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## The Relationship between Electricity Consumption and Economic Growth in Developing Countries: The Case of Turkey

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The Relationship between Electricity Consumption  
and Economic Growth in Developing Countries:  
The Case of Turkey

by

Thorsten Mehltrittter and Torsten Amelung

May 1986

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Kiel Institute of World Economics

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List of Contents

Page

I.	Introduction	1
1.	Links Between Growth and Electricity	2
1.1	Characteristics of the Power Sector	2
1.2	Structural Aspects of Electricity Demand and Supply	7
1.3	Development Strategies and Power Supply Policy	15
2.	The Case of Turkey	19
2.1	The Power Sector in Turkey	19
2.2	Sectoral Growth and Electricity Consumption	21
	Conclusions	27
	Appendix	28
	References and Data Sources	33



## I. Introduction

The power sector plays an important role in building up the infrastructure in a developing country. Historically the case of the USSR and the USA reveals a strong link between the development of the power sector and economic growth. Based on this so-called "iron link", many planners in developing countries have looked at the power sector as an indicator for a country's overall level of development. This has led to assigning the power the role of a "precursor" of development.<sup>1)</sup>

The question raised in this paper is to what extent the power sector can go beyond merely accompanying economic growth. Can an increase in power supply in itself bring about increased output growth due to the key role of the power sector in a developing economy?

In the first section we look at the links between growth in output and electric consumption on a theoretical basis. We first give a brief overview on the properties of the power sector and its product. In 1.2 we derive causalities between structural development and electricity consumption. Thereafter we discuss the impact of various development strategies on this relationship.

Using the case of Turkey, we look at the link between output and electric consumption from a sectoral rather than a macroeconomic point of view. This is the main contribution of this paper as all previous studies to our knowledge have taken the aggregated approach.

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<sup>1)</sup>See Pachavri, R.K. (1982), p. 190.

## 1. Links Between Growth and Electricity

### 1.1 Characteristics of the Power Sector

Energy sources can be divided into two major groups depending on the way they are provided. Primary energy sources can be used in their natural state, while secondary energy sources are gained by a transformation of primary energy sources.

In comparison with other forms of secondary energy electricity can be generated by using nearly all commercial or non-commercial primary energy sources.

For large scale generation, gas, oil, lignite, coal, hydro-power and nuclear power are used as inputs, while other alternatives such as solar energy, wind, biomass, geothermal energy etc. are only available for small scale production.

The fact that electricity is a secondary energy source has certain implications with respect to its relationship with other energy sources. By definition this relationship is complementary, since primary energy sources serve as inputs for power generation. However, at the end user level there is a certain degree of substitutability vis-à-vis other energy sources, which makes the picture more complex, as it will be shown later.

Apart from the flexibility in power generation, electric energy has some further advantages. Electric power can be very easily transported, since it can be distributed by a grid serving a large number of consumers. For this reason power plants are likely to be built at locations where the required primary energy sources are available.

Nevertheless, there are some limits to these considerations, since the losses within grid make the long distance transportation over 800 km unreasonable from the economic point of view. Furthermore, a supply by a grid may not be economical. When the consumer is located far away from the next existing connection to the grid, the construction of a transmission line bears high fixed costs. In this case a supply by autogeneration through diesel generators and alternative technologies (wind, mini-hydro, solar, biomass) or a substitution by another source of energy have to be considered.

The investments that have to be undertaken in the construction of power plants and grids have a time horizon of about 30 years. The high amount of fixed costs in comparison to variable costs imply increasing returns of scale (decreasing marginal costs).<sup>1)</sup>

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<sup>1)</sup> See Schürmann, H.S. (1981), p. 171.



This is a sufficient, though not necessary condition for the so-called natural or technical monopoly. The power supply via an electrical grid is a technical monopoly, so that a given demand can be provided at lower costs by one single supplier than by a larger number of suppliers, since the supply of electricity to single groups of consumers is more costly than a common supply to all consumers.

A free competition among several suppliers in a given area will inevitably lead to a predatory pricing behaviour and wasteful double investments. For this reason a regulation by the government is welfare-superior to free competition. However, the scope of administrative control varies widely, but nevertheless, the power sector is always linked to political considerations and development strategies.

Price controls are most common in all developing countries. Since electric power is a quite heterogenous good pricing policy must consider specific properties of supply:

- 1) voltage/frequency;
- 2) time schedule of supply;
- 3) load factor.

Transmission of electricity is more economical at higher voltage, since grid losses are avoided. A transformation of high voltage to low voltage electricity is costly. For this reason, consumers of high voltage electricity (i.e. industrial demand) face lower prices. The level of the voltage cannot be chosen by the consumer deliberately as it is always due to the use of electricity.

The impacts of the time schedule and the load factor on prices deserve a detailed explanation. The power sector generally provides two services:

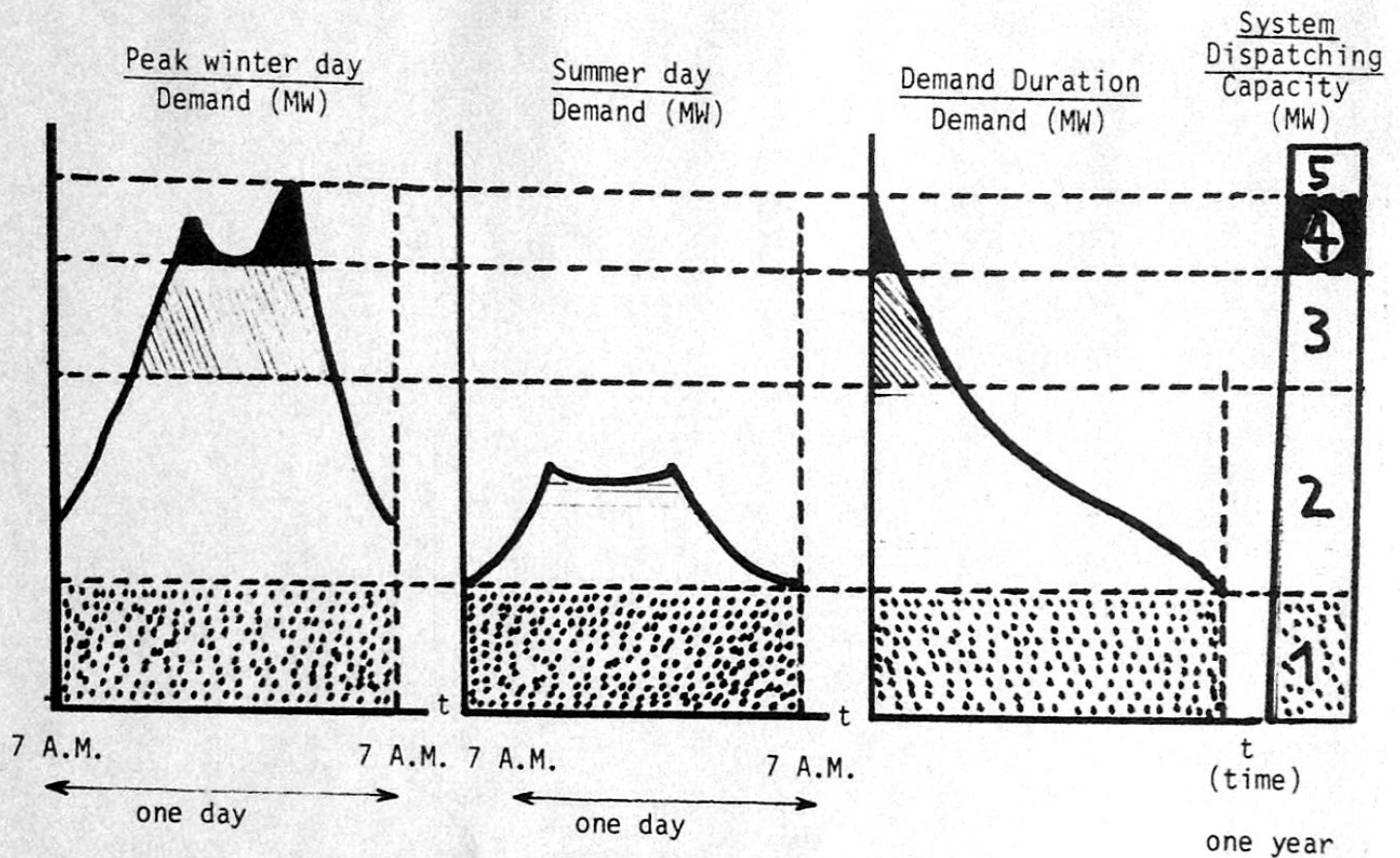
- 1) supply of electricity;
- 2) capability and readiness to supply any potential demand with high reliability at given prices.

The relevance of the second point becomes more obvious if we consider that the demand for electricity is subject to heavy fluctuations. One component of these fluctuations occurs in a quite erratic pattern, so that the supplier of electricity is supposed to hold excess capacities to meet these unanticipated demand shocks.

On the other hand, the demand for electricity fluctuates systematically as electricity consumption is driven by certain patterns of living (i.e. household demand). The fluctuations of demand that have to be met by a variation of supply are subject to a hourly, daily, and monthly regularity, as it can be seen from Figure 1.

Figure 1

Daily Load Variation



Source: Ralph Turvey, Dennis Anderson (1977), p. 258.

- Capacity:
- 1 Nuclear, Hydro
  - 2 Coal, Lignite
  - 3 Oil, old fossil fired plants, pump water
  - 4 Gas turbines
  - 5 Excess capacity (for erratic fluctuation) consisting of various systems.

The daily load variation curves indicate the fluctuations of demand during a day. The demand duration curve measures the persistence of demand levels in fractions of one year.

The column for system dispatching reflects the order according to which the systems are charged. For the continuous demand nuclear and hydro capacities will be used, while the uneven demand is met by gas generators.

The supplier has to hold some idle capacities to ensure a reliable supply during certain hours of the day in particular seasons. Those idle capacities will not be utilized during a considerable part of their lifetime. For this reason it is advisable to meet this peak demand by systems that bear relati-



vely low capital costs. The variable costs of such peak load systems is not that important, since the quantity of production is quite limited.

On the other hand, the amount of demand which is stable during the entire year has to be met by a system with low variable costs. Since those systems work all through the year, capital costs of those base load systems are less relevant with respect to the unit cost of production.

As it can be seen from Figure 1, plants are arranged in ascending order of marginal operating cost and descending order of capital cost.

Nuclear and hydro-plants are typical base load facilities, which bear high capital costs and work all through the year, as it can be seen from the demand duration curve. On the other hand, gas turbines work only during a rather small part of the year.

An even electricity demand is to be favoured since the peak demand and the implicit existence of idle capacities bear high supply costs.

For this reason the price of electricity has to consider the demand variation of the individual consumer as far as possible. In addition to that, consumption during peak hours should be charged with a higher price, as production of electricity during these hours is more costly. Therefore, it is justifiable that those consumers who demand electricity during peak hours pay for the existence of idle capacities.

This kind of price differentiation is determined by the so-called "peak load pricing model", which is illustrated in Figure 2.

The static diagram shows that the pressure on the capacity arises due to peak demand  $D_p$ , while the off-peak demand does not infringe on the capacity  $\bar{Q}$ . The optimum pricing rule involves two distinct rating periods differentiated by the time of day:

$$\begin{aligned} \text{peak period price: } P_p &= a+b \\ \text{off-peak period price } P_{op} &= a. \end{aligned}$$

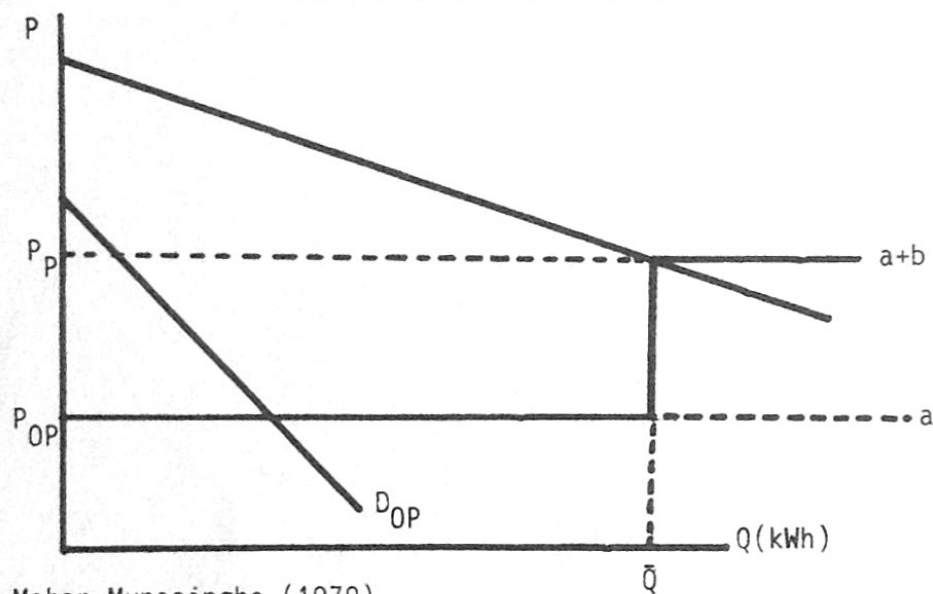
The justification of this pricing rule is that peak users are the cause of capacity additions.

In this sense price differentiation can be justified from an economic point of view. Large scale industrial consumers have an even demand profile that can be provided by base-load systems to a large extent. Since contracts with such consumers are negotiated individually, there is large scope for price differentiation. Furthermore, a systematic interruption of power supply during peak hours are subject to negotiations. Price differentiation among households and smaller consumers which hold the major share of electricity consumption in developing countries cannot be achieved. For this reason demand fluctuations in developing countries are quite considerable requiring

expensive idle capacities. In this context, the reliability of power supply does not serve as a decision variable since the costs of system break downs cannot be calculated in developing economies. For this reason interruptions and system reliability are determined on a rule-of-thumb basis not being reflected in the prices. In addition to that, developing countries impose different prices with respect to social aims.

Both consumption and production of electricity are quite costly since consumers have to acquire equipment and appliances for the use of electric energy, while on the production side the transformation of another energy source involves losses and sophisticated production processes.

Figure 2 The Peak Load Pricing Model



Source: Mohan Munasinghe (1979).

- Q - Quantities of demand and supply.
- P - Unit price.
- $P_P$  ( $P_{OP}$ ) - Peak period (off-peak period) price.
- $D_P$  ( $D_{OP}$ ) - Peak period (off-peak period) demand curve.
- $\bar{Q}$  - Capacity of the system.
- a - Variable costs (operating and maintenance).
- b - Capacity costs (long run marginal cost of adding to capacity, e.g., investment costs suitably annuitized and distributed over the lifetime output of the plant).

These relative disadvantages of electricity are offset by environmental advantages of electricity consumption the widespread facilities for usage in the modern sector of developing countries.

For this reason the power sector often gets closely interlinked with the rest of the economy due to the beginning of the industrialization process. In this respect the power sector can be considered as a part of a country's infrastructure which has to be taken into account in development planning.



## 1.2 Structural Aspects of Electricity Demand and Supply

Kaynesian and neoclassical growth theories have put an emphasize on the importance of capital accumulation. However, this is only a necessary condition for development, since the productivity of capital seems to be even more important.

In this respect the creation of an infrastructure serves as a useful instrument to influence the productivity of capital. Infrastructure has the characteristics of a capital good since it is created by investments, which is paid off in later periods of a considerable lifetime.

The amortization of such an investment is partly due to indirect non-pecuniary returns as infrastructure creates external benefits. The output of infrastructure has some qualities of a public good which is supplied to a large number of consumers. The exclusion principle is of very limited use as the costs of production cannot be associated with a particular consumer.

The following institutions are usually characterized as a country's infrastructure:<sup>1)</sup>

- 1) transportation and communication systems;
- 2) supply of gas, electricity and water;
- 3) health care and education;
- 4) facilities for sports, culture, recreation and research;
- 5) protection against environmental damages.

As far as developing countries are concerned, the first three items are the more important tools for growth policy. Within these three institutions the electricity sector plays a central role as supplier of inputs for the production of other infrastructure goods and services.<sup>2)</sup>

The power sector which is embedded in this infrastructure has indirect effects on the productivity of private capital, since it helps to diminish the capital coefficient. The electrification of a region by local grids or interconnection creates a potential growth as producers do not have to invest in autogeneration systems that make the same production more capital intensive. A wide scope of production processes are more likely to be put into practice when the availability of power supply is ensured.

In regions where public supply already exists, an improvement of the quality of electricity supply prolongs the lifetime of machinery and discourages the investments in autogeneration systems for stand-by purposes.

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<sup>1)</sup> See Frey, R.L. (1979), p. 77.

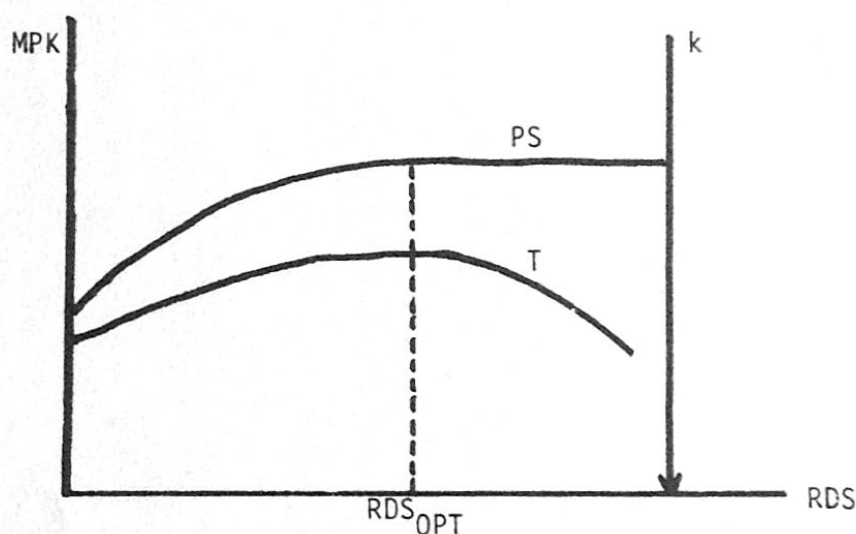
<sup>2)</sup> See Starr, C. (1981), p. 365.

Furthermore, enterprises are challenged to give up those systems where they already existed.

However, growth effects are not to be achieved by a partial improvement of the power sector but rather an improvement of the entire infrastructure.

The links between productivity and infrastructure (power supply being a part of it) can be explained by Figure 3.

Figure 3                      Links Between Capital Productivity and Infrastructure



Source: Rene Frey (1979), p. 79.

- MPK - marginal productivity of capital
- k - capital coefficient
- PS - private sector capital productivity curve
- T - total capital productivity curve
- RDS - relative degree of infrastructure supply

The PS-curve illustrates the increase of the marginal productivity of capital in the private sector due to increases of the relative supply of infrastructure services. As long as we are to the left of  $RDS_{OPT}$ , there is a lack of infrastructure in a sense that the marginal productivity of private capital can still be improved.

In case of initial non-availability, an investment in infrastructure causes large improvements of private capital productivity. These improvements, however, become increasingly smaller, and finally, infrastructure investments do not affect private capital productivity at all. Going beyond  $RDS_{OPT}$  diminishes the total capital productivity since the excess supply of capital in



the infrastructure could have been used more efficiently in private investments.

The optimal degree of infrastructure supply does not keep its absolute level over time since technology and structural changes of the private sector call for a permanent improvement of the infrastructure according to the stage of development. In the same way the optimal degree of infrastructure in rural regions will quite differ from the optimal level in urban areas.

The following table shows how the optimal degree of power supply changes with respect to developmental stages.

Table 1      Power Supply as Infrastructure Investments

<u>Stage of Development</u>	<u>Infrastructure</u>
1) Agriculture (subsistence level)	
↓	← Village technologies, local grid
2) Agrobusiness, Handicraft, Services	
↓	← Interconnected system
3) Manufacturing industry (medium size)	
-----	
↓	← Growth oriented base load systems supplying cheap electricity
4) Industrialization	

In most developing countries all these stages exist simultaneously due to social and regional dualism. At each level of development the suitable endowment of electric infrastructure has to be optimized to encourage investments leading to the next stage. The last developmental stage, namely the industrialization process, may be supported by supply of cheap energy. However, this approach is questionable and has to be discussed in further detail.

The infrastructure argument simply states that the non-availability of electric power is a barrier to growth and development, since even less electricity-intensive producers may need a minimum supply of electricity and other infrastructure services depending on electricity. When there is quantitative or qualitative non-availability of power supply investments in this sector create growth potentials for private production.

Nevertheless, once the optimal relative degree of infrastructure has been achieved, there is no reason to believe that there is a link between growth and development according to the infrastructure argument.

However, the contribution of the particular sectors to the gross national product may change over time as the process of development alters the structure of demand and supply. If power- and energy-intensive sectors are favoured

by development, there will be a link between energy policy and gross national product.<sup>1)</sup>

In this context it is necessary to regard energy as an input factor in the production function.

Capital formation is believed to be a necessary condition for the growth of output. Since the consumption of energy is often due to appliances and equipments, there is to some degree a complementary relation between energy and capital.

In capital-abundant countries this complementary relation does not hold since energy saving can be achieved by investments in modern, more sophisticated machinery. For developing countries, however, the substitution of energy by capital is rather limited as there are financial restraints, so that energy may prove to be a factor which is less scarce than capital. In addition to that, it has to be considered that the production function in some sectors is limitational as it can be observed in transportation and the manufacturing industry of many developing countries. If these sectors bear a considerable growth potential, there will be an increasingly strong link between output and energy consumption.

However, it is questionable if this link implies also a growth in electricity demand since power is subject to substitution by oil, coal and lignite. Non-commercial traditional forms of energy become increasingly unimportant and are substituted by commercial energy sources.<sup>2)</sup>

Nevertheless, the usage of those three fossil energy sources is limited by two considerations.

Firstly, most countries had to make painful adjustments during the oil crisis. For this reason there is a reasonable reluctance to make the economy even more dependent on oil, as far as oil-importing developing countries are concerned.

The second point is that industrial technology is mainly developed in industrialized countries where electric power is a favoured input for machinery, while coal and lignite lost their role as a main input factor.

Developing countries that import those technologies often face limitational production functions especially in the processing of agricultural products, textile industry, and in the non-ferrous metal production.

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<sup>1)</sup> See Kriegsmann, K.-P. and Neu, A.D. (1981), p. 56.

<sup>2)</sup> See Hoffmann, L. (1981), p. 69.



In addition to that, developing countries might favour electricity since they might have a comparative advantage in the production of power vis-à-vis other countries.

Regions that are well endowed with hydro facilities or a considerable supply of coal and lignite might export electricity or shift their production towards electricity-intensive products like aluminium.

As the demand profile of electricity-intensive industries is quite even, the growth of this demand can be met by a growth of supply of constant or sometimes even decreasing prices.

Summarizing the previous arguments, it can be said that the role of the power sector as an instrument for growth policy depends heavily on the interlinks with other sectors.

In order to measure those interlinks and to identify the power sector's role as a so-called key sector we can turn to indices developed by P. Noerregard Rasmussen.<sup>1)</sup> The index he developed has some advantages, since it takes into account both direct and indirect increases of output in the key sector. In addition to that, it brings out the relative strength of various industries in the economy by weighting them with respect to their structural importance.

An index of backward linkage of sectors can be defined as follows:

$$(1) \quad BLI_j = \frac{\frac{1}{m} \sum_{i=1}^m Z_{ij}}{\frac{1}{m^2} \sum_{j=1}^m \sum_{i=1}^m Z_{ij}} .$$

In the same way, an index of forward linkage of sector  $i$  can be defined as:

$$(2) \quad FLI_i = \frac{\frac{1}{m} \sum_{j=1}^m Z_{ij}}{\frac{1}{m^2} \sum_{i=1}^m \sum_{j=1}^m Z_{ij}} ,$$

where  $Z$  is the inverse matrix of technical coefficients. The elements  $Z_{ij}$  of this matrix can be interpreted as the increase in the output in industry  $i$  per unit increase in the final demand for the product of industry  $j$ .

$m$  is the number of endogenous producing sectors in the input-output matrix.

The weighting has been done with respect to the relative importance of the sector's final demand.

As far as the interpretation of these indices is concerned we may derive the following statements on a key sector's interlinks:

<sup>1)</sup> See Rasmussen, P.N. (1956), p. 32.

A BLI (FLI) that is greater than unity means that an increase in the demand of sector j (i) by one unit of output implies a bigger than one unit increase in the output of the backward (forward) interlinked sectors and vice versa. Similarly a BLI (FDI) smaller than unity indicates that this particular sector does not heavily draw or push on the rest of the economy.

Prem S. Laumas<sup>1)</sup> calculated the values those indices for several key sectors in Taiwan, Ceylon, Korea and Malaysia. Some of his results are listed in Table 2.

Table 2      Backward and Forward Linkages of the Power Sector in Comparison to other Key Sectors

a) Power Sector

Country	BLI	FLI	Year
Taiwan	0.657	1.162	1964
Malaysia	0.340	0.940	1961
Korea	0.181	1.058	1963
Ceylon	0.116	1.082	1965

b) FLI in other Sectors

<div>Sector Country</div>	Transport	Agriculture, Livestock, Fishing	Machinery
Taiwan	1.276	0.716	1.098
Malaysia	1.823	3.658	0.644
Korea	0.802	3.104	0.594
Ceylon	0.442	3.125	0.588

Source: Prem S. Laumas (1975), p. 71.

With respect to the BLI values it can be definitely said that the power sector does not have much influence on sectoral growth. The values of the FLI are greater though it is still to be doubted whether this makes the electric power production a growth leading sector that should be used as a policy tool.

<sup>1)</sup> See Laumas, P.S. (1975), p. 77.

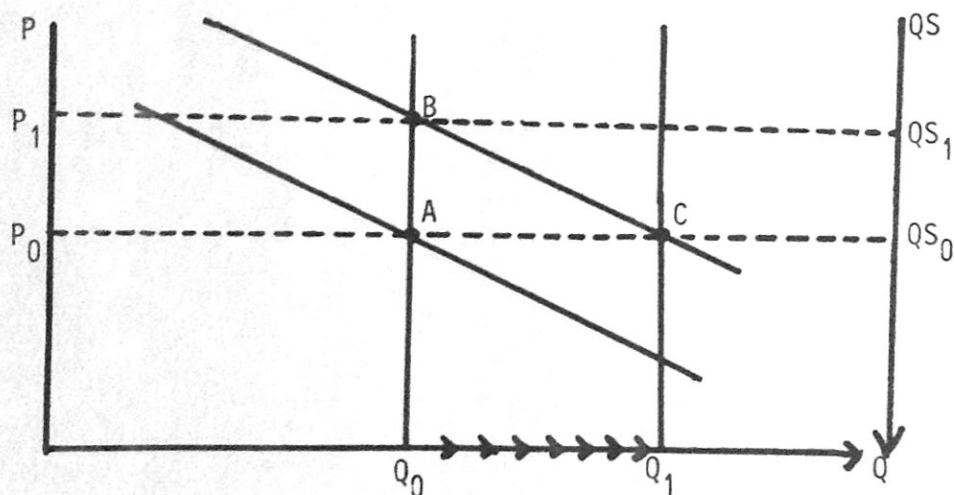


However, the links are big enough to cause a linear relationship between electricity demand and growth since the values are close to unity. Apart from that, these figures may change in the course of the development process so that a detailed interpretation of these results with respect to the role of the power sector over time is not justified.

Another aspect of structural development is given by the demand function of households. When the disposable income of the households grows, and increased acquisition of consumer durables, i.e. electrical appliances can be expected. The increase of electricity demand in non-productive uses can be observed both in rural areas, where this process just started, and in urban areas where it is far from reaching the saturation level.

As households and small enterprises are supplied by the same grid, price differentiation between productive and non-productive uses is not possible in developing countries. For this reason the quantitative increase in household demand is met by an increased power production as it can be illustrated in Figure 4.

Figure 4 Demand of Households and Small Consumers



$P_0$  - per unit price of electricity

$QS_0$  - desired quality of supply

$Q_0$  ( $Q_1$ ) - quantitative supply to achieve  $QS_0$ .

Initially this consumer group faces a price  $P_0$  and a desired quality of supply  $QS_0$ , that can be provided by a quantitative supply of  $Q_0$ . If the index elasticity of household demand is big enough the demand curve  $D_0$  will gradually shift from  $D_0$  to  $D_1$  due to larger number of consumers and electrical appliances. Since the capacity of the power sector has not changed higher prices have to be charged. In addition to that the quality of supply decreases, since a higher potential demand has to be met by a constant capacity. If all potential consumers use their appliances during peak hours at once, this will lead to voltage drops or interrupties, which cause more negative welfare effects than the price increases.

As most of the consumers use the same grid it is advisable to extent the capacities to serve  $Q_1$ . For this reason an increase of disposable income is often associated with a growth of quantitative supply.

### 1.3 Development Strategies and Power Supply Policy

As it was discussed in the previous section, it is the structure of the economy and its change over time that determines the strength of the link between economic growth and electricity demand. The structure of a developing country is not only changed by a process of organic development but also by strategic choices of the policy maker.

The power sector can be attributed two different roles within the framework of a development strategy. On the one hand, electricity can be used as an instrument of growth policy. In this context the power sector is supposed to be a motor of development initiating growth effects in other sectors of the economy.

On the other hand, the electric power sector is supposed to provide and guarantee the electricity needs of the country at minimal economic costs, as it was postulated by Theodor Wessels.<sup>1)</sup> The instrumental use of electricity is a rather passive one following the assignments of the development strategies according to the infrastructure argument.

Let us first turn to the discussion of the first policy. A sector can be used as a tool for active growth policy if it is strongly interlinked with the rest of the economy so that the growth effects of the so-called key sector will trickle down to the rest of the economy. The strategic relevance of a key sector was formulated by A.O. Hirschman<sup>2)</sup> in his theory of unbalanced growth.

This development strategy is built on the assumption that entrepreneurs in developing countries have to be given considerable incentives for investments in order to stimulate economic activity. To establish such an incentive structure, policy makers intentionally create bottlenecks and excess supplies of particular goods. An autonomous investment in key sectors can induce further investments if there is an excess demand for inputs in the key sector. This is the so-called backward linkage effect. The forward linkage effect implies that an autonomous investment provides an excess supply of its own products, which is the input of the induced industries.

The backward linkage effect of the power sector is limited to the development of primary energy sources, which is a very capital intensive process and not sufficiently interlinked with the rest of the economy. Table 1 shows that the BLI of electricity is comparatively low. The forward linkages of the power

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<sup>1)</sup> See Schneider, H.K. (1967), p. 21.

<sup>2)</sup> See Hirschman, A.O. (1958), Chap. 6.



sector are more important for this strategy. However, as it was discussed in Section 1.2, the successful performance of unbalanced growth in the power sector is constrained by the following assumption:

- a) limitational production functions and high electricity demand in related industries;
- b) sufficient spill-overs of the related industries into the rest of the economy.

The strategy of unbalanced growth is most likely to be successful if the developing country is able to establish a comparative advantage both in the cheap production of power due to resource endowment and in the related electricity-intensive industry leading to export-led growth.

Since the power sector and electricity-intensive industry are relatively capital-intensive, this policy is difficult to be put into practice, especially in low-income developing countries.

Nevertheless, the power sector has at least a passive role in the development process. Since the goals given by the development strategy implicitly draw upon the existence of an adequate infrastructure, a shortage of electric power supply hinders development, even though the power sector does not explicitly initiate growth.

The assignments given to the electricity suppliers depends on the kind of development strategy. In this context:

- a) industrialization strategies, i.e. import substitution<sup>1)</sup> and export-led industrialization;
- b) balanced growth strategies.

Industrialization strategies put an emphasis on the development of selected industrial sectors, while the wealth and the growth effects achieved by the comparatively more dynamic growth sectors are expected to trickle down to the rest of economy.

Apart from this "trickle-down" mechanism the development of the agricultural sector is neglected.<sup>2)</sup>

Industrial societies are capital-intensive leading to a rapid rise in the use of commercial energy sources. Since industrial production depends on human capital, cheap labor, and a well developed infrastructure, enterprises are usually located in an urban area.

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<sup>1)</sup> See Dunkerley, S., et al. (1981), p. 92.

<sup>2)</sup> See Howe, S.W., et al. (1981), p. 40.



Industrialization and the normally associated increased urbanization has to be accompanied by centralized power supply policy enabling the fast and efficient production of goods and services.

Supplying urbanized demand centers is cheaper than supplying small dispersed consumers. For this reason, the urban grid and the base-load system has to be extended to serve large-scale industrial demand. In addition to that, the establishment of an interconnected system covering the urban demand centers and remote base-load production, i.e. coal, hydro, and lignite, helps to achieve considerable economies of scale.

Import substitution has built-in tendency toward increasing energy-intensity as the process develops since the first stage usually consists of final assembly from imported components or semifabricated materials, in which the bulk of the needed electricity has already been embodied. Basic metal industries, however, have a high electricity-intensity right from the beginning.

Export orientation tends to start at a lower electricity-intensity since it is often linked to fabrication of agricultural products and a semifabrication of raw materials. Since export orientation tends to provide trade balance than import substitution, it facilitates the import of capital goods for vertical extension of the export sector as well as equipment for large-scale power generation. For this reason, the change of electricity-intensity over time cannot be described in general terms.

In the mid '60s some countries turned away from pure industrialization as it could not create much employment due to a failure of the "trickle-down" mechanism causing severe social problems.

Industrialization was not abandoned, but in addition to that the role of agriculture was stressed with priority for improved agricultural productivity and rural development. Since the base of agricultural production has dispersed all over the rural areas, the power supply policy has to follow a process of decentralization.

In most countries this is done by increased rural electrification implying interconnection to the grid, which is very costly because the ratio between length of the transmission lines and power demand is quite high. In addition to that, the rising use of electric energy for household purposes add to the intensity of demand fluctuations calling for an extension of expensive idle capacities. Therefore, increasingly other forms of electricity supply are considered, especially village technologies producing electricity for local grids.

Such small-scale systems are usually sufficient to serve the low demand due to low electricity-intensity in agricultural production. Apart from to that, electricity for agricultural use can easily be substituted for other energy sources.

The tactics for the power sector derived from the development strategies have generally to consider the following constraints:<sup>1)</sup>

- a) abundant manpower, high unemployment, high migration from rural areas into the cities;
- b) high capital costs;
- c) limited public budgets;
- d) high foreign exchange requirements;
- e) limited ability to pay.

The power sector is usually explicitly drawn into general macro policies by imposing pricing and self-sufficiency policies. Using the electricity supply as a tool for macro policies, however, violates the growth supporting function of the power sector. Therefore, self-sufficiency policies and pricing are to be conducted on pure economic terms.

This can be put into practice since the exclusion principle works rather efficiently in the power sector. The prices should reflect the long-run marginal costs of production including a net profit reflecting alternative uses of the capital. Since production costs cannot be attributed to a consumer, there is a certain degree of cross-subsidization.

Trade in electric power is limited because of transmission problems. Primary energy resources for power production, however, are traded, especially coal and lignite.

Since an energy self-sufficiency policy might be very costly even with respect to foreign exchange, policy makers should not reject the import of energy for power production unless the extraction of domestic resources is economically reasonable.

Electricity supply produces some external benefits, especially in rural electrification. Since modern infrastructure depends on electricity (health care, education, telecommunication) and the availability of power might alleviate the problems of rural-urban migration, a subsidization in order to ensure power supply in those areas seems to be justifiable. However, the subsidization should not be reflected in lower prices for electricity leading to price distortions due to cross-subsidization. As the rentability of electric power supply authorities must be subject to very strict control, a subsidization by external funds is a more suitable instrument.

In this respect, it is important to note that only a power sector which is viable in an economic sense may contribute to growth inducing development policies by avoiding misallocation and overinvestment.

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<sup>1)</sup> See Tybout, R.A. (1962), p. 177.



## 2. The Case of Turkey

### 2.1 The Power Sector in Turkey

In Section 1.2 we have shown the relationship between the power sector and structural change in the other sectors. The growth in electricity demand is closely related to the development of the output in specific sectors. This links can be strengthened by strategic choices regarding development policies as it was shown in Section 1.3. This section is an attempt to illustrate the theoretical considerations for the case of Turkey. We selected Turkey because it pursues de facto a development policy of balanced growth. In this environment both the agricultural and the industrial sector are attributed growth potential so that each sector is taken into account by the power supply policy.

We will first provide some general information regarding the role of the power sector for the case of Turkey. Then we will take a sector-specific approach to analyze the link between sectoral growth and electricity consumption.

The production of electricity in Turkey was rather dependent on oil. Meanwhile this situation has changed. As far as the capacity is concerned, hydropower (47%) and lignite (26%) play a dominant role since the country is very well endowed with those two resources.<sup>1)</sup> Coal (4 %) and oil (23%) have a smaller share in the capacity.

However, oil still has a considerable role in the production of electricity, namely 27% (lignite 29%, hydropower 42%). This can be explained by the fact that oil-fired peak load plants have to meet medium load demand since the growth of capacity cannot keep up with the growth of demand. This is confirmed by the necessity to import electricity (8% of effective demand) and to impose interruptions during peak demand periods (5% of effective demand).

For this reason the role of autogeneration is still quite important (9% of total capacity, 7% of total production).

The main producer of electricity is a state-owned enterprise, the so-called Türkiye Elektrik Kurumu (TEK), which provides 86% of the capacity and 87% of domestic production.

The TEK was founded in 1970 and gradually took over most existing power plants and grids.<sup>2)</sup>

It is legally obliged to earn a minimum net profit that amounts to 8% of net assets per year. In this respect it is also supervised by the World Bank,

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<sup>1)</sup> Data in this section were calculated on the basis of TEK statistics for 1983.

<sup>2)</sup> See Aysan, M. and Özmen, S. (1981), p. 186.



which assisted in establishing the interconnected system and in the rural electrification plans.

For these reason the scope for subsidization through pricing is limited. However, there is some degree of cross-subsidization since each power unit is taxed by a certain amount, that is paid into a fund to foster rural electrification.

The interlinks of the Turkish electric power sector with the rest of the economy are quite weak. The linkage indices that have been calculated in a study by Berberoglu reveal the following results:<sup>1)</sup>

$$FLI = 0.84$$

$$BLI = 1.34.$$

It is remarkable that the FLI is smaller than the BLI, since all values for the power sector tend to be the other way around, as it can easily be seen in Table 1. Comparing these results to other sectors in the table, it can be stated that the FDI is rather weak. This points to the fact that the power sector in Turkey is not likely to have a "key sector" function in Hirschman's sense.

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<sup>1)</sup> See Berberoglu, N. (1982), p. 148. The indices were calculated on the basis of an inverse technical coefficient matrix for 1973.

## 2.2 Sectoral Growth and Electricity Consumption

Past studies have focussed on the link between economic growth and electricity consumption from a macroeconomic point of view. One such study<sup>1)</sup> for the case of Turkey has found a strong relationship between growth and electricity consumption. Another study<sup>2)</sup> has challenged these results arguing that the cost of electricity makes up only 3% of total production cost. As was made clear in the theoretical section, establishing a causal relationship between economic growth and power consumption on a global basis is questionable since such a link should also be tested on a sectoral basis. This is due to the diversity of production functions across sectors.

Therefore, we have approached this issue on a disaggregated level. The Turkish economy was divided into 17 sectors. These sectors represented 95% of total real output in 1973. Some of their main characteristics are featured in Table 3.

In 1973 the agriculture share of total real output was 24.4%. The industrial sector (sect. 2 - 12) made up for 28.4%, whereas services, which is dominated by public enterprises, had 42.7% of the total. Within the industrial sector food, beverage, and tobacco industries as well building and public works are of major significance. We find almost the same situation in 1983. Manufacture of chemicals gained somewhat, whereas food, beverage, and tobacco industries have lost insignificantly. Practically all of the manufacturing industries have shown impressive growth, in particular the manufacture of chemicals and the manufacture of earthenware and cement. These figures illustrate that Turkey is on a balanced growth development path.

Households and the manufacturers of earthenware and cements are the main consumers of electricity. Non-ferrous metal basic industries and the agricultural sector have shown the stongest average growth in electric consumption.

To give a rough indication of the financial burden due to electric consumption, we calculated the current cost of electricity to nominal output ratio. This was done because data on energy intensities could not be produced. The consumption of electricity seems to be an important cost factor particularly for the non-ferrous metal basic industries and the manufacture of earthenware and cement. The trend is rising for the non-ferrous metal industries and falling for the mining sector. One can also observe that electricity plays a larger role in import substituting sectors (e.g., iron and steel basic industries, non-ferrous metal basic industries) than in the export-intensive sectors (e.g., agriculture; food, beverage, and tobacco industries; man, of textiles, leather, and clothing).

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<sup>1)</sup>See Berberoglu, N. (1982), p. 135.

<sup>2)</sup>See World Bank (1971), p. 4.



Table 3 Some Characteristics of the 17 Sectors of the Turkish Economy Included in the Investigation

Sectors	Real Output <sup>a)</sup>			Consumption of Electricity <sup>c)</sup>				Cost of Electricity <sup>b)</sup>		
	Share of total Real Output in %		Average Yearly Growth Rate in %	Share of total consumption in %			Average Yearly Growth Rate in %	Nominal Output in %		
	1973	1983		1973	1983	average		1973	1983	average
1. Agriculture, forestry, hunting, and fishing	24.4	23.0	4.1	0.5	0.8	0.7	13.8	0.03	0.07	0.07
2. Coal and lignite mining; other mining industries	1.7	2.0	7.2	6.7	3.8	4.3	3.1	7.53	2.87	4.28
3. Food, beverage, and tobacco industries	5.2	4.6	6.0	8.1	7.6	7.5	8.3	0.95	1.10	0.97
4. Manufacture of textiles, leather, and clothing	2.7	2.7	7.9	11.4	9.4	9.8	6.9	2.11	1.91	1.92
5. Manufacture of wood, paper, and allied products	0.9	0.8	5.6	5.7	5.0	5.3	7.5	3.71	3.72	3.63
6. Manufacture of rubber products	0.6	0.5	5.9	1.3	1.7	1.6	12.7	1.36	1.89	1.63
7. Manufacture of chemicals	3.9	5.2	12.4	7.3	7.7	7.6	9.7	1.28	0.74	1.01
8. Manufacture of earthenware and cement	0.8	0.9	9.6	11.5	10.1	10.7	8.0	8.85	6.37	7.00
9. Iron and steel basic industries	1.6	1.5	8.2	7.9	8.4	8.0	9.6	3.67	3.45	3.26
10. Non-ferrous metal basic industries	0.5	0.5	8.3	2.2	6.9	6.2	25.9	2.95	9.06	8.38
11. Manufacture of machinery, electrical appliances, and transport equipment	3.7	3.3	6.0	2.8	2.0	2.2	5.4	0.44	0.35	0.38
12. Building and public works	6.8	6.4	3.6	0.2	0.2	0.2	6.8	0.07	0.06	0.05
13. Public administration and public utilities	10.2	11.0	5.3	8.5	9.9	9.5	11.1	1.13	2.23	1.56
14. Commerce services and handicrafts	22.1	23.2	5.5	6.2	6.8	6.7	10.1	0.47	0.47	0.47
15. Transportation and communication	10.4	9.2	3.8	2.0	1.0	1.2	1.8	0.35	0.17	0.21
16. Public illumination	.	.	.	2.1	1.3	1.6	4.8	.	.	.
17. Households	.	.	.	13.2	16.4	15.3	11.5	.	.	.

a) Output valued at factor cost and in 1968 prices. The following prices indices were used as deflators: wholesale price index for food-stuffs (sector 3); w.p.i. for textiles (sect. 4); w.p.i. for chemicals (sect. 7); w.p.i. for minerals (sect. 9 and 19); w.p.i. for construction materials (sect. 12); general w.p.i. (sect. 5, 6, 7, and 11). Data on real output for all other sectors could be taken directly from data source. Yearly data was used.

b) Cost of electricity of a sector is its electricity consumption multiplied with the average cost of electricity in that year.

c) Sectoral data for electric consumption for the period of 1980-83 was estimated by the data source, as is evident in Table A.6.

Source: Prime Ministry Institute of Statistics, Statistical Yearbook of Turkey (SYT) and Türkiye Elektrik Kurumu, Türkiye Elektrik İstatistikleri Özeti (1984); own calculations.



To establish a causal link between the growth in output and electric consumption on a sectoral basis, the nature of the specific production function and its stability over time should be analyzed. The estimation of sector-specific production functions was not possible, however, since data on energy inputs was not available to us. This is why we had to resort to the calculation of correlation coefficients between output and electric consumption.

How are these coefficients to be interpreted? A high correlation coefficient would indicate that changes in output and power consistently move into the same direction. There may be three reasons for that:

- a) Assuming a fixed relationship between output and energy, the elasticity of substitution for electricity with respect to all other energy sources is very low.
- b) Substitution of other sources of energy by electricity. This is not uncommon for developing countries due to enforced rural electrification and substitution of oil and traditional energy sources for economic reasons.
- c) Labor is substituted by capital while there exists a complementary relationship between capital and electricity. This is the usual implication of an industrialization process in developing countries.

A low coefficient would indicate a weak link between output and electric consumption. This may be so for several reasons:

- a) The consumption of electricity is fixed, i.e., it does not rise with increasing output. This is particularly relevant for the service sector.
- b) Electric power is substituted by capital, labor, and other energy sources for economic reasons. This case is rather unlikely for developing countries due to scarcity of capital. In addition most of the technology coming from the developed countries tends to favour electricity as the energy source.
- c) Electricity is rationed by public authorities forcing the entrepreneurs to substitute electricity for other energy sources. This is more common for developing countries since the price of electricity often does not reflect economic scarcity. In Turkey, however, this is not the case, as was mentioned in Section 2.1.
- d) Rising prices of electricity can lead to less waste in its use so that higher production is possible with a less than proportionate increase in electric consumption.

It is not possible for output to react with lag to a change in electricity consumption and vice versa because, unlike other inputs, electricity cannot be stored. It enters the production process immediately. Therefore, we do not have to take into account any lead or lag structures between the two variables.

We began our analysis by first calculating the correlation coefficient bet-

ween growth in total real output and in total electric consumption, as was done in previous studies. We found a coefficient of 0.73 for the period of 1973 to 1983 indicating a fairly strong positive relationship between the two variables (see also Table A.2 in the Appendix).

Then we calculated the coefficients using our sectoral data. Since reliable data was only available for the period of 1973 to 1979, we had to pool our data. The results are reported in Table 4.

Table 4      Correlation Coefficients for Real Output and Electrical Consumption in Turkey by Sectors Using Pooled Data (1973-1980)

Sectors	Correlation Coefficients	
	Using Absolute Values <sup>a)</sup>	Using Rates
1. Agriculture, forestry, hunting, and fishing; Food, beverage, and tobacco industries.	0.69	0.24
2. Mining; Manufacture of earthenware and cement.	0.79	0.03
3. Manufacture of textiles, leather, and clothing; Manufacture of wood, paper, and allied products.	0.86	0.32
4. Manufacture of rubber products; Manufacture of chemicals.	0.34	0.53
5. Iron and steel basic industries; Non-ferrous metal basic industries.	0.27	0.48
6. Manufacture of machinery, electrical appliances, and transport equipment; Manufacture of industries not elsewhere classified.	0.32	-0.13
7. Building and public works; Public administration and public utilities.	0.67	-0.27
8. Transportation and communication; Commerce services and handicrafts.	0.47	0.13

<sup>a)</sup> Standardized absolute values of real output and electrical consumption were taken. For further notes see Table 3.

Source: SYT; own calculations.

As can be seen from Table 4, the coefficients are quite high when absolute values of output and electric consumption are used. This may be due to a positive trend in both variables. We therefore calculated the correlation coefficients using rates of change to eliminate an influence of the trend. This led to a significant reduction in the values of the coefficients.

We did not find a strong relationship between the growth in output and electric consumption. The coefficient is highest for the manufacture of rubber products and chemicals where it reaches 0.53. The share of total output, however, was only 5.7% for the two sectors. The metal basic industries show a coefficient of 0.48, but here again the share of total output was only 2.0% in 1983. All other coefficients are too low to be considered significant in any way.

Obviously the sectoral approach leads to quite different results than the aggregate approach. The strong link between growth in output and electric consumption that came out of the aggregate approach could not be confirmed when the economy is disaggregated into a number of sectors. Although the coefficients vary to a considerable extent between sectors pointing to the different role of electricity in the sectoral production functions, they always remain well below the correlation coefficient of the aggregate approach. The low sectoral coefficients can be explained to some extent by the high variation in rates of change of both electric consumption and output (see Table A.4 and A.6).

On the aggregate level these fluctuations balance out somewhat leading to a more stable relationship between the two variables considered. Another reason for the low sectoral coefficients is the high share of services in total real output and the relatively minor importance of electricity for this sector as evidenced by the low correlation coefficients for sectors 13 - 15. The electricity-intensive sectors may have become less wasteful in their use of power due to rising prices of energy so that rising output could be achieved with relatively less electricity consumption. Our results indicate therefore that a strong link between output and consumption of electricity on the macro-level is not so much the cause of strong links between the two variables on the sectoral level as it is due to a major extent to the smoothing of fluctuations through the aggregation process. It is also the influence of the household sector's electric consumption, which has a high share of total electricity consumption and correlates closely to total real output (the correlation coefficient was 0.54), that helps to improve the coefficient on the aggregated level.



Our results would imply that the role of the power sector in inducing growth in output is a rather limited one, particularly as far as output growth in particular sectors is concerned. Using the electricity sector as an engine for growth in total output would also seem questionable since the share of total output for traditionally electricity-intensive sectors (e.g., non-ferrous metal basic industries, iron and steel basic industries) is quite low. This does not take anything away of the infrastructure argument for the power sector, however. Sufficient growth in quantity and quality of power supply remains a necessary precondition for output growth.

It should be stressed, however, that these results can only be preliminary. A broader data base is necessary to arrive at better founded conclusions.

## Conclusions

This paper has focused on the link between output and electric consumption in a developing economy.

In the theoretical section we have shown that the so-called "iron link" cannot exist since this relationship depends on the structural evolution brought about by the development process. The economic structure, in turn, follows closely the development strategy of the policy makers. An active role of the power sector in growth policy is subject to restrictive assumptions. The accompanying role of the power sector, however, remains unchallenged.

Our empirical results support the theoretical considerations in that the fairly strong link between growth in output and power consumption prevailing on the aggregate level could not be supported on a sectoral basis. However, further research is necessary to determine the exact nature of the sector-specific production functions and the role of electric power as an input factor in order to further substantiate our conclusions.

# Appendix

**Table A.1** Correlation Coefficients for Real Output and Electrical Consumption in Turkey by Sectors for the Period of 1973 to 1979<sup>a)</sup>

Sectors	Correlation Coefficients		
	Using Absolute Values ( $V_t$ )	Using Differences ( $V_t - V_{t-1}$ )	Using Rates ( $\frac{V_t - V_{t-1}}{V_{t-1}}$ )
1. Agriculture, forestry, hunting, and fishing.	0.95	-0.16	0.16
2. Coal and lignite mining; other mining industries.	0.83	-0.15	-0.20
3. Food, beverage, and tobacco industries.	0.26	0.25	0.33
4. Manufacture of textiles, leather, and clothing.	0.86	0.20	0.28
5. Manufacture of wood, paper, and allied industries.	0.74	0.71	0.58
6. Manufacture of rubber products.	0.98	0.85	0.85
7. Manufacture of chemicals.	-0.85	0.32	0.74
8. Manufacture of earthenware and cement.	0.89	0.52	0.40
9. Iron and steel basic industries.	-0.12	-0.34	0.11
10. Non-ferrous metal basic industr.	0.49	0.89	0.71
11. Manufacture of machinery, electrical appliances, and transport equipments.	0.91	0.45	0.35
12. Building and public works.	0.72	-0.09	-0.32
13. Public administration and public utilities.	0.94	-0.30	-0.02
14. Commerce services and handicrafts	0.72	-0.07	0.32
15. Transportation and communication	0.34	0.14	0.17

<sup>a)</sup> Due to the very low number of observations, the value of the correlation coefficients must be regarded as somewhat accidental.

For further notes see Table 3.

Source: SYT; own calculations.



**Table A.2**      **Growth of Total Real Output and Electric Consumption in Turkey**  
(1974 - 1984)

		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Growth of total <sup>a)</sup> real output	in %	8.8	8.9	8.9	4.9	4.3	-0.6	-1.0	4.7	4.3	4.1	5.8
Growth of total electric consumption		7.9	21.2	16.8	11.8	5.4	3.9	4.9	7.4	7.9	3.4	12.4

a) Total real output data was taken from SYT (national accounts). Output was valued at factor cost and in 1968 prices.

Source: SYT.

**Table A.3**      **Yearly Average Price of Electricity in Turkey (1973 - 1983)**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Price in TL per kw/h	0.409	0.531	0.538	0.620	0.727	0.995	1.296	3.142	4.621	6.253	7.867

Source: Türkiye Elektrik Kurumu, Türkiye Elektrik İstatistikleri Özeti (1984); own calculations.

Table A.4

## Growth of Real Output in Turkey by Sectors (1974-1983) in %

Sectors	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1. Agriculture, forestry, hunting and fishing	10.3	10.9	6.1	0.4	2.7	2.8	1.7	0.1	6.3	-0.1
2. Coal and lignite mining; other mining industries	20.9	11.6	1.7	42.9	16.2	-15.9	-10.7	0.3	-5.6	7.6
3. Food, beverage, and tobacco industries	5.0	9.6	-1.2	14.0	-16.0	2.9	5.9	27.0	11.3	1.3
4. Manufacture of textiles, leather and clothing	6.0	36.5	5.3	-6.5	28.2	0.5	-13.0	8.6	11.0	2.4
5. Manufacture of wood, paper, and allied industries	2.9	11.3	2.2	13.3	0.5	-13.8	6.2	25.3	12.9	-5.2
6. Manufacture of rubber products	-1.2	9.7	10.2	18.2	8.3	-2.2	0.5	11.5	14.0	-10.4
7. Manufacture of chemicals	27.9	-2.1	4.8	-7.7	-16.1	-2.4	69.2	35.4	12.7	2.2
8. Manufacture of earthenware and cement	11.7	10.7	17.4	16.7	1.0	-13.9	30.1	23.3	11.8	-12.9
9. Iron and steel basic industries	12.7	6.3	21.5	14.2	-22.7	-27.1	26.3	19.2	25.6	5.8
10. Non-ferrous metal basic industries	-20.0	22.7	19.6	19.8	-38.5	-5.5	46.6	24.4	7.1	6.6
11. Manufacture of machinery, electrical appli- ances, and transport equipments	-5.9	24.0	5.9	4.5	6.5	-9.1	-3.1	15.2	12.4	9.6
12. Building and public works	6.2	8.5	6.2	7.7	4.2	4.2	0.8	0.4	0.5	0.6
13. Public administration and public utilities	6.5	5.8	7.0	6.0	6.2	4.2	5.8	4.0	5.4	4.2
14. Commerce services and handicrafts	10.1	9.0	6.5	7.7	3.9	-11.8	9.0	9.2	4.2	5.8
15. Transportation and communication	8.3	8.1	8.9	7.3	2.5	-4.4	-3.6	4.3	0.6	3.3

Footnotes: See Table 3.

Source: SYT.

Table A.5 Cost of Electricity to Nominal Output Ratio for Turkey by Sectors (1973-1983) in %

Sectors	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1. Agriculture, forestry, hunting and fishing	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.22	0.16	0.07
2. Coal and lignite mining; other mining industries	7.53	6.05	5.69	5.41	3.54	3.50	3.04	3.35	2.83	3.26	2.87
3. Food, beverage, and tobacco industries	0.95	0.94	0.79	0.92	0.91	1.03	0.86	1.09	1.00	1.03	1.10
4. Manufacture of textiles, leather and clothing	2.11	1.81	1.74	2.04	2.12	1.90	1.43	2.09	1.98	2.03	1.91
5. Manufacture of wood, paper, and allied industries	3.71	4.42	3.81	3.90	3.59	3.40	2.90	3.62	3.42	3.47	3.72
6. Manufacture of rubber products	1.36	1.59	1.53	1.64	2.04	1.78	1.18	1.56	1.66	1.67	1.90
7. Manufacture of chemicals	1.28	1.12	1.03	1.24	1.27	1.34	0.97	0.79	0.68	0.69	0.74
8. Manufacture of earthenware and cement	8.85	8.42	9.60	8.18	7.09	6.77	5.42	5.53	5.32	5.46	6.37
9. Iron and steel basic industries	3.67	3.06	3.28	3.39	2.86	2.96	2.68	3.23	3.73	3.52	3.45
10. Non-ferrous metal basic industries	2.95	5.25	7.45	10.38	12.41	11.98	7.33	7.60	8.42	9.30	9.06
11. Manufacture of machinery, electrical appli- ances, and transport equipments	0.44	0.51	0.39	0.42	0.40	0.34	0.26	0.36	0.37	0.38	0.35
12. Building and public works	0.07	0.05	0.03	0.03	0.04	0.03	0.04	0.04	0.05	0.06	0.06
13. Public administration and public utilities	1.13	1.41	1.51	1.47	1.10	1.31	1.07	1.68	2.10	2.15	2.23
14. Commerce services and handicrafts	0.47	0.52	0.46	0.49	0.50	0.46	0.39	0.46	0.46	0.50	0.47
15. Transportation and communication	0.35	0.26	0.26	0.27	0.21	0.18	0.13	0.15	0.16	0.18	0.17

Footnotes: See Table 3

Sources: SYT and Türkiye Elektrik Kurumu, Türkiye Elektrik İstatistikleri Özeti (1984); own calculations.



Table A.6

Growth of Electric Consumption in Turkey by Sectors (1974-1983) in %<sup>a)</sup>

Sectors	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1. Agriculture, forestry, hunting and fishing	5.7	30.0	40.6	22.9	1.2	14.2	4.2	8.1	8.0	3.5
2. Coal and lignite mining; other mining industries	-12.0	6.5	4.0	4.8	-0.1	4.2	4.2	8.0	8.0	3.4
3. Food, beverage, and tobacco industries	2.2	9.1	15.1	19.4	7.6	5.8	4.2	8.0	8.0	3.4
4. Manufacture of textiles, leather and clothing	-7.6	17.7	25.4	5.0	3.9	1.3	4.2	8.0	8.0	3.4
5. Manufacture of wood, paper, and allied industries	19.7	5.6	6.5	14.3	6.8	-1.2	4.2	8.0	8.0	3.4
6. Manufacture of rubber products	12.6	16.5	20.3	61.0	6.0	-12.7	4.2	8.0	8.0	3.4
7. Manufacture of chemicals	19.0	11.9	14.5	14.1	8.0	5.7	4.2	8.0	8.0	3.4
8. Manufacture of earthenware and cement	3.9	38.9	1.9	10.9	8.2	-7.3	4.2	8.0	8.0	3.4
9. Iron and steel basic industries	7.7	13.7	20.1	6.4	12.6	11.5	4.2	8.0	8.0	3.4
10. Non-ferrous metal basic industries	63.0	73.7	59.3	58.5	-16.4	-2.4	4.2	8.0	8.0	3.4
11. Manufacture of machinery, electrical appli- ances, and transport equipments	5.2	5.4	16.5	9.2	0.0	-5.6	4.2	8.0	8.0	3.4
12. Building and public works	-19.1	-32.8	16.0	41.4	-0.1	39.9	4.0	8.1	8.1	3.3
13. Public administration and public utilities	13.6	40.0	11.2	-2.3	14.3	10.4	4.2	8.0	8.0	3.4
14. Commerce services and handicrafts	24.8	10.0	16.1	12.9	2.5	11.1	4.2	8.0	8.0	3.4
15. Transportation and communication	-19.2	21.6	11.4	-11.4	-3.9	-3.7	4.2	8.0	8.0	3.4
16. Public illumination	2.5	12.7	18.0	-13.9	8.6	5.0	-0.3	4.0	6.9	3.4
17. Households	7.5	26.5	22.4	15.4	10.4	8.5	9.2	4.7	7.2	3.4

Source: SYT.

<sup>a)</sup> Sectoral data for the period of 1980-83 was obviously estimated by the data source.

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