tion per capita, and with 2.2 percent growth of total energy use per capita.

Felix comments: "Electricity growth is, practically by itself, the 'locomotive' of GNP growth, whereas non-electric energy, while basic to the economy, has very little relation to growth. At this time, we note that the growth in electricity use must either outpace economic growth by two percentage points or progress as a 50 percent faster rate, as the case may be." Felix's data for the 41 countries with the highest rates of GNP per capita growth during the 1970s show this pattern in every case with the exception of the East block countries. For these economies, there is a "5.4-5.4-3.1" law, a difference which Felix ascribes to the higher proportion of industrial investment (as opposed to consumer goods investment) in the East bloc economies.

Felix draws the following conclusion concerning the overall importance of electricity growth: "To those who would write off growth in electricity use as a luxury to be dispensed with, the above is a powerful reminder that whatever limitation is placed on electricity growth will amputate economic growth correspondingly."

3) Even more important

Felix finds *a close relation between productivity growth and growth in electricity consumption.* Figure 2 (also taken from the Felix paper) shows this relation for the major industrialized countries—those with the higher growth rates in productivity also have the higher growth rates in electricity consumption. Especially striking is the position of Japan, averaging productivity growth rates of approximately 10 percent a year, along with electricity consumption growth rates of 10 percent a year. This connection is the most indicative of the infrastructural nature of electricity production and consumption. Electricity is more than a source of energy, or a form of energy delivery. Its use qualitatively modifies the environment for all economic activity: *it produces productivity.*

Felix's conclusions regarding the cause of this extraordinary property of electricity are illuminating:

> Electricity, unlike any other energy source, is the end-product of a complex thermo-mechanical-electrical conversion process which delivers not just another fuel, but a finely elaborated, highly sophisticated form of energy. . . . Among the qualities of electricity that can be cited: the higher productivity, flexibility, and versatility of electricity at the point of use, the better working environment it creates, the contribution of electricity to innovative processes, the methods, designs, technological advances, and improvements towards the creation of new products, which, besides creating new jobs, conserve energy, reduce costs, improve quality, and enhance reliability.

The LaRouche model charts a path for industrial growth

by Sylvia Barkley

The importance of infrastructure—highways, power plants, waterworks—is appreciated by anyone who has been responsible for moving a factory, or even a family, to a new location. Most econometricians, however, lack such experience in how the real world works. By and large, they assert that infrastructure investment and maintenance should be assessed in relationship to the rest of the economy as an expense which produces little or no new value.

The LaRouche-Riemann model's computer analysis of the effect of infrastructure investment on the functioning of the U.S. economy demonstrates just the opposite: that investment in inland waterways, water delivery systems to farms, industries, and cities, and the rest of the "domestic improvements" encouraged by American System economists of the 19th century benefits overall economic productivity.

In order to assess the effect of the water- and nuclear-

Figure 1

Average U.S. infrastructure investment, 1960-80

(million constant U.S. dollars)

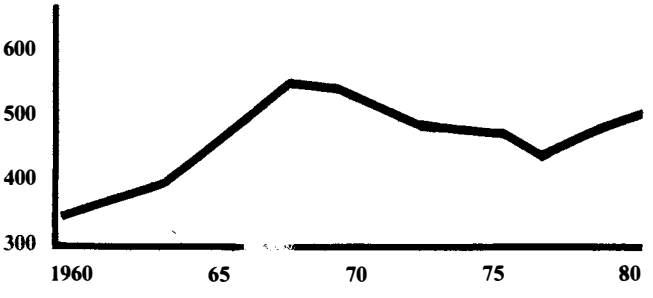
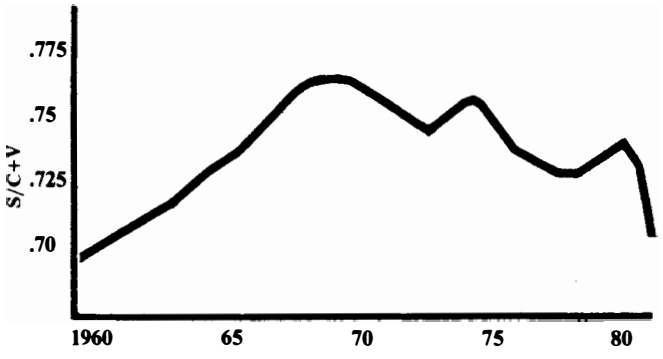


Figure 2

Reproductive ratio of the U.S. economy, 1960-80



energy-centered development program proposed by the National Democratic Policy Committee and its spokesman Lyndon H. LaRouche, Jr., the *EIR* economics staff examined the historical record of the U.S. economy. The study found that the net effect of such a plan can be determined: *it would lift the economy out of the current recession, and lead to a doubling of its size within 8 to 10 years.*

The first question which had to be addressed in preparing the computer simulation concerned the way in which infrastructure works in an economy. Although a dam or a nuclear plant creates power, a saleable product, this product alone cannot account for the total effect of these structures on the economy. Were the effect so simple, cost-benefit studies would not so uniformly oppose these projects. What infrastructural investments do, in general terms, is not to create value themselves. Rather, they *improve the capability of other factors to produce wealth.*

A new machine needs power, a new product needs an efficient and cheap transportation system, a worker or an executive needs water for his home. Thus, the historical course of the *changes in overall real productivity* was the source for the quantitative values—the data base—used in the LaRouche-Riemann analysis.

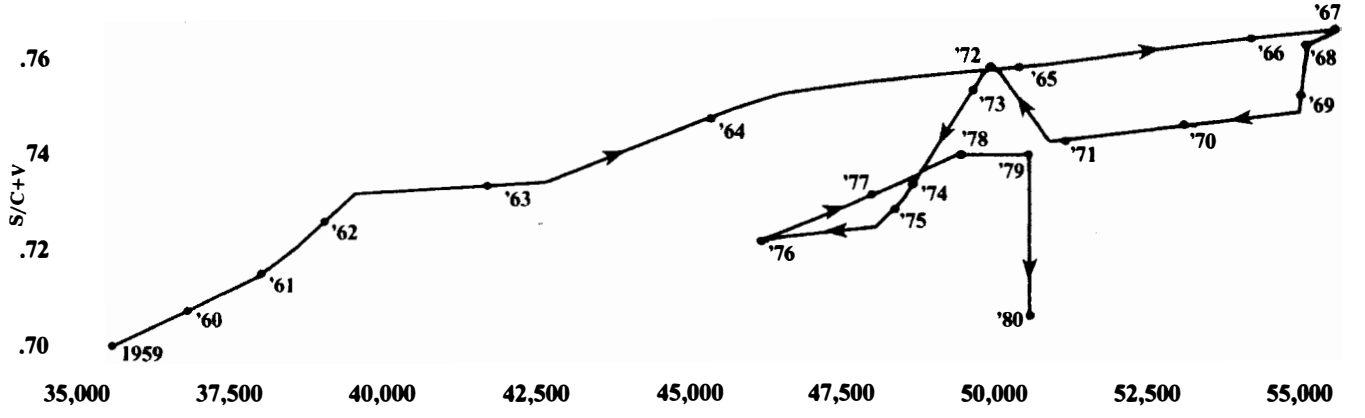
The historical record

The *EIR* team compared infrastructure investment over history with secular patterns of productivity. The improvements in infrastructure were assessed as the sum of constant-dollar spending on industrial plant, farm construction, railroads, highways, water, and sewer systems, and electric, gas, and telephone utilities. The time-course of such investment (Figure 1) rose steeply during the early 1960s, leveled off in the late 1960s, at the same time that the peak of NASA spending was reached, and then fell to a trough in 1976. Recent figures indicate a modest rise to 1979, indicating the economy's temporary rebounding from the Oil Crisis of 1973-74, and then a halt to this advance in 1980.

The model demonstrated that the measure of productivity which is most directly correlated with infrastructure spending is, as could be expected, the overall capability of the economy to generate surplus, or the ratio of total surplus to real operating costs (S/C+V, where S is total profit generated by the economy, C represents the total cost of maintaining the economy's productive plant and equipment, and V represents the consumption of the productive work force.) This measure of economic performance, which could also appro-

Figure 3

Reproductive ratio of economy (S/C+V) compared to infrastructure investment in previous year
(in million 1972 dollars) Note: Years refer to investment dates



The LaRouche-Riemann study of infrastructure and productivity

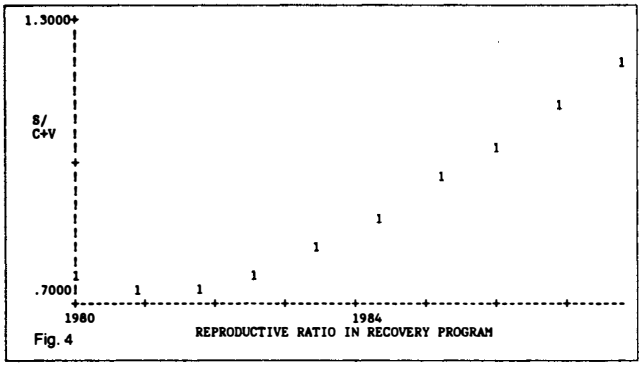


Fig. 4

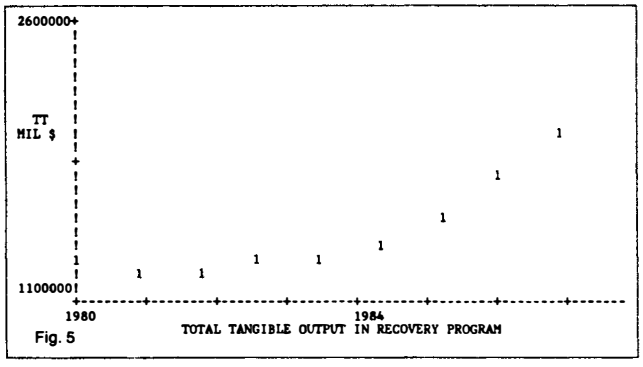


Fig. 5

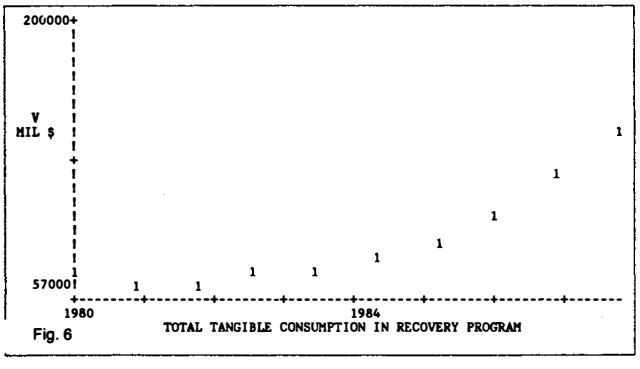


Fig. 6

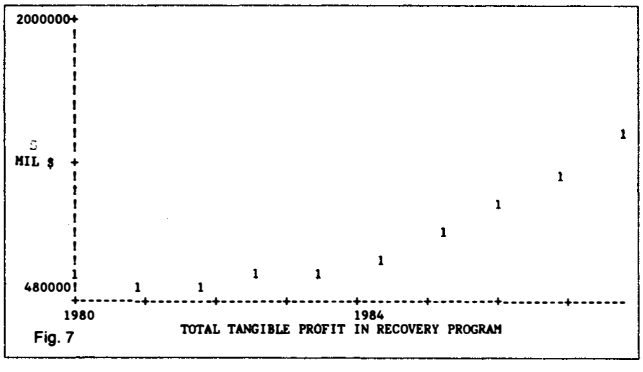


Fig. 7

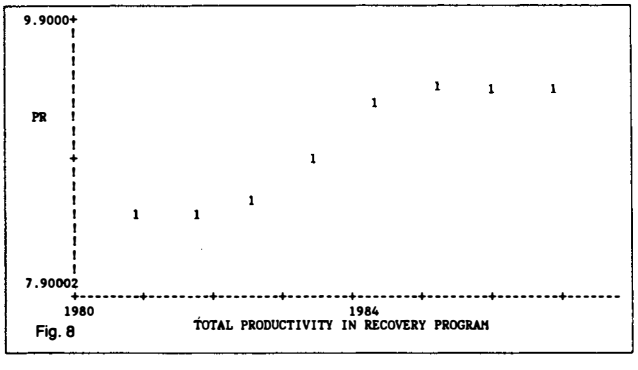


Fig. 8

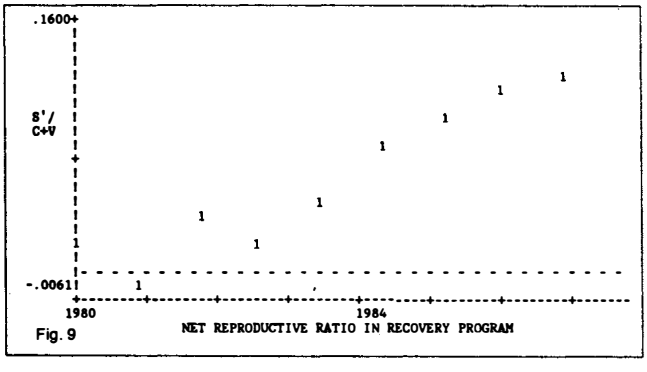


Fig. 9

priately be called the economy's reproductive ratio, is charted over the past two decades in Figure 2.

A pattern broadly similar to that of infrastructure investment is shown here, with the exception of an anomalous "recovery" in 1973-74, which resulted from price distortions due to the oil crisis.

The interrelation of the two variables is shown in Figure 3, where the vertical axis again represents the reproductive ratio, the horizontal axis reports the infrastructure spending for the previous year and the time-course of the U.S. economic is graphed.

The continued growth of the 1960s is followed by a steep downward trend beginning after 1967, illustrating the sensitivity of a growing economy to a cut-off of infrastructure growth. Apart from the "recovery of 1973-74," the downward trend continues at a more moderate slope, and the mild recovery of 1977-79 retraces the same path. However, the halt in this increase, occurring between 1979 and 1980, appears to cause a very severe drop-off in the reproductive ratio for 1981.

The correlation of the two measures is very high during the period of growth, indicating that a real connection exists. An immediate question was raised by the short time-lag between the investment and the productivity response. Although some immediate bene-

fit may be felt from the spending, the crucial mechanism appears to be the kinds of decisions which individuals make. That is, if major infrastructure projects are gotten under way, there is an immediate response in the willingness of individual businessmen to invest in expansionary ways. Conversely, when the climate is changed by a halt in infrastructure spending, there is a retrenchment and concentration on marginal adjustments which send overall productivity plummeting.

The NDPC program

The National Democratic Policy Committee study calls for two specific programs of infrastructure investment, a massive build-up of nuclear power, and the upgraded version of the North American Water and Power Alliance which was described earlier. The nuclear proposal calls for an ambitious 150 gigawatts of nuclear power to be built over 10 years, and the NAWAPA proposal would cover 12 years and double the water available for irrigation in the United States.

The LaRouche-Riemann model cannot make useful predictions for such a long period in the future for the U.S. economy; analysis was therefore limited to the first seven years of the program. Average infrastructure investment was estimated at $25 billion 1972 dollars per year (approximately $59 billion in current dollars). Spending increased during the period of the computer analysis, reaching the average level by 1985, the third year of the program.

Spending was included in the category of non-productive expenditure, the same category as military, health, and education spending. However, the relationship shown in Figure 3 was used to generate a rate of increase in the reproductive ratio, which was directly programed into the model. The time course of this variable, shown in Figure 4, was therefore used to encode the effects of the investment program on the economy as a whole.

The model showed that the economy will respond slowly at first to the program, but as the destructive effects of the past years of credit crunch and investment cutbacks are overcome, the response will become more and more dramatic.

Exponential growth

Total tangible output (Figure 5) has fallen between 1980 and 1981, and the model showed a lag of a year until this fall is recouped, and two more years before any significant improvement above the 1980 levels is felt. After this period, however, growth is exponential, with a final value of almost $2 trillion in 1972 dollars, compared to a historical maximum of $1.135 trillion, reached in 1974.

The total tangible consumption available to the labor force (V) shows a similar trend (Figure 6) with rapid recovery to 1980 levels from the trough of 1981, but with a slow expansion from that point. The previous high level of wages is not exceeded until 1985, but again, after this point an exponential growth rate expresses itself. This is made possible by the continued increase in tangible profit (S) (Figure 7) which can be reinvested in expansion, and the increase in productivity (Figure 8).

Productivity increases, as calculated here, are the result only of allocation of surplus to more productive sectors of the economy. Because of this, the entire run is conservative in its positive projections; no technological advances were included. Under conditions of massive economic growth and dirigist policies, such advances, with associated jumps in productivity, would be expected to appear at least by the end of the period being described.

The crucial ratio

The most fundamental parameter of any economy is the net reproductive ratio ($S'/C+V$) the actual investment in expanding the productive base as a fraction of the operating costs of the existing economy. This ratio, shown in Figure 9, has fallen from a historical maximum in the United States of 0.11 to a 1980 value of 0.02, and an estimated level of -0.06 for 1981. (This value is an estimate because calculation of the value requires data from the following year.) The value of the ratio rises during the recovery program, with a single dip in 1982 caused by the impact of assigning the spending to the "non-productive" category.

It should be emphasized, however, that even after seven years, and an approximate doubling of the size of the real economy, the value of this crucial index is projected by this analysis to have reached only 0.12, barely greater than during the 1966-67 period. This reflects the tremendous erosion of economic health that has occurred in the last years, and the magnitude of the effort which will be required to restore the United States to its appropriate and necessary position as a driving force in world economic development.

The overall result of this analysis is to demonstrate that the National Democratic Policy Committee program represents a realistic solution to the economic collapse which is now overtaking the U.S. economy. The effect, as shown by the series of graphs above, is somewhat like that of a Saturn launch, in which the initial thrust moves the enormous mass only slowly, but with an irresistible force, and as upward motion begins, the acceleration increases continually. Like the Saturn rocket, these programs too will "burn out" unless replaced by new technologies; but they represent the only competent method now proposed to get the economy off the ground, or more precisely, out of the swamp of economic collapse.