The energy crisis of the 1970s had a dramatic effect on Ohio's electric utilities. The comparative costs of electrical utilities across the nation. Triggered by the emergence of OPEC, oil prices in the United States increased 350 percent, while coal prices rose only 85 percent. The prices of coal, natural gas, and other natural fuels (see chart 3) rose 175 percent between 1973 and 1982. Hence, the ability to improve productivity through technological changes was not as high as in the early 1970s. Nevertheless, by increasing the level of capital utilization and returns to scale, utilities would have room for lowering their cost per unit of output. The rate base, which would put constant upward pressure on their prices. Under this scenario, more companies would find it advantageous to settle in other states, thus increasing the excess capacity of Ohio's utilities and incurring greater payments to the remaining customers for idle capacity.

While factors not considered in the preceding scenarios can affect electricity prices, many factors can be incorporated in the framework of these scenarios. Acid rain proposals, for example, would require utilities to increase capital expenditures and, at the same time, lower productivity; then the declining TFP and the rising rate base undoubtedly would increase electricity prices, as explained in scenario II.

Conclusion
While the energy price shocks in the 1970s created a price advantage for Ohio's electric utilities, a relatively slow reduction in Ohio's nonfuel expenses is needed. As a result, this period also jeopardizes this advantage. Especially in a period of flat energy prices, which is widely expected in the 1980s, Ohio's electric utilities may risk significantly compared with those of other states. This would be great concern to the state officials, as energy prices, although not decisive, are an important factor in the location decisions of industries. It is thus important to preserve Ohio's historical advantage in electricity prices.

What are the sources of price improvements that can be expected in the coming years? The productivity of Ohio's utilities rose until the early 1970s, but afterwards it declined. Apparently, the ability to improve productivity through technological changes was not as high as in the early 1970s. Nevertheless, by increasing the level of capital utilization and returns to scale, utilities will have room for lowering their cost per unit of output. However, the current high level of CWIP should be allowed into the capital (the rate base) of the utility, price of electricity relative to other states may be significantly increased, which would have an adverse effect on Ohio's economic development in the long run. To prevent that, PUCO should consider basing its prices not only on the utility's performance but also on changes in regional price differences throughout the United States.

Ohio's Electric Prices
by Philip R. Israilevich

The 1973 and 1979 oil embargoes dramatically increased fuel costs of electrical utilities across the nation. Triggered by the emergence of OPEC, oil prices in the United States increased 350 percent, while coal prices rose only 85 percent. The prices of primary energy sources (oil, coal, and natural gas) are a major cost component in the production of electricity. As a result, the ability of electricity utilities that use coal as the major fuel to generate electricity experienced a much smaller increase in production costs than oil or gas-dependent utilities. With 90 percent of their electricity generated from coal, Ohio's utilities have been major beneficiaries, along with Ohio's businesses and consumers, of a decline in coal prices relative to other natural fuels.

The relative decline of fuel costs to Ohio's utilities produced one of the slowest rates of electrical price increases in any state in the nation. In Ohio, utility prices are regulated, and changes in production costs are the major component of price changes. However, the nonfuel factors, such as declining utilization rates, increasing capital costs, and falling returns to scale, also increase the cost of producing electricity. One of the questions that we address in this article is whether falling relative coal prices have been overwhelmed by nonfuel factors that are rising more rapidly in Ohio than elsewhere. Or, how beneficial has it been to Ohio's consumers that their electrical utilities are coal-based?

Fuel Costs and Electricity Prices

The 1973 and 1979 oil embargoes dramatically increased fuel costs of electrical utilities across the nation. Triggered by the emergence of OPEC, oil prices in the United States increased 350 percent, while coal prices rose only 85 percent. The prices of primary energy sources (oil, coal, and natural gas) are a major cost component in the production of electricity. As a result, the ability of Ohio's utilities to generate electricity experienced a much smaller increase in production costs than oil or gas-dependent utilities. With 90 percent of their electricity generated from coal, Ohio's utilities have been major beneficiaries, along with Ohio's businesses and consumers, of a decline in coal prices relative to other natural fuels.

The relative decline of fuel costs to Ohio's utilities produced one of the slowest rates of electrical price increases in any state in the nation. In Ohio, utility prices are regulated, and changes in production costs are the major component of price changes. However, the nonfuel factors, such as declining utilization rates, increasing capital costs, and falling returns to scale, also increase the cost of producing electricity. One of the questions that we address in this article is whether falling relative coal prices have been overwhelmed by nonfuel factors that are rising more rapidly in Ohio than elsewhere. Or, how beneficial has it been to Ohio's consumers that their electrical utilities are coal-based?
electricity consumption in 1981.) In four of these seven states (Florida, California, Ohio, and Texas), the share of oil and natural gas in electricity production exceeded energy from coal. Oil and natural gas are used extensively for electricity production, particularly in the United States where oil and gas production is considered to be a leading source of energy (in Btu). For the remaining six states, this share is below 20 percent.

The average price of electricity after the oil embargoes decreased in coal-consuming states compared with the average for the United States. Electricity prices in Ohio decreased relative to those of the oil-consuming states of California, Florida, New York, and Texas. The relative price differential between Florida and Ohio, for example, varied from 19 percent in 1971 to 40 percent in 1981; between California and Ohio, from 1 percent to 28 percent. Electricity prices in Texas were 9 percent lower than in Ohio in 1971, but rose to 6 percent above Ohio prices in 1981. On the other hand, electricity in the state of Washington was 58 percent cheaper than Ohio's in 1971 and 65 percent cheaper than Ohio's in 1981. Because most of the electricity in Washington is generated by hydro-resources, the price of Washington's electricity was little affected by the energy crisis. Electricity prices are one component of electricity prices, we need to look at nonfuel factors to better understand the relationship between fuel costs and electricity prices. As shown in table 1, the lowest rate of change in the price of electricity took place in Ohio, as we would expect based on analysis of fuel prices alone. Moreover, one might also expect that Ohio's price of electricity in the future would be much smaller than that of California's. In fact, Ohio's composite fuel price in Ohio rose only 4 percent between 1971 and 1981 period; in California the price of a composite fuel rose 12 percent. Yet, electricity prices increased in Ohio only slightly less than in California (a three-fold increase in Ohio, compared with a four-fold increase in California).

In other words, California's utilities compensated for the surge in fuel expenses by the decline in nonfuel expenses so that, despite the surge in fuel prices, the actual price of electricity in California did not rise much above the price of electricity in Ohio. In fact, all of the states listed in table 1 seem to do better than Ohio in reflecting fuel price increases in terms of lowering their nonfuel expenses in the production of electricity. The contribution of non-fuel factors to California's electricity prices would have resulted from (1) an increase the purchasing of cheaper electricity from other states; (2) technological changes that allowed substitution cheaper fuels; and (3) improved productivity.

Realizing that each state's utilities have their own character, we might consider the nonfuel factors that could improve the performance particularly of Ohio's utilities. The purchase of electricity from other states historically was minimal in Ohio, and its future expansion is doubtful. Since demand for electricity, which would be improbable. Therefore, improvement in productivity would most probably assure stable electricity prices in Ohio relative to other states (again, assuming no change among fuel prices).

Yet, the regulatory price mechanism has no feedback from the failing demand for electricity, which would stop the price hike (see box 1). In Ohio, as well as in other states, regulators may or may not monitor the prices of regulated utilities. Profits of privately owned utilities are established by methods that are relatively uniform and comparable all over the country, yet regulators do not compare prices among states. Consequently, electricity prices vary considerably among states, even when the profits of utilities are regulated to the same level in every state.

## Table 1: Electricity Prices and Production of Composite Fuel

<table>
<thead>
<tr>
<th>State</th>
<th>Electricity Price: Dollars per million Btu</th>
<th>Production of Composite Fuel: Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio</td>
<td>9.40</td>
<td>14.68</td>
</tr>
<tr>
<td>California</td>
<td>4.97</td>
<td>18.77</td>
</tr>
<tr>
<td>Florida</td>
<td>5.82</td>
<td>20.62</td>
</tr>
<tr>
<td>Texas</td>
<td>4.47</td>
<td>15.56</td>
</tr>
<tr>
<td>United States</td>
<td>5.27</td>
<td>16.09</td>
</tr>
</tbody>
</table>

The price of electricity prices is important to measure a combined price of electricity. Lower electricity prices would be possible if fuel prices were to stabilize. Considering that Ohio's utility prices are regulated, it is important to compare Ohio's utility prices with those of other states. Although utilities in various states do not compete directly with each other for electricity sales, there is an indirect competitive mechanism. Regulators who drive utility prices above the price levels of other states can cause a decline in the industrial base in the state with higher electricity prices.

To analyze the price mechanism, it is important to measure a combined price of electricity. The price improvement was combined with moderate hikes in input prices. Even so, productivity improvements were so great that electricity prices in nominal terms declined. Post-1972 TFP started to decline, providing upward pressure on the price of electricity. In addition, during this period the price of fuel for electric utilities increased almost five times in nominal terms. As a result, revenue collected from electricity sales grew faster than the amount of electricity sold, and thus electricity prices rose. From 1980 to 1981, the electricity prices rose to the highest price increase in the last two decades (see chart 2). The accompanying increase in TFP for most states was modestly to the decline in the consumption of electricity. Despite this decline, utilities in most states raised their capital rates (basis) to meet an anticipated demand that never materialized. The rate-base, however, passed on the decline of electricity. The combination of an increasing rate base and declining demand for electricity prices increased almost five times in nominal terms.

### Implications for Future Prices of Electricity

Lower electricity prices allow lower production costs, translating into a competitive advantage for Ohio's businesses. Declines in electricity prices do not necessarily ensure expansion of businesses in a state, as a firm's localization decision is affected by many factors. Nevertheless, three of the Ohio-owned companies have been Ohio competitors in economic expansion, and the advantage of lower electricity prices in Ohio resulted mainly from fuel price differentials. Relative stability of fuel prices could eliminate this advantage in the future, making nonfuel factors a prime reason for interstate electricity price differences. The change from the relative decline of electricity prices to its relative increase could promote a deterioration of Ohio's industrial base.

Based on the historical observations of seven major Ohio utilities, two possible scenarios could shape electricity price changes in Ohio in the remainder of the 1980s:

**Scenario 1:** The excess capacity accumulated in the last decade will allow

1. Composite fuel prices represent the average fuel prices used exclusively in the production of electricity, measured in dollars per million Btu.

2. This is revealed by elasticities of electricity prices to fuel prices, which are reported below for 1971-81, derived from double log regressions for each state. Ohio has the highest elasticity, i.e., 1 percent of the fuel price increase would reduce the highest increase of electricity prices in Ohio compared with the other listed states: Ohio 0.62 (26).

3. According to the equation shown in box 1, a utility rate increases from $100 to $120 per MWhr (1971-81), where terms in parentheses are the factor products.

4. There are two sources of TFP growth: (1) growth in output (electricity consumed) adjusted for price, i.e., output increases, input necessary to produce units of output decline), and (2) the effect of technological change. For more information, see the Federal Reserve Bank of Cleveland, "Electricity composite fuel prices, fuel prices, Electricity Fuel prices, Fuel price ratio: Ohio.

5. This price is illustrated in "Ohio's Electric Utilities," forthcoming working paper of the Federal Reserve Bank of Cleveland.

6. Theoretically, energy prices should play an important role in industrial location decisions. Presentations provide an indication of the significance of the role of energy in plant locational decisions. For example, electricity in Ohio is cheaper than in Florida or California, and the gap in prices widened by 1981. Nevertheless, there were more companies settling in California and Florida at that time.

**Scenario 2:** The excess capacity accumulated in the last decade will allow

1. Composite fuel prices represent the average fuel prices used exclusively in the production of electricity, measured in dollars per million Btu.

2. This is revealed by elasticities of electricity prices to fuel prices, which are reported below for 1971-81, derived from double log regressions for each state. Ohio has the highest elasticity, i.e., 1 percent of the fuel price increase would reduce the highest increase of electricity prices in Ohio compared with the other listed states: Ohio 0.62 (26).

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electricity consumption in 1981.) In four of these states (Texas, Florida, California, and New York), the share of oil and natural gas in electricity production dropped whereas the share of coal increased. The reduction in oil and natural gas usage contributed to the reduction in the share of oil and natural gas in electricity production in these states, with the exception of Florida, where coal usage increased.

For the remaining six states, this share is below 20 percent. The average price of electricity after the oil embargoes decreased in coal-consuming states compared with the average for the United States. Electricity prices in Ohio decreased relative to those of the oil-consuming states of California, Florida, New York, and Texas. The relative price differential between Florida and Ohio, for example, rose from 19 percent in 1971 to 40 percent in 1981; between California and Ohio, from 1 percent to 28 percent.

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In 1971, the cost of producing one unit of electricity was the same across states, but the prices of electricity were different. In 1981, the price of electricity in Ohio was lower than in California but higher than in Florida and Texas. This was due to the difference in the price of fuel. In Ohio, the price of fuel was lower than in California, but higher than in Florida and Texas. The price of fuel was also lower in Florida and Texas than in Ohio, which explains the difference in the price of electricity.

To analyze the price mechanism, it is important to measure a combined price index of fuel and nonfuel factors. This index is measured in dollars per million Btu.

Chart 2 Electricity Prices and Quantity Sold by Ohio's Major Electric Utilities, 1964 to 1982

Lower electricity prices allow lower production costs, translating into a competitive position in the interstate market. Declines in electricity prices do not necessarily ensure expansion of business in a state, as a firm's location decision is affected by many factors.
The energy crisis of the 1970s had a dramatic effect on Ohio's electric utilities. The comparative costs of electrical utilities across the nation. Triggered by the emergence of OPEC, oil prices in 1970 increased by 175 percent between 1972 and 1973 (after adjusting for inflation). Over the same period, primary energy prices (oil and natural gas) increased 350 percent, while coal prices rose only 85 percent. The prices of primary energy components, electricity, and TFP climb upward. Also, energy source prices might stop their tremen
dously increased. If demand rises, price increases; if demand falls, price declines. Nevertheless, under the current regulatory rule, a rise in consumption of electricity tends to lower electricity prices, and a decline in consumption tends to raise electricity prices for the following reasons. The rise in electricity consumption is greater than utilization increases in electricity prices, which would have an adverse effect on Ohio's economy. The relative decline of fuel costs to Ohio's utilities produced one of the slowest rates of electrical price increases in any state in the nation. In Ohio, utilization is regulated, and changes in production costs are the major component of electrical price changes (see box 1). Fuel prices, of course, are not the only factor determining electrical prices. Nonfuel factors, such as declining utilization rates, increasing capital costs, and failure to invest, also increase the cost of producing electricity. One of the questions that we address in this article is whether falling rela
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sumers that their electrical utilities are coal-based?

**Fuel Costs and Electricity Prices**

**Box 1 Utility Regulation in Ohio**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>$Q$</td>
<td>electricity output</td>
</tr>
<tr>
<td>$r$</td>
<td>price per unit of output (Kwhr)</td>
</tr>
<tr>
<td>$L$</td>
<td>variable inputs (material, fuel, labor, services) used by utilities</td>
</tr>
<tr>
<td>$w$</td>
<td>cost of variable inputs</td>
</tr>
</tbody>
</table>

The goal of utility regulation is to award the regulated utility a "fair rate of return" (electrically called the rate base), which is the sum of its assets. The process of price-setting can be expressed as the following equation:

$$P = Q - wL - rK$$

The main purpose of the Public Utilities Commission of Ohio (PUCO) is to adjust electricity prices to achieve the allowable rate of return. In other words, revenue ($PQ$) should cover variable costs and capital costs ($PQ = wL + K$). Therefore, electricity prices should be set so that the level that guarantees no excess profit or loss ($=0$). Variable costs ($wL$) increase, revenues would have to go up by the same amount, other factors being constant. Or, if the capital stock (the rate base) expanded, then the electricity price would have to be raised to cover the increase in the rate base (rate base = $K$). PUCO is not allowed to include construction work in progress (CWP) in the rate base until the construction work is at least 75 percent complete, after which PUCO uses its own discretion to account for CWP.

In reality, PUCO cannot control prices continually. According to the well-accepted view of Jensen (1978), PUCO is a passive agent. It exercises its power when a utility files a petition regarding incurred losses or when it is pressured by consumer advocates to lower a utility's profit.

In a competitive environment, if demand rises, prices increase; if demand falls, prices decline. Nevertheless, under the current regulatory rule, a rise in consumption of electricity tends to lower electricity prices, and a decline in consumption tends to raise electricity prices for the following reasons. The rise in electricity consumption is greater than utilization increases in electricity prices, which would have an adverse effect on Ohio's economy. The relative decline of fuel costs to Ohio's utilities produced one of the slowest rates of electrical price increases in any state in the nation. In Ohio, utilization is regulated, and changes in production costs are the major component of electrical price changes (see box 1). Fuel prices, of course, are not the only factor determining electrical prices. Nonfuel factors, such as declining utilization rates, increasing capital costs, and failure to invest, also increase the cost of producing electricity. One of the questions that we address in this article is whether falling relative coal prices have been overwhelmed by nonfuel factors that are rising more rapidly in Ohio than elsewhere. Or, how beneficial has it been to Ohio's con-

**References**


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