,993	52.3
Sri Lanka	2,335	135.8
Mexico	2,181	25.9
Malaysia	2,146	122.6
Bangladesh	2,075	18.9
Philippines	1,906	29.6
Turkey	1,621	28.3
Nepal	1,525	78.9
Peru	1,294	58.8
Chile	1,197	91.2
Vietnam	1,142	17.1
Tanzania	1,043	40.7
Ecuador	874	84.7
Kenya	835	34.9
Iran	794	13.8
Venezuela	785	40.6
Total, 24 countries	$60,550	18.8
All other countries, multi-country, and unspecified	$20,331	
total	$80,881	

Source: Project-Level Aid Database

Table 4 lists the ten largest electrification projects in each decade from 1970-1999. The large aid projects covered virtually all aspects of electrification, including generation, transmission, and distribution infrastructure, but the largest projects, which

absorbed a substantial amount of aid funds were hydroelectric facilities and their associated networks. These thirty very large projects, funded mostly by multilateral aid agencies, consumed nearly 15% of total electrification aid in the period. While making electricity available to many people, some of these projects turned out to be quite controversial, including the Victoria Dam in Sri Lanka,[39] the Pueblo Viejo-Quixal Hydroelectric project on the Chixoy River in Guatemala,[40] and the Yacyretá Hydroelectric project on the border between Argentina and Paraguay.[41] We next will attempt to explain the pattern of electrification aid across countries and time.

Figure 3. The controversial and unfinished Yacyretá hydroelectric project on the Paraná River at the border of Argentina and Paraguay.
Notes: The project is jointly owned by Argentina and Uruguay and is state owned.
Source: http://www.industcards.com/hydro-argentina.htm

[39] Pearce, Britain's other dam scandal.
[40] Johnston, Volume one: Chixoy dam.
[41] Filho, Murrieta, and Heyman, Final report.

Table 4. Ten largest electrification aid projects by decade, 1970-1999

1970-79

Recipient	Donor	Amount (mil 2000 $US)	Year	Project
Guatemala	IDB	437	1975	Pueblo Viejo-Quixal hydro project
Brazil	World Bank	411	1973	Itumbiara hydroelectric project
Sri Lanka	United Kingdom	392	1979	Victoria hydroelectric dam
Argentina	World Bank	389	1979	Yacyretá hydroelectric project
Cent. and E. Europe	W. Germany	382	1974	electrical distribution systems
Zambia	World Bank	378	1973	Kafue hydro power project, stage 2
Brazil	World Bank	289	1970	Marimbondo hydroelectric project
Argentina	IDB	287	1979	Alicurá hydroelectric project
El Salvador	IDB	267	1977	San Lorenzo hydroelectric project
Brazil	World Bank	244	1971	Salto Osorio hydro project

1980-89

Recipient	Donor	Amount (mil 2000 $US)	Year	Project
Brazil	World Bank	678	1986	Electric Power Sector Loan Project
Mexico	World Bank	568	1989	hydroelectric development project
Argentina	IDB	552	1982	Piedra del Agula hydro project
Colombia	World Bank	519	1981	Guavio hydroelectric project
Chile	IDB	433	1986	Pehuenche hydroelectric plant
Turkey	World Bank	432	1987	Energy Sector Adjustment Loan
Colombia	World Bank	398	1987	Power Sector Adjustment Loan
Argentina	World Bank	327	1988	Electric Power Sector Loan Project
Argentina	IDB	324	1988	Yacyretá hydroelectric project
India	Japan	264	1988	hydroelectric power project

1990-99

Recipient	Donor	Amount (mil 2000 $US)	Year	Project
Venezuela	IDB	555	1993	Caruachi Central hydro project
Brazil	World Bank	453	1990	Elect. trans. and conservation project
China	World Bank	434	1991	Ertan hydroelectric project
China	World Bank	433	1995	Ertan (2) hydroelectric project
Malaysia	Japan	399	1993	Port Klang power station
Brazil	IDB	396	1997	Itá hydroelectric project
Mexico	IDB	388	1990	Electrical Sector Investment Program
Iran	Japan	385	1993	Kadur River hydroelectric project
Colombia	IDB	373	1998	Electricity Sector Program
Colombia	IDB	364	1993	Porce II hydroelectric power plant

Source: Project-Level Aid Database

An Empirical Model of the Determinants of Electrification Aid

The relationship between aid and GDP growth has received a substantial amount of interest in economic literature recently.[42] According to some development economists, the answer to the question of whether aid causes growth is unequivocal: "Aid increases growth and by implication reduces poverty."[43] But according to a recent methodological article, the debate is ongoing and far from settled.[44] Clearly the type of aid matters, but whether or not recipient nations must pursue "good" policies also remains subject to debate. Whether or not aid has been effective, there has been substantial interest in explaining the allocation of aid based on both donors' and recipients' characteristics.[45] The bulk of this work relates to overall aid or focuses on specific countries. In this paper we focus on the electric power sector, seeking to explain the pattern of electrification aid per capita to countries. A fundamental problem is that electrification aid often is lumpy, meaning that there are some years when relatively large investments occur (say in a major hydroelectric project), which then are followed by years with very little or no aid received, even though the project is on-going. For this and other reasons, we aggregate the data into five-year panels and then estimate pooled time-series and cross-section regressions for the 1970s (1972-81), 1980s (1982-91), and 1990s (1992-2001), as well as

[42] An excellent summary of recent work, including substantial *caveats* regarding aid effectiveness, can be found in Easterly, Can foreign aid buy growth; also see *Sachs, The End of Poverty*.
[43] McGillivray, What determines, p. 1003.
[44] Deaton, Instruments.
[45] Alesina and Dollar, Who gives foreign aid; Neumayer, *The Pattern of Aid*; McGillivray, What determines; Andersen, Hansen, and Markussen, US Politics; Feeny and McGillivray, What determines.

for the whole period.[46] For econometric reasons we use data for the first year of each of the panels for the independent variables in the model. This mitigates endogeneity concerns. We use both ordinary least square (OLS) and left-censored Tobit regressions.

The model contains a variety of macroeconomic and institutional variables, including Gross Domestic Product (GDP), the investment share of GDP, geographical location, and several governance (political and economic freedom) variables. We use GDP to see if electrification aid flowed toward higher or lower income countries and to see if there were changes over time. We are particularly interested in whether the political changes of the late 1980s and 1990s have had an impact on the allocation of electrification aid. An important question regarding aid is whether the quality of recipient country governance matters. Institutional political and economic variables have been established as one of the fundamental determinants of growth and development in general.[47] Loots, for example, recently emphasized the relationship between "good governance" and aid in Africa.[48] Many developed countries, as well as multilateral lenders such as the World Bank and the European Bank for Reconstruction and Development now seek to condition their aid on standards of governance, including the regulatory framework.[49] In order to control for governance structures, we include Freedom House ratings for political rights (1=best, 7=worst) as an explanatory variable in

[46] This approach follows the work of Alesina and Weder, Who gives foreign aid; and Burnside and Dollar, Aid. We also ran regressions for each five-year period separately and for non-pooled ten-year periods. The results are similar to those presented in the paper and are available from the authors.
[47] Hall and Jones, Why do some countries; Alesina and Dollar, Who gives foreign aid; Alesina and Weder, Do corrupt governments; Neumayer, *The Pattern of Aid Giving*.
[48] Loots, Aid and development.
[49] European Bank for Reconstruction and Development, Regulating the power sector.

our model.[50] While there are other potential ratings and indexes, the Freedom House data are available for a broad set of countries since the early 1970s. We expect the rating to be inversely related to aid (since lower ratings indicate more freedom, including economic freedom). From the 1990s there are additional, and more precise, governance ratings available and we have selected the Fraser Institute ratings for the use of markets as an additional indicator for governance.[51] Finally, we include several control variables, including the initial investment share of GDP and regional dummy variables (for Africa, Asia, and the Caribbean). The initial investment share is used to capture the potential benefit of a growing capital stock for electrification aid. The logic is that since large infrastructure projects of any kind require considerable maintenance, a higher initial investment share should be a good signal for donors that aid for electrification will be effective and can have lasting effects. All GDP, investment, and population data are from the Penn World Table.[52]

We specify our initial model as follows:

$$\log(AID)_{it} = \beta_0 + \beta_1 \log(GDP)_{it} + \beta_2 (I)_{it} + \beta_3 (FH)_{it} + \gamma X_{it} + \varepsilon \quad , \qquad (1)$$

where AID is electrification aid per capita in real (2000) US dollars, GDP is initial panel year GDP per capita, I is initial investment share, FH is initial Freedom House rating, and X is a matrix of geographic dummy variables for Africa, Asia, and the Caribbean island countries. Table 5 presents the results of this specification estimated by ordinary least squares (OLS). We include in this specification only observations of countries that

[50] Freedom House (2008)
[51] Gwartney and Lawson, *Economic Freedom*.
[52] Heston, Summers, and Aten, Penn World Table.

received positive amounts of electrification aid at time t. Below, in table 8, we estimate a model which also includes observations with zero aid received.

Table 5. Determinants of electrification aid
Dependent variable: log (aid per capita)

Pooled Whole Period and Decadal Regressions	**1972-2001**	**1972-1981**	**1982-1991**	**1992-2001(1)**	**1992-2001(2)**
Initial GDP per capita in logs	-0.042 (0.144)	0.233 (0.309)	0.017 (0.171)	-0.231 (0.248)	-0.699** (0.349)
Initial Investment Share in % of GDP	0.027** (0.009)	0.014 (0.019)	-0.003 (0.010)	0.050** (0.015)	0.058** (0.028)
Initial Freedom House Rating	-0.020 (0.057)	-0.083 (0.113)	-0.140* (0.072)	-0.229** (0.098)	--
Fraser Institute measure of use of markets	--	--	--	--	0.290** (0.123)
Africa Dummy	-0.855** (0.296)	-1.620** (0.571)	-0.469 (0.352)	-1.150** (0.520)	-0.800 (0.656)
Asia Dummy	-0.442 (0.286)	-1.068* (0.566)	-0.565 (0.351)	-0.148 (0.491)	0.057 (0.589)
Caribbean Dummy	0.079 (0.425)	-2.215* (1.230)	0.904* (0.483)	0.080 (0.675)	-0.773 (0.980)
R-squared	0.075	0.188	0.123	0.125	0.117
Recipient Countries	144	86	99	132	83
Observations	532	131	183	218	142

Standard Errors in parentheses. Superscripts */**/*** denote 10, 5, 1 percent significance levels. A constant (not reported) was included in all regressions.

For the pooled data covering the whole time period (the first column of results) the investment share has the expected positive sign and is statistically significant at the 5 percent level. African countries received significantly less aid per capita for the whole period. The Freedom House measure for political freedom is not statistically significant although it has the expected negative sign. Some of the results change in the pooled decadal regressions. The point estimate of the Freedom House measure becomes larger (more negative) and is statistically significant at the 10 percent level starting in the 1980s and at the 5 percent level in the 1990s. This lends support to the idea that donors moved

toward rewarding countries with more political freedom and open markets. Political governance does appear to matter for electrification aid in our model, especially in the 1990s.[53]

As an additional test of the political, or governance, factor we introduced a second measure of the use of markets in the economy developed by the Fraser Institute.[54] This measure of "production and allocation via political mandates rather than private enterprises and markets" ranged from 0 (least reliance on markets) to 10 (most reliance on markets). Insufficient country coverage prior to 1990 prevents us from estimating regressions for the 1970s and 1980s. The estimated coefficient, which we hypothesize should have a positive sign, is statistically significant in the 1990s at the 1 percent level and is also quite large in magnitude. A two point increase in the index (for example, the difference between India at 3.5 and Turkey at 5.4), more than doubles predicted aid per capita, *ceteris paribus*. Overall, these specifications suggest that electrification aid by the 1990s appeared to have moved marginally toward countries that were more politically free and where the role of markets was more robust.

The 1990s also are the only decade where the investment share is positive and statistically significant. The coefficient on GDP per capita is negative and statistically significant for the 1990s in the regression which uses the measure of market reliance from the Fraser institute; it is also negative yet not significant when including the Freedom House index. The results thus show that poorer countries received relatively more aid per capita in that decade. This may have been a reflection of the changing policies of the World Bank and other multilateral and bilateral donors or may have been

[53] Alesina and Weder, Do corrupt governments, did not find a statistically significant effect of corruption on overall aid.
[54] Gwartney and Lawson, *Economic Freedom*.

related to the availability of private international finance in higher-income countries. To summarize, electrification aid in the 1990s seems to have moved towards poorer countries with better governance and a greater existing capital stock, *ceteris paribus*. In terms of the regional patterns of the 1990s, African countries, when controlling for the variables in the model, did receive statistically significantly less aid compared to countries in Asia and South America in one of our specifications.

The above analysis aggregates bilateral and multilateral aid flows. If these different classes of donors had differing motivations or objectives, such aggregation could lead to potentially biased estimates. Thus, we estimated the same model using only electrification aid by multilateral donors. This, of course, substantially reduces the sample size. The results are presented in table 6.

Table 6. Determinants of multilateral electrification aid
Dependent variable: log (multilateral aid per capita)

Pooled Whole Period and Decadal Regressions	**1972-2001**	**1972-1981**	**1982-1991**	**1992-2001(1)**	**1992-2001(2)**
Initial GDP per capita in logs	-0.010 (0.243)	-0.464 (0.360)	-0.005 (0.379)	-0.299 (0.400)	0.352 (0.531)
Initial Investment Share in % of GDP	0.020 (0.012)	0.042* (0.025)	0.003 (0.015)	0.044* (0.023)	0.007 (0.053)
Initial Freedom House Rating	-0.125 (0.085)	-0.188 (0.158)	-0.057 (0.128)	-0.274* (0.147)	--
Fraser Institute measure of use of markets	--	--	--	--	0.130 (0.187)
Africa Dummy	-1.827*** (0.492)	--0.891 (0.531)	-1.629** (0.790)	-2.494*** (0.832)	-2.814** (1.149)
Asia Dummy	-1.623*** (0.406)	-2.268*** (0.497)	-1.811*** (0.629)	-1.139* (0.671)	-1.656* (0.872)
Caribbean Dummy	0.289 (0.587)	--	0.927 (0.675)	-0.515 (1.076)	-1.322 (1.324)
R-squared	0.183	0.362	0.271	0.251	0.250
Recipient Countries	92	36	49	67	45
Observations	195	43	67	85	59

Standard Errors in parentheses. Superscripts */**/*** denote 10, 5, 1 percent significance levels. A constant (not reported) was included in all regressions.

The coefficient on the Freedom House index remains statistically significant (at the 10 percent level) in the 1990s, and the point estimates are generally similar to the ones in Table 5. The lack of significance on the Fraser Institute index when concentrating on purely multilateral electrification aid may be due to the smaller number of observations. There does not seem to be a fundamental difference between bilateral and multilateral aid so far as this institutional factor is concerned. Multilateral aid appeared to flow marginally toward countries with better governance structures, especially in the 1990s. A somewhat different pattern, however, emerges for the region dummies. Countries in Africa and Asia received significantly less multilateral aid per capita compared to the excluded regions of Latin America and Eastern Europe. This may partly

reflect the large size of the Inter-American Development Bank, with its focus on Latin America, and the large amounts of bilateral Japanese aid to Asia. Note also that the investment share of GDP is no longer statistically significant, as is initial GDP per capita in the 1990s.

As a further test of institutional governance, we have adapted an "electricity sector privatization index" developed by Brown and Mobarak. This index is the measure most closely related to the electric utility industry.[55] For each country and year, Brown and Mobarak's index takes on the values 0 (no sector reform), 1 (sector reform instituted), or 2 (sector primarily privatized). We convert this to a dummy variable that takes the value 0 if there is no reform and 1 if sector reform was instituted or if the sector was primarily privatized. We can use this variable only for the last decade of our model since most values were 0 prior to 1992. The results are presented in table 7.

Table 7. Effect of electric utility privatization on aid, 1992-2001
Dependent variable: log (aid per capita)

[55] Brown and Mobarak, The transforming power. We thank the authors for making their index available to us.

Time Frame	**1992-2001(1)**	**1992-2001(2)**
Initial GDP per capita in logs	-1.131*** (0.376)	-1.142*** (0.374)
Initial Investment Share in % of GDP	0.079** (0.032)	0.082** (0.032)
Electricity Privatization Index	0.154 (0.515)	2.184* (1.245)
Fraser Institute measure of use of markets	0.313** (0.123)	0.377*** (0.130)
Fraser measure Electricity × Privatization Index	--	-0.448 (0.298)
Africa Dummy	-0.767 (0.641)	-0.760 (0.638)
Asia Dummy	-0.159 (0.579)	-0.217 (0.577)
Caribbean Dummy	-0.978 (0.955)	-0.955 (0.950)
R-squared	0.137	0.151
Recipient Countries	80	80
Observations	138	138

The specification which introduces the privatization index directly does not show it to be significant. But once we also include an interaction term between privatization of the electricity sector and the Fraser Institute measure of the use of markets in general, privatization of electricity becomes significant at the 10 percent level. Thus a country that had little use of markets in general (as indicated by a low value of the Fraser Institute index) was awarded more aid per capita if it, at least partially, privatized its electricity sector.

We also are concerned that focusing only on observations with positive amounts of electrification aid might bias the results. Thus we perform an additional check by including in the estimation observations for all time periods all countries in the database that had received aid in any time period'. For example, Singapore received electrification

aid in the 1970s but not thereafter. Countries that never received electrification aid during the entire period of the study remain excluded. We estimate a left-censored (Tobit) regression that includes all observations where zero electrification aid was received, provided data for the control variables are available. This leads to an additional challenge. Some countries, like Singapore, likely did not receive further aid because it became unnecessary as living standards rose to Western levels, while other countries might not have received aid due to poor governance institutions. We attempt to control for this possibility by including a second order term for initial GDP per capita in this regression.[56] We include both multilateral and bilateral aid in these regressions. Results are presented in table 8.

[56] We also used this quadratic term in the previous regressions but it was never significant.

Table 8. Determinants of electrification aid – left censored Tobit regression
Dependent variable: log (aid per capita)

Pooled Whole Period and Decadal Regressions	**1972-2001**	**1972-1981**	**1982-1991**	**1992-2001(1)**	**1992-2001(2)**
Initial GDP per capita in logs	30.042*** (4.748)	13.528 (12.938)	25.382*** (8.061)	37.613*** (5.534)	40.721*** (6.276)
Initial GDP per capita in logs squared	-1.991*** (0.294)	-0.959 (0.813)	-1.751*** (0.499)	-2.413*** (0.341)	-2.637*** (0.384)
Initial Investment Share in % of GDP	-0.053** (0.021)	-0.175*** (0.055)	-0.022 (0.031)	-0.009 (0.029)	-0.017 (0.042)
Initial Freedom House Rating	-0.636*** (0.141)	-0.734** (0.350)	-0.934*** (0.225)	-0.417** (0.190)	--
Fraser Institute measure of use of markets	--	--	--	--	0.404** (0.196)
Africa Dummy	0.199 (0.740)	0.122 (1.725)	2.765** (1.163)	-2.631*** (0.971)	-2.939*** (1.022)
Asia Dummy	0.758 (0.724)	1.402 (1.772)	-0.105 (1.139)	0.058 (0.934)	-0.316 (0.935)
Caribbean Dummy	-1.257 (0.982)	-7.449** (3.090)	-0.136 (1.402)	-1.179 (1.226)	-1.235 (1.527
Observations	745	217	246	282	178

Standard Errors are in parentheses. Superscripts */**/*** denote 10%, 5%, and 1% significance levels. A constant (not reported) was included in all regressions.

The results clearly indicate the existence of a non-linear relationship with respect to a country's initial GDP. At low income levels electrification aid increased with income, then peaked (at an income level roughly of $1,500-$2,000 per capita) with the relationship then becoming negative. The estimate for the governance measure, the Freedom House rating, has the expected sign and is statistically significant throughout. The Fraser Institute measure of the use of markets is positive and statistically significant. The regional dummies have a somewhat different pattern when compared to our baseline specification (Table 5). In the pooled regression (first column) none of the regional

dummies are statistically significant. However, African countries appeared to receive higher electrification aid in the 1980s but lower in the 1990s.[57]

Conclusion

In this paper we have used a unique dataset to extract and compile information on multilateral and bilateral electrification aid projects from 1970-2001. To get a sense of the magnitude of electrification aid we have presented information on the developed (non-Communist) world's largest donors as well as recipients of aid and have identified the largest projects undertaken over the period. We also aggregated all identified projects and presented data on trends in total electrification aid, adjusted for inflation, over the period. Total (real) electrification aid fluctuated substantially, which is not surprising given that such infrastructure aid can be "lumpy." There was an overall upward trend from the mid-1970s to 1990. Between 1990 and 2001 there were dramatic annual fluctuations, but with on overall downward trend with aid falling to the mid-1970s level by the end of the period. Donor countries and organizations tended to be more concentrated than recipients and we found particularly that there were a relatively small number of large and influential multilateral donors. These multilateral donors were capable of substantially influencing overall policy. We examined the history of World Bank policies toward aid to the electric utility sector, noting that policy clearly shifted from supporting large infrastructure projects of vertically-integrated, government-owned utilities, to support for liberalization, privatization, and restructuring of the electric utility industry, with aid often hinging on reforms of this nature. The World Bank clearly was a

[57] This result is consistent with Copson, Africa. For an extensive study of aid to Africa and its future prospects, see Easterly, Can the west.

proponent of the "Washington Consensus" from the mid-1980s onward, although this consensus has weakened substantially in more recent years. One by-product of the liberalization, privatization, and restructuring movement (aided, of course, by the collapse of the Soviet Union) was an increase in foreign direct and foreign portfolio investment in the electric utility sector during the 1990s, which impacted both the need for and direction of electrification aid.

In the final section of the paper, we specified a model to explain aggregate electrification aid over ten-year time periods, as well as for the whole period, using various macroeconomic, institutional, and geographic variables. We believe that this is the first attempt to estimate such a model specifically for electrification aid. The models were reasonably consistent across various specifications. In many ways the results for the 1990s were most interesting. Multilateral institutions, led by the World Bank, shifted their policies in the mid to late 1980s, emphasizing the creation of more liberal market structures but also seeking to direct more aid to the poorest countries. We found evidence of a small shift of electrification aid to countries with lower GDP per capita, and toward countries with better governance structures and toward countries that had made progress toward the privatization of the electric power sector. World Bank policy did appear to have an impact. However, while controlling for these factors, we found that electrification aid to African countries, many of which are among the poorest in the world, was lower (with the possible exception of the 1980s) than to other areas of the world, a distressing result.

Finally, since aid has been related to economic growth, a next logical step in this research is to attempt to establish the impact of these projects on national growth rates.

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