

# Production and High Energy Price: A Case of Japan and the United States

Manjulika Koshal and Rajindar Koshal, Ohio University

## Manjulika Koshal

is a professor of operations management at Ohio University. She received her Ph.D. in industrial and labor relations from Patna University, Patna, India, in 1964 and taught at Ohio University on a part-time basis from 1968-1975. She has published 75 articles in scholarly journals, contributed to three books, and has presented 115 papers in various professional meetings and conferences at both the national and international levels. Dr. Koshal's areas of research and teaching have been varied from global business, business policy, and production and operations management to labor economics and environmental pollution. Her research interests are in the area of production management with special emphasis on quality management, JIT and economics of education. [koshal@ohio.edu](mailto:koshal@ohio.edu)

## Rajindar K. Koshal

is a professor of economics at Ohio University. He received his B.Sc. degree in physics-mathematics from Delhi University and his M.A. and Ph.D. from the University of Rochester. He has experience in planning organization, and his consulting experience includes economic input-output analysis for the General Research Corporation, Oak Ridge National Laboratory, as a member of the proposal evaluating panel, National Science Foundation, and impact of energy on transport for the Asian Development Bank. He has published more than 150 articles in journals such as Indian Statistical Journal, Land Economics, Journal of Transport Economics and Policy, Social Indicators Research, Revue Suisse d' Economic Politique et de Statistique, Bulletin of the International Statistical Institute, Managerial & Decision Economics, Economic Education, Applied Economics and Economics of Education Review. [koshalr@ohio.edu](mailto:koshalr@ohio.edu)

Since 1973, the world has faced many episodes where crude oil prices suddenly increased. In most economies, these fluctuations in energy prices also affect the price of other goods and services, and creates a disturbances in the production of goods and services. Because energy resources are vital to producing goods and services, higher energy prices directly affect the economy's production potential.

This subject has come under close scrutiny since the energy crisis of the 1970s, when economic research led to an improved understanding of the potential adverse economic consequences of rising real energy costs, both in terms of long-run equilibrium costs and short-run adjustment of costs. Long-run equilibrium costs are associated with reducing reliance on energy in favor of other factors of production, including labor and capital, which become relatively cheaper as energy costs rise. As capital becomes relatively cheaper, new energy saving technologies are invented. This eventually allows for production methods that require less energy.

In Japan and the U.S., these events occurred during both the first energy crises of 1973-74 and the second energy crises of 1979-80. An increase in energy price results in price increases in other areas of the economy that could introduce cyclical behavior. This would result in employment and output losses in the short run. The measurement of losses in actual GDP incorporates the transitional cost to the aggregate economy as it adjusts to its long-run path. As the increase in energy prices plays out over time, resources may be less than fully employed, resulting in the economy moving in a cyclical fashion.

For a variety of structural, cultural, and other reasons, Japan is one of the least energy-intensive countries in the world. The country's heavy industry, formerly a major energy consumer, was severely injured by the oil shocks in the 1970s and

was thus forced to streamline industrial production. Japan shifted away from energy-intensive industries and developed extensive energy efficiency programs. Japan now consumes 5,100 Btu/\$ (measured in 1997 dollars), less than half the U.S. rate of 11,600 Btu/\$.

In the sections that follow, we provide some specific facts about production and consumption of energy in Japan as well as the U.S.

## Japan, 1970-95

For the Japanese economy, Figure 1 provides the pattern of per capita energy consumption and energy use per unit of GDP (in constant yens), for the period 1970-95. A glance at this graph clearly indicates that during this period there was a continuous decline in the consumption of energy to produce goods and services. A recent reversal of trends may be evident from 1994-95. These facts confirm our earlier assertion—as energy prices increase, the production technology becomes more energy efficient as capital becomes relatively less expensive.

However, the per capita energy consumption suggests a different pattern. Since 1983, per capita energy consumption has experienced a rather sharp upward trend. This upward trend appears to be the result of Japanese people using more energy for leisure activities like larger and more powerful motor vehicles.

Next, an examination of Figure 2 shows the annual percentage change in energy per capita use as well as per yen of GDP. It is rather interesting to note that the percent changes in the two series move remarkably together except for the short period 1987-91. The two series in this graph depict a similar pattern. However, the change in the per capita use is always higher than the change in energy use in the productive sector. The overall energy consumption may be increas-

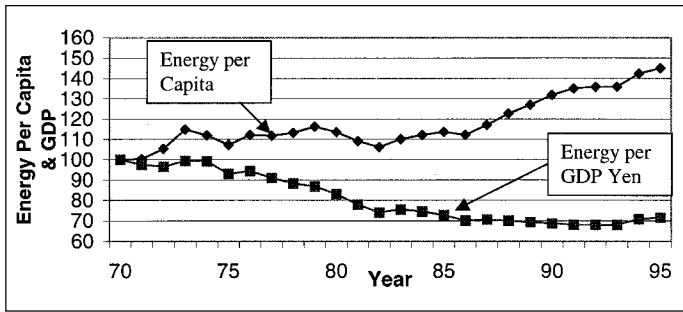


Figure 1: Energy consumption per capita and GDP yen in Japan.

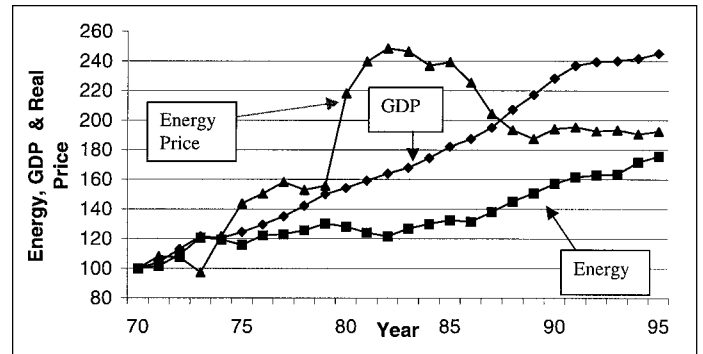


Figure 3: Energy, GDP and real price of energy in Japan (1970 = 100).

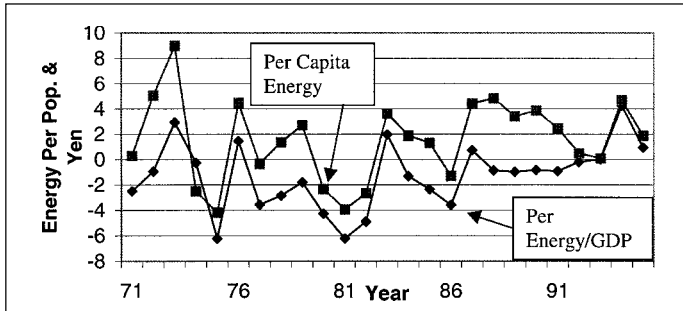


Figure 2: Percent change in per capita and per yen energy consumption.

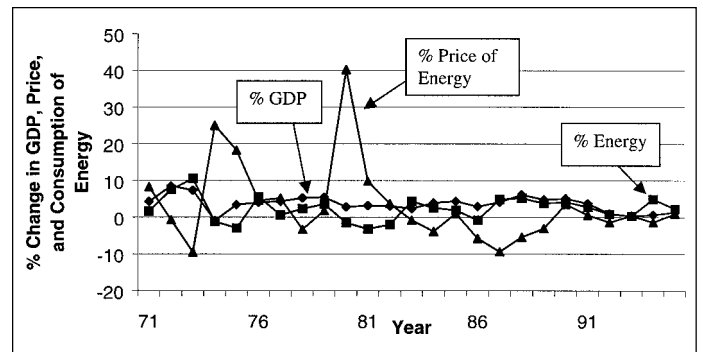


Figure 4: Percent change in GDP, price, and consumption of energy in Japan.

ing faster than energy in production due to the fact Japan has been one of the least energy intensive countries.

Figure 3 gives three indices (1970=100)-total energy used, GDP in constant yen and real price of energy. Once again, one observes that during the period 1970-86 the use of energy was growing at a lower rate than in the later period 1987-95 when the energy use took a sharp upward trend; this fact is also evident from the previous graphs.

Figure 4 shows the above three series in term of the annual percentage changes. We see that changes in GDP and energy move together except when there are sharp changes in energy price. It is also interesting to observe a continuous decline in real energy price during the period 1986-89. It is obvious that this decline in real energy resulted in a sharp upward trend in per capita energy use.

### United States, 1970-98

For the U.S., the energy consumption per dollar of GDP in Figure 5 shows a sharp downward trend over the period 1970-98. This trend is quite similar to the Japanese

energy consumption per yen of GDP. However, the trend in the per capita energy consumption for the U.S. shows rather a different story than for Japan. First, during this period (28 years), the per capita use of energy has increased only by 3.8 percent. For Japan, we observed a substantial increase of 45.0 percent. Remember that in terms of GDP production and per capita Japan's energy consumption is only half that of the U.S. However, if both countries continue the present trend in per capita energy usage, in the future there would be some narrowing down of the energy efficiency gap between Japan and the U.S. It is important to note that energy used in inefficient personal use does not produce extra goods. For the U.S., it is also interesting to note that both 1973-74 and 1979-80 energy crises brought a sharp decline in energy use. The second crisis had relatively a greater decline. It is obvious that such a reduction in the use of energy could be accomplished by improving technology that uses less energy.

Figure 6 provides plots of annual percentage changes in the above two time se-

ries. This graph depicts a similar pattern as we saw for Japan in Figure 2. An examination of this graph also would convince a reader that percentage change in per capita energy use follow almost the same pattern as the percentage change in energy used per dollar of GDP.

For the period 1970-98, Figure 7 depicts the trend in GDP, energy use and real price of energy in the U.S. It is noteworthy that except for the two energy crises, the real price of energy has shown an overall decline. During this period 1970-98, the real price of energy decreased almost by 30 percent, the energy consumption increase by about 37 percent but the GDP grew by more than 137 percent.

Figure 8 plots yearly percentage changes in the above three time-series: GDP, energy and real price of energy. This graph clearly suggests that a sharp rise in the price of energy, in the short-run, follows with a decline in energy use and GDP. Thus, one may conclude that real energy price is negatively related to energy consumption and GDP. Furthermore, one may conclude that the impact of energy prices is similar in both

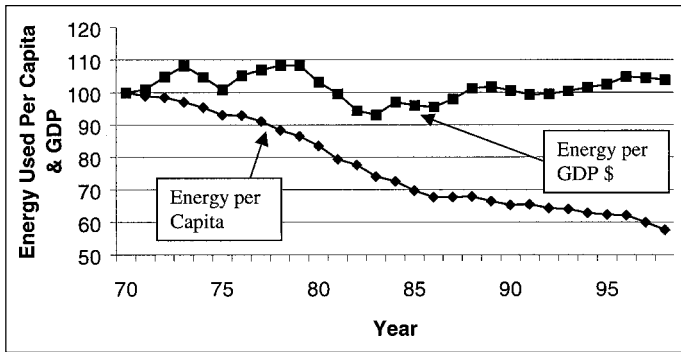


Figure 5: Energy consumption per capita and per GDP \$ in the U.S.

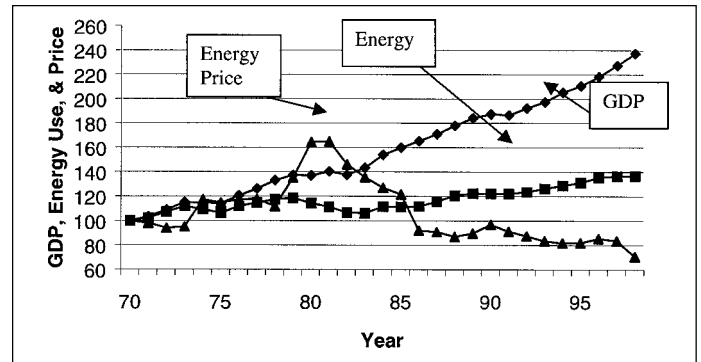


Figure 7: GDP, energy use, and price in the U.S.

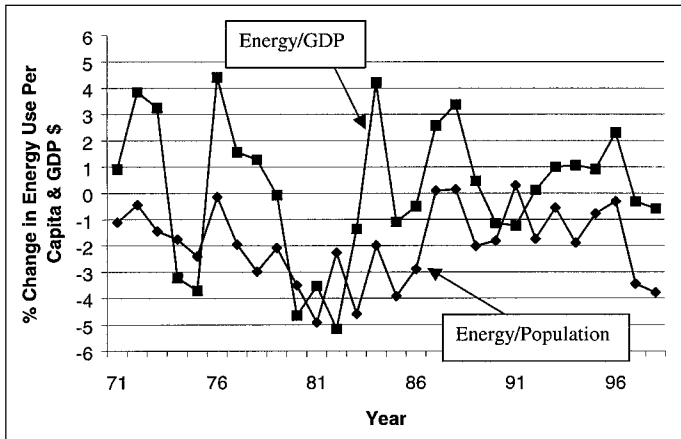


Figure 6: Percent change in energy use per capita and GDP \$ in the U.S.

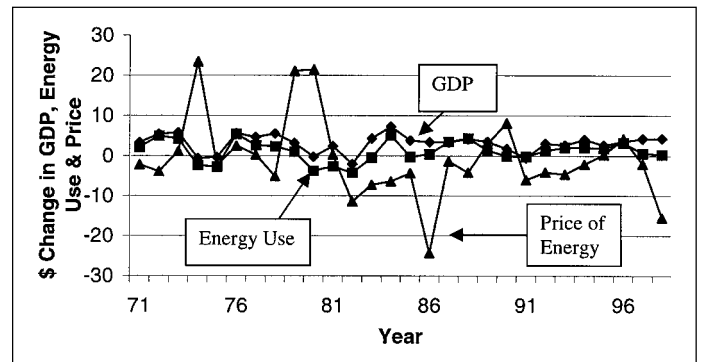


Figure 8: Dollar change in GDP, energy use, and price in the U.S.

the countries, although the degree of impact varies.

### Summary

To summarize our main finding, we provide, in Table 1 for the period of 25 years (1970-95), the percentage change in various series that we discussed above.

In Table 1, the percentage changes over 25 years suggest that in spite of the two major energy crises that have occurred in the economies of Japan and the U.S., both countries have done well in the long run. Japan is more efficient in overall use of energy, but, during the period under consideration, the gap between Japan and the U.S. has narrowed down. Thus the main impacts of high price of energy on the economy are:

1. In the short run, a high price reduces the use of energy, which results in lower gross domestic product. This slowing down of the economy brings unemployment.

Item	Japan	U.S.
Real price of energy	92.3	-19.2
Total energy use	75.6	31.3
Gross domestic product in constant prices	145.0	110.8
Energy per unit of GDP	-28.4	-37.7
Energy use per capita	45.0	2.4

Table 1: Percent change over 25 years, 1970-95.

2. The price of capital and labor relative to the price of energy becomes less.
3. In the long run, this encourages new investment in technology that is more energy efficient.
4. In the long run, this brings growth and increase in employment. ■

**Dr. Robert E. Markland**  
 Department of Management Science  
 College of Business Administration  
 University of South Carolina  
 Columbia, SC 29208  
 (803) 777-7448  
 fax: (803)777-6876  
 email: bobbym@darla.badm.sc Carolina.edu.