ESTIMATING THE IMPACT OF HIGHER ELECTRICITY RATES ON INTERSECTORAL PRICES: AN INPUT-OUTPUT APPROACH

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Abstract

A recent ruling by the United States Supreme Court makes it more likely than ever that the cost overruns associated with nuclear power plant construction will be passed on to consumers. The ruling of the court did not address the retail sale of electricity directly. However, an implication of the opinion is that wholesale electric price increases will be passed on to the final consumers. This paper employs an input-output framework, the RAS matrix updating technique, and an energy price model to determine the intersectoral price impact of an electric rate hike on a plains state economy. The purpose was to generate information on the process of price shock transmission throughout a regional economy and to identify the sectors most affected. Moreover, the upper limit of the price shock to the household sector also is discussed. The major findings of the paper are that the services sector is most affected by the electric rate hike and agriculture is least affected. Furthermore, the results indicate that no sector is significantly impacted. However, the cumulative result on households could be substantial and cause a reduction in their purchasing power.

Introduction

The economic consequences of multibillion dollar cost overruns associated with nuclear power plant construction have taken on a new urgency. The United States Supreme Court recently ruled by a six to three margin that interstate electric utility holding companies are exempt from the decisions of state regulatory bodies. The June 1988 ruling was based on the case of the Mississippi Power and Light Company v. the State of Mississippi. The pertinent part of the ruling, for the purposes of this paper, is that the Federal Energy Regulatory Commission, not the states, will decide on the merits of a wholesale electric rate increase when the parent firm sells electricity to its subsidiaries. In the opinion of lawyers for the National Association of State Utility Consumers, the Federal agency seldom has found imprudence on the part of utilities (New York Times, 1988a). Moreover, they believe that the federal government historically has been more willing than the states to assess consumers for costs associated with uneconomic investments made by utilities. This situation exists partially because of the political and geographic distance between the policy making board and the affected areas. The possibility arises, therefore, that many areas of the country will become more vulnerable to large rate increases, ceteris paribus (New York Times, 1988b).

The purpose of this article is threefold. First, it attempts to quantify the static impact of substantially higher electricity costs on sectoral output prices for each industry in a selected region. Second, the article addresses the price impact on the household sector. Third, the results of this paper will facilitate a detailed description of price change behavior that takes account of intersectoral linkages. The mathematical foundation of the study is derived from input-output theory, the RAS matrix updating procedure, and a price change model.

Input-output analysis, which is required for detailed examination at the regional level, has been hindered by a lack of survey data, a situation likely to continue into the foreseeable future (Miernyk, 1982). The primary cause for this has been the expense of collecting the information required for the construction of an input-output table. Given the budget tightening activity of governmental units in the late 1980s, the situation is not likely to improve.

Thus, there has been continued effort by regional economists to devise procedures that circumvent the concomitant problems of scarcity of regional input-output data and the costs of generating data bases. This paper will offer an approach whereby researchers can conduct detailed price change analyses using previously published input-output tables.

The Problem

Opinion as to the degree to which an electric rate hike can effect regional sectoral output prices covers a continuum ranging from little to no impact to major ramifications for the regional economy. *This paper is an* attempt to quantify this relationship for a region so that it will not be necessary to leave the argument to idle speculation and hearsay. Furthermore, it addresses the question:

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which industries will be most affected through intersectoral linkages?

The region selected for analysis was the state of Kansas and the year was 1982. Selection of 1982 was based upon: (1) construction of a nuclear generating plant at Wolf Creek, Kansas occurred during the early 1980s; (2) federal census data needed in the RAS updating procedure were published in 1982; and (3) the census data used were, and still are the most current, complete set available.

To facilitate the study, the 1969 Kansas Input-Output Table was used as the initialization matrix in the RAS iterative updating process (University of Cambridge, 1963). This complete survey table was the most current available at the time of the research (Emerson, 1971a). The purpose and process of RAS is described by Bacharach (1970):

> The RAS method deals primarily with changes that arise when (1) the relative intersectoral relationships between intermediate demand and final demand changes, and (2) the relative intersectoral relationships between intermediate inputs and primary inputs change. The first relationship reflects the degree of absorption in the industrial structure. The second one reflects the degree of fabrication. The former operates across rows; the latter works along columns. The main assumption of the RAS method is that given initial changes, the degree of absorption per unit of output and the degree of fabrication per unit of input, change proportionally for each row and column.

Moreover, a price change model was adapted and linked to the RAS updated Kansas processing matrix (Melvin,1976a).

Models

To determine the impact of raising electrical rates on sectoral output prices consider the following.
Let

- U = a vector of regional intermediate outputs, i.e. the row constraint, (n x 1)
- V = a vector of regional intermediate inputs, i.e. the column constraint, (n x 1)
- X = a vector of regional total outputs, (n x 1)
- ′ = a transpose sign
- ^ = a diagonalized vector
- A = a technology matrix of direct requirements, (n x n)
- i = an identity vector, (n x 1)
- Subscript = the iteration number

The RAS iteration process begins by noting the relationship

$$U_1 = A_1X. \qquad (1)$$

The matrix A_1, or the initializing matrix to be updated, is the 1969 Kansas technology matrix. The vector X represents an estimation of the vector of total outputs for the year of interest. The term U_1 represents a first iteration estimate of a vector of regional intermediate outputs. Next let

$$A_2 = \hat{U}\hat{U}_1^{-1}A_1 \qquad (2)$$

Where A_2 represents the condition that the technical coefficients of A_1 are adjusted to conform to the row constraint, U. A similar process is required for the columns of A_2. That is

$$V_1 = \hat{X}A_2'i \qquad (3)$$

In equation (3), V_1 represents a first iteration estimate of a vector of regional intermediate inputs. Furthermore let

$$A_3 = A_2\hat{V}\hat{V}_1^{-1} \qquad (4)$$

This indicates that the technical coefficients of A_3 are adjusted with respect to the column restraint. However, due to this process, the row constraint no longer is in effect. Thus, the RAS process commences again and

$$U_2 = A_3X \qquad (5)$$

and

$$A_4 = \hat{U}\hat{U}_2^{-1}A_3 \qquad (6)$$

Thus the rows of the matrix are now adjusted to their constraint; however, the columns no longer agree with their constraint because of the action taken in equation (6). The columns will be adjusted in the manner illustrated by using A_4 as the initializing matrix. This iteration process continues until the A matrix converges toward the simultaneous satisfying of both the row and column constraints. Bacharach (1974) offers formal proof that the process converges to a unique solution. Furthermore, Czamanski and Malizia (1969, p.71) state "the striking fact is that the process converges extremely rapidly...as a matter of fact, the differences in the results obtained after ten iterations and those obtained after the first iteration were never nearer than in the fourth or fifth decimal place".

Furthermore, there is a body of scholarly literature that supports RAS as the most accurate of the matrix updating techniques, e.g., Morrison and Smith (1974), McMenamin and Haring (1974a), Butterfield and & Mules (1980a). Moreover, the literature indicates that RAS yields reasonable estimates of such aggregates as output multipliers in part because of the cancellation of errors. McMenamin and Haring (1974b), report that, if the primary use of the table is to generate regional income or output multipliers, the RAS method provides quite satisfactory results. Price change vector aggregation is similar in nature, and plays an important role in the compilation process. Therefore the RAS method is appropriate when aggregates are to be employed. However, it is well known that structural changes in an individual industry may not be captured and subject to substantial estimation errors when using RAS (Butterfield and Mules,1980b).

To facilitate the research it was necessary to construct estimates of the U, V, and X vectors. This was accomplished by utilizing a variety of government and industry data. For example the U,V, and X vectors for the electric sector were updated to 1982 by data collected from the Kansas Corporation Commission (1982). All other sectoral estimates of intermediate output, intermediate input, and total output were updated by using figures from the U.S. Census - Kansas, for Agriculture (USDC,1984a), Mineral Industries (USDC 1986), Construction (USDC 1985a), Manufacturing (USDC 1985b), Wholesale Trade (USDC 1985c), Retail Trade (USDC 1985d), and Service Industries (USDC 1985e). Data also were gathered from the Kansas Department of Insurance (1982), Kansas Banker's Association (1983), and the Kansas Department of Banking (1985). Moreover, additional data were taken from various issues of USDC County Business Patterns, RMA Annual Statement Studies (Morris Assoc. 1982), and from the 1969 Kansas Input-Output Table (Emerson 1971), and the 1977 Detailed Input-Output Table of the United States (USDC 1984b). A more in depth treatment of the updating procedure is given in Cray (1986).

The next phase of the development of the model required the adoption of a price change model that was adapted for this study from Melvin (1976b). An explanation of the model follows. Assume that there are only three industries in the region. Moreover, under an input-output framework total output must equal total input, i.e. input and output are an accounting identity. Mathematically, the system can be represented as:

$$X_1 = X_{11} + X_{21} + X_{31} + L_1 + V_1 + M_1 \qquad (7)$$
$$X_2 = X_{12} + X_{22} + X_{32} + L_2 + V_2 + M_2 \qquad (8)$$
$$X_3 = X_{13} + X_{23} + X_{33} + L_3 + V_3 + M_3 \qquad (9)$$

Where

X_j = The total dollar value of all inputs purchased by sector j that are required to produce the total output of sector j during an accounting period.

X_{ij} = The dollar value of newly produced output created by sector i and purchased by sector j to produce the total output of sector j during an accounting period.

L_j = The dollar value of the labor input purchased from households by sector j in producing its total output of sector j during an accounting period.

V_j = The dollar amount of value added, other than labor, needed to produce the total output of sector j, e.g. undistributed corporate profits, corporate taxes, and capital asset depreciation, during an accounting period.

M_j = The dollar value of inputs produced outside the region purchased by sector j to produce the total output of sector j during an accounting period.

Note: the subscripts in the above model refer to row and column designations of the Kansas A matrix. Furthermore, fixed production relationships with constant returns to scale are assumed to exist in the system. This allows the division of equation (7) by X_1, equation (8) by X_2, and (9) by X_3. As a result of the indicated division the system becomes

$$1 = a_{11} + a_{21} + a_{31} + l_1 + VA_1 + m_1 \qquad (10)$$
$$1 = a_{12} + a_{22} + a_{32} + l_2 + VA_2 + m_2 \qquad (11)$$
$$1 = a_{13} + a_{23} + a_{33} + l_3 + VA_3 + m_3 \qquad (12)$$

Where

$a_{ij} = X_{ij}/X_j$
$l_j = L_j/X_j$
$VA_j = V_j/X_j$
$m_j = M_j/X_j$

Now assume that industry, number 3 is given permission to raise the rates that it can charge customers, i.e. industry 3 is a regulated monopoly. Therefore, the term a_{31} in equation (10) can be written as $a_{31}(1+R)$. Where R equals the percentage change in the rate. In other words, for industry 1 the cost of purchasing inputs from industry 3 has risen. Remembering that by definition total input must equal total output, and assuming that the returns to labor and capital do not change, then the price charged by industry 1 for its commodity must rise by an amount equal to the change in its input cost. Furthermore, prices charged by industries 2 and 3 also must rise as they both require inputs from industry 3, i.e. a_{32} and a_{33}. The direct and indirect price effects can be represented for industry 1 as,

$$1 + \dot{P}_1 = a_{11}(1+\dot{P}_1) + a_{21}(1+\dot{P}_2) + a_{31}(1+R)(1+\dot{P}_3) + V_{A1} + m_1 \qquad (13)$$

where $\dot{P}_1$ is defined as the percentage change in the price of output due to an exogenous shock. Note that the price of the input purchased from industry 3 by industry 1 has two adjustment components. The first, (1+R), reflects the rate change. The second, $(1+\dot{P}_3)$, reflects the increase in the commodity price caused by increased input costs.

Multiplying equation (13) by the indicated operations and substracting equation (10) yields,

$$\dot{P}_1 = a_{11}\dot{P}_1 + a_{21}\dot{P}_2 + a_{31}(1+R)\dot{P}_3 + a_{31}R \qquad (14)$$

Similar operations on equations (11) and (12) for industries 2 and 3 respectively, yield results that can be written in the general form of equation (14) and can be set out as,

$$\dot{P}_2 = a_{12}\dot{P}_1 + a_{22}\dot{P}_2 + a_{32}(1+R)\dot{P}_3 + a_{32}R \qquad (15)$$

$$\dot{P}_3(1+R) = a_{13}\dot{P}_1 + a_{23}\dot{P}_3 + a_{33}(1+R)\dot{P}_3 + a_{33}R \quad (16)$$

Furthermore, in matrix notion the system can be represented as:

$$\dot{P} = A' \cdot \dot{P} + a_3 \cdot R \quad (17)$$

or

$$\begin{bmatrix} P_1 \\ P_2 \\ P_3(1+R) \end{bmatrix} = \begin{bmatrix} a_{11} + a_{21} + a_{31} \\ a_{12} + a_{22} + a_{32} \\ a_{13} + a_{23} + a_{33} \end{bmatrix} \bullet \begin{bmatrix} P_1 \\ P_2 \\ P_3(1+R) \end{bmatrix} + \begin{bmatrix} a_{31} \\ a_{32} \\ a_{33} \end{bmatrix} \bullet R$$

Finally, equation (17) can be solved for P,

$$\dot{P} = (I - A')^{-1} \cdot a_3 \cdot R \quad (18)$$

To summarize, $\dot{P}$ is a (3X1) vector of percentage changes in sectoral commodity prices; I is a (3X3) identity matrix; a_3 is the column vector (a_{31}, a_{32}, a_{33}); R is a scalar that is defined as the electricity rate change. The matrix, A', is the transpose of the technology matrix of the input-output system. The generalized energy model easily can be expanded to handle a larger system, e.g. the state of Kansas.

Limitations of this approach should be discussed. First, substitution effects resulting from rising electric inputs costs are ignored. That is, to the extent that it is possible for some sectors to substitute other domestic or imported inputs for domestically generated electricity in the production process, estimates of the percentage price changes will be biased upward. Furthermore, substitutions could occur due to increases in the prices of outputs of other industries when supplying industries raise prices in response to the higher electric rates.

Second, the notion that returns to capital and labor are unaffected, is implicit in the assumption that energy cost increases will be passed on entirely in the form of higher commodity prices. An argument can be made that an unknown portion of the higher energy costs will be absorbed by a reduction in the returns to capital and labor. To the extent that this occurs, the price change vector will be biased upwards.

Third, the static approach of this type of model does not take into account the time dimension. The approach assumes that the price structure of a region at time 0 will achieve a new level at time 1; however, the path of the adjustment between time 0 and time 1 is not specified. This deficiency is not critical if the only purpose is to measure the total impact after an unspecified period time.

The Hybrid Energy Price Model

The price model is interfaced with the RAS matrix updating technique to form a hybrid energy price model.

$$\dot{P} = [I - A'_{UKS82}]^{-1} \cdot a'_{UKS82} \cdot R \quad (19)$$

where $\dot{P}$ = an (n x 1) vector of percentage changes in commodity prices.

a'_{UKS82} = the (n x 1) transposed updated electricity row from A_{UKS82}

A'_{UKS82} = the (n x n) transpose of the RAS updated 1982 Kansas technology matrix.

The hybrid model can be employed to estimate a vector of percentage changes in prices for the region. Information regarding one of the major economic impacts of a nuclear power plant- the effect of electricity rates on regional output prices- will be generated. For this analysis, R, the weighted average rate change, was assumed to be 14 percent in determining the sensitivity of the $\dot{P}$ vector to electric rate change (Table 1). Table 1 was constructed by taking the 1982 operating revenue of the three utilities involved with Wolf Creek as percentages of total industry revenue in the region. The percentages were multiplied by the proposed average rate increase to approximate the weighted impact on the Kansas economy. [1] Price responsiveness with respect to a hypothetical 1 percent electric rate change also will be calculated for each sector for reference purposes.

Results

Table 2 presents the results of the hybrid energy model. The coefficients in column 1 represent the percentage changes in industry commodity prices derived for the open version of the model. Column 2 shows the price change coefficients for the closed model which treats the household sector as an endogenous component of the system. For example, the Business Services Industry classification in the open model indicates a 0.20 percent price increase, and in the closed version a 0.51 percent price increase in response to an estimated 14 percent rise in electricity costs.[2]

The 11 industrial sectors that would be most affected by a rate increase are presented in Table 3 for the closed model. The results provided by the Hybrid Model give regulators and policy makers a first approximation as to the industries that will be most affected by their decisions. After the industrial groupings were aggregated, the electric rate hike had the following average impacts under the closed model (Table 4). Ignoring the utility sector where the input cost disturbance originated, the aggregated industrial classification most affected by the electricity price increase was the services industry. SIC industries in this group include hotels, motels, automobile repairs, motion pictures, medical and health services, et.al. The least affected broad aggregate was agriculture, including the SIC categories corn, wheat, dairy products, and hogs, et.al.

Table One
Weight Given To The Electric Rate Increase

Utility	(1) 1982 Operating Revenue (Dollars)	(2) Proposed Average Rate Increase (percent)	(3) Operating Revenue As A Percent Of Total Revenue (percent)	(4) Weight Given Increase (2) X (3) (percent)
Kansas City Power and Light	132,891,253	14.7	12.0	2.0
Kansas Gas And Electric	313,652,186	36.7	29.0	11.0
Kansas Electric Power Co-op	18,012,089	25.0	2.0	1.0
Totals	464,555,528			14.0
1982 Industry Total Revenue	1,090,465,361			

Source: Kansas Corporation Commission, Topeka, Kansas.

The coefficients in Tables 3 and 4 can be interpreted as indicating the importance of the electrical input in the production process when intersectoral linkages are considered. In other words, an activity such as Lodging Services has an output price change coefficient of 1.2 percent. This coefficient is relatively large, compared to those of other industrial classifications. Casual observation of the process of providing lodging reveals that hotels and motels use large amounts of electricity relative to other intermediary inputs. Heating and air conditioning often are provided by electrical devices. Furthermore, laundry services are performed by most lodging establishments. That is, linens and towels are washed and dried by in-house electrical units. This casual observation as to the importance of the electricity input can be confirmed by examining the direct coefficients matrix for Kansas. Table 5 gives the percentage price changes for the open and closed models for a hypothetical 1 percent increase in electricity rates. This table is provided for pedagogical reasons. For example, note that for Business Services a 1 percent electricity rate increase would cause 0.014 and 0.036 percent increases in sectoral output prices for the open and closed models, respectively.

The Price Level Impact on the Household Sector

The impact of the electricity price increase on the household sector is examined in this section. Concern is with the determination of the total price change that households in the region will experience, given a 14 percent electricity rate hike. The impact analysis starts with the price change vector generated by the 1982 RAS Kansas closed input-output model. This vector was weighted by a column derived from the 1969 direct coefficients matrix. This weighting vector was constructed by dividing the amount of output purchased by households from the i th industry dividing by the total output of the i th industry. For example, the household sector consumes 86.3 percent of the total output created by the eating and drinking industry. Therefore, 86.3 percent of the price increase in that industrial sector will be transmitted to the household sector. The weighted vector, Table 6, represents the price level impact on households given their historic consumption patterns. The sum of the vector, 6.6 percent, is the weighted price level change that households would experience, given the hypothetical change and intersectoral linkages. Because of the discussed rigidities of the price change model and input-output analysis, the 6.6 percent increase represents a theortical maximum one time only change.

Due to the paucity of regional data, no attempt was made to construct household price elasticities. Furthermore, it was not possible to use national numbers to construct regional elasticities given the uniqueness and detail of the Kansas I/O system. That is, the 11 agricultural sectors of the unabridged Kansas system have no national

Table Two
1982 Total Percentage Price Change, By Sector, Resulting From An Electric Rate Increase Of 14.0 Percent

Sector	Price Changes (Open Model 1982 R=14.0) (percent)	Price Changes (Closed Model 1982 R=14.0) (percent)
1. Agricultural Products	2.320056	3.769116
2. Agricultural Services	0.352449	0.577428
3. Crude Oil and Natural Gas	0.045700	0.107812
4. Oil and Gas Field Service	0.179733	0.431752
5. Nonmetalic Mining	0.286437	0.368935
6. Other Mining	0.791152	1.007086
7. Building Construction	0.156200	0.360806
8. Heavy Construction	0.200168	0.390917
9. Special Trade Construction	0.085186	0.277149
10. Meat Products	0.168411	0.267433
11. Dairy Products	0.619995	0.820402
12. Grain Mill Products	0.225172	0.340515
13. Other Foods and Kindred Products	0.327214	0.466414
14. Apparel	0.120271	0.293173
15. Paper and Allied Products	0.412845	0.575103
16. Printing and Publishing	0.127050	0.263795
17. Chemical Products	0.385488	0.529455
18. Petroleum and Coal Products	0.485449	0.667182
19. Rubber and Plastic Products	0.700298	0.913640
20. Stone, Clay, and Glass Products	0.208710	0.387960
21. Primary Metals Industry	0.224704	0.465456
22. Fabricated Metal Products	0.578380	0.822325
23. Farm Machinery and Equipment	0.304464	0.500460
24. Construction Machinery	0.213798	0.422944
25. Food and Special Industry Machinery	0.198456	0.395393
26. Electrical Machinery	0.104847	0.303086
27. Other Machinery	0.433601	0.629449
28. Motor Vehicles	0.720900	0.978756
29. Aerospace	0.305712	0.533788
30. Trailer Coaches	0.247501	0.550445
31. Other Transportation Equipment	0.017842	0.300980
32. Miscellaneous Manufacturing	0.240568	0.454477
33. Rail Transportation	0.130897	0.298145
34. Trucking and Warehousing	0.117975	0.272077
35. Water, Air, and Pipeline Services	0.256766	0.387432
36. Communications, Gas, and Sanitary Services	0.160998	0.349265
37. Electrical Production	3.726232	3.798496
38. Groceries and Related Products	0.511071	0.636532
39. Farm Products and Raw Materials	0.398489	0.496442
40. Machinery, Equipment and Supplies	0.341710	0.525560
41. Other Wholesale Trade	0.207353	0.312529
42. Farm Equipment Dealers	0.361945	0.544555

Table Two (continued)
1982 Total Percentage Price Change, By Sector, Resulting From An Electric Rate Increase Of 14.0 Percent

Sector	Price Changes (Open Model 1982 R=14.0) (percent)	Price Changes (Closed Model 1982 R=14.0) (percent)
43. Gasoline Service Stations	0.400435	0.552414
44. Eating and Drinking Places	0.359326	0.576396
45. Other Retail Trade	0.257934	0.387274
46. Banking	0.320784	0.612437
47. Other Financial Institutions	0.153322	0.470171
48. Insurance and Real Estate	0.208999	0.516599
49. Lodging Services	1.003232	1.158920
50. Personal Services	0.330961	0.550553
51. Business Services	0.195605	0.506219
52. Medical Services	0.158299	0.348322
53. Other Services	0.200968	0.426802
54. Education	0.577734	0.820183
55. Households	———	0.320169

I/O-table counterparts and it was beyond the scope of the study to develop regional elasticities. Lastly, one of the major objectives of this paper was to provide an upper bound to the price shock, or a worst case scenario.

Conclusion

This paper has examined the impact and linkages of rising electricity rates on regional sectoral output prices.

Table 3
Rank Order Of Industries Sustaining The Greatest Impact From The Electric Rate Hike

Sector	Price Change (percent)
Electrical Production	3.80
Lodging Services	1.16
Other Mining	1.00
Motor Vehicles	0.98
Rubber and Plastic Products	0.91
Fabricated Metal Products	0.82
Dairy Products	0.82
Education	0.82
Petroleum and Coal Products	0.67
Groceries and Related Products	0.63
Other Machinery	0.63

Table 4
Rank Order Of The Average Effect Of A 14.0 Percent Electric Rate Increase On Major Industrial Groups

Sector	Price Change (percent)
Utilities	2.07
Services	0.64
F.I.R.E.	0.53
Manufacturing	0.52
Retail Trade	0.52
Wholesale Trade	0.50
Mining	0.48
Construction	0.34
Agriculture*	0.34

*The complete Kansas Input-Output table contains eleven agricultural sectors.

Table 5
1982 Total Percentage Price Change, By Sector, Resulting From An Electric Rate Increase Of 1.0 Percent

Sector	Price Change (Open Model 1982 R=1.0) (percent)	Price Change (Closed Model 1982 R=1.0) (percent)
1. Agricultural Products	0.165718	0.269223
2. Agricultural Services	0.025175	0.041244
3. Crude Oil and Natural Gas	0.003254	0.007701
4. Oil and Gas Field Services	0.012838	0.030839
5. Nonmetalic Mining	0.020460	0.026353
6. Other Mining	0.056511	0.071935
7. Building Construction	0.011157	0.025772
8. Heavy Construction	0.014298	0.027923
9. Special Trade Construction	0.006085	0.019796
10. Meat Products	0.012029	0.019102
11. Dairy Products	0.044285	0.058600
12. Grain Mill Products	0.016084	0.024322
13. Other Foods and Kindred Products	0.023372	0.033315
14. Apparel	0.008591	0.020941
15. Paper and Allied Products	0.029489	0.041079
16. Printing and Publishing	0.009075	0.018843
17. Chemical Products	0.027535	0.037818
18. Petroleum	0.034675	0.047656
19. Rubber and Plastic Products	0.050021	0.065260
20. Stone, Clay, and Glass Products	0.024908	0.027711
21. Primary Metals Industry	0.016050	0.033247
22. Fabricated Metal Products	0.041313	0.058738
23. Farm Machinery and Equipment	0.021747	0.035747
24. Construction Machinery	0.014175	0.028242

Table 5 (continued)
1982 Total Percentage Price Change, By Sector, Resulting
From An Electric Rate Increase Of 1.0 Percent

Sector	Price Change (Open Model 1982 R=1.0) (percent)	Price Change (Closed Model 1982 R=1.0) (percent)
25. Food and Special Industry Machinery	0.014175	0.028242
26. Electrical Machinery	0.007489	0.021649
27. Other Machinery	0.030989	0.049961
28. Motor Vehicles	0.051493	0.069911
29. Aerospace	0.021837	0.038128
30. Trailer Coaches	0.017679	0.039318
31. Other Transportation Equipment	0.001274	0.021499
32. Miscellaneous Manufacturing	0.017183	0.032463
33. Rail Transportation	0.009350	0.021296
34. Trucking and Warehousing	0.008427	0.019434
35. Water, Air, and Pipeline Services	0.018340	0.027674
36. Communications, Gas, and Sanitary Services	0.011500	0.024948
37. Electrical Production	0.266159	0.271321
38. Groceries and Related Products	0.036505	0.045467
39. Farm Products and Raw Materials	0.028405	0.035460
40. Machinery, Equipment and Supplies	0.024408	0.037540
41. Other Wholesale Trade	0.014811	0.022323
42. Farm Equipment Dealers	0.025853	0.038897
43. Gasoline Service Stations	0.028602	0.039458
44. Eating and Drinking Places	0.025666	0.041171
45. Other Retail Trade	0.018424	0.027662
46. Banking	0.022913	0.043746
47. Other Financial Institutions	0.010952	0.033584
48. Insurance and Real Estate	0.014929	0.036900
49. Lodging Services	0.071660	0.082780
50. Personal Services	0.023640	0.039325
51. Business Services	0.013902	0.036159
52. Medical Services	0.011307	0.024880
53. Other Services	0.014355	0.030486
54. Education	0.041267	0.058585
55. Households	———	0.022869

The magnitude of the impact on the output prices of a given sector reflects the dollar importance of the electricity component, measured as a percentage of total intermediate inputs in the production process, and intersectoral linkages. Furthermore, a method showing how the RAS updating technique can be employed to allow for detailed sector static analysis was demonstrated.

Finally, the price impact on the household sector was examined. As indicated earlier, the results will be biased upward. Therefore, the reported impact on the household sector can be thought of as a theoretical maximum price increase. Thus a 6.6 percent rise represents a potential one-time reduction in the purchasing power of the average household. However, the passage of time will allow households to change consumption patterns and business firms to modify their production process. These factors and others alluded to earlier will mitigate the impact to and indeterminable degree. Therefore, the usefulness of this

Table 6
The 1982 Price Change Vector, Weighted By
Kansas Household Consumption Patterns

Sector	1982 Price Change Vector (percent)
1. Agricultural Products	0.073936
2. Agricultural Services	0.030256
3. Crude Oil and Natural Gas	0.000000
4. Oil and Gas Field Services	0.000000
5. Nonmetalic Mining	0.000000
6. Other Mining	0.000000
7. Building Construction	0.000000
8. Heavy Construction	0.000000
9. Special Trade Construction	0.012444
10. Meat Products	0.041853
11. Dairy Products	0.267696
12. Grain Mill Products	0.000885
13. Other Foods and Kindred Products	0.147480
14. Apparel	0.006715
15. Paper and Allied Products	0.008857
16. Printing and Publishing	0.022528
17. Chemical Products	0.037062
18. Petroleum and Coal Products	0.158856
19. Rubber and Plastic Products	0.011512
20. Stone, Clay, and Glass Products	0.027933
21. Primary Metals Industry	0.000000
22. Fabricated Metal Products	0.005346
23. Farm Machinery and Equipment	0.001025
24. Construction Machinery	0.000000
25. Food and Special Industry Machinery	0.000000
26. Electrical Machinery	0.002031
27. Other Machinery	0.002140
28. Motor Vehicles	0.004163
29. Aerospace	0.000747
30. Trailer Coaches	0.008802
31. Other Transportation Equipment	0.012914
32. Miscellaneous Manufacturing	0.009362
33. Rail Transportation	0.020006
34. Trucking and Warehousing	0.023345
35. Water, Air, and Pipeline Services	0.177560
36. Communications, Gas, and Sanitary Services	0.118461
37. Electrical Production	2.020744
38. Groceries and Related Products	0.158542
39. Farm Products and Raw Materials	0.000943
40. Machinery, Equipment, and Supplies	0.006201
41. Other Wholesale Trade	0.010032
42. Farm Equipment Dealers	0.002505
43. Gasoline Service Stations	0.354649
44. Eating and Drinking Places	0.497429

Table 6 (continued)
The 1982 Price Change Vector, Weighted By
Kansas Household Consumption Patterns

Sector	1982 Price Change Vector (percent)
45. Other Retail Trade	0.362411
46. Banking	0.206820
47. Other Financial Institutions	0.383659
48. Insurance and Real Estate	0.178847
49. Lodging Services	0.428217
50. Personal Services	0.291132
51. Business Services	0.016655
52. Medical Services	0.300880
53. Other Services	0.117797
54. Education	0.039615
55. Households	0.015304
56. Total [Rows 1-55]	6.625969

approach results from the worst case scenario it provides. In other words, the approach generates a plausible upper limit to guide regulators in their decision making. Thus, even though the impact on any particular industrial sector may be small, the cumulative impact on the household sector could be significant in reducing consumer purchasing power.

The results for Kansas serve as a reference point for examining the complex nature of price change transmission throughout a region. However, the economic structure of Kansas more than likely would yield results peculiar to the economy of a Plains State. Further research in the area should include investigation of the response of other state economies to electricity rate increases. The degree of similarity or lack thereof would provide valuable insight into how exogeneous shocks to the price structure of a region are passed on through intersectoral linkages.

Footnotes

[1]The weight given to each utility company rate increase was based on the percentage its revenue was of total industry revenue. This is a proxy for the preferred method of weighting the rate hike by the number and type of user for each utility. Furthermore, the rate increase proposed for each company represents the average increase for all users.

[2]Note that for the electrical sector the price change does not equal 14 percent. The reason for this is that the P value for this sector, and for all sectors, is equal to the induced change caused by the rate increase.

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