Forthcoming in Science

THE ONLY IMPENDING SHORTAGE IS A SHORTAGE OF BAD NEWS

Julian L. Simon

False bad news about population, resources, and environment is rampant despite upbeat evidence.

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Fact: This widely-reported "index" is, according to the National Wildlife Federation which prepares and disseminates it, "a subjective analysis . . . judgment [which] represents collective thinking of the editors of the National Wildlife Federation Staff." That is, the EQI represents casual observation rather than hard statistical facts. It includes such subjective judgments as that the trend of "living space" is "down . . . vast stretches of America are lost to development yearly." (42)

Yet the objective statistical facts indicate that the environment is getting better. Earlier we saw that "living space" is not declining, and recreational areas are increasing rapidly. The official Council on Environmental Quality's data on major air pollutants show sharp improvements in the last decade (Figure 13). With respect to water, "major improvements in the quality of polluted streams have been documented" with hard data, says the Council. (43) (See Figure 14.) The fish catch in Lake Erie, long ago said to be "dead" by Barry Commoner, has been increasing. The most important indicator of environmental quality is life expectancy; it continues to rise--and at increasing rate: a gain of 2.1 years from 1970-1976, compared to a gain of only 0.8 years in the entire decade of the 1960's. (44)

Statement: Increased population density leads to psychological and social pathology.

Fact: The statement is sheer myth, based on faulty analogies to animal behavior. Social surveys show that density has no general ill effects on such measures of welfare as longevity of life, crime rate, mental illness rates, and recreational facilities. (45)

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Summary:

False bad news about population growth, natural resources, and the environment is published widely in the face of solid contradictory evidence. For example, the world supply of arable land has been increasing, the scarcity of natural resources including food and energy has been decreasing, and basic measures of U.S. environmental quality have positive trends. The aggregate data show no long run negative effect of population growth upon the standard of living, and my models that embody forces omitted in the past -- especially the influence of population size upon productivity increase -- suggest a long run positive effect. There are various possible reasons why the false bad news dominates the true good news. Personal values are certainly a key factor.

THE ONLY IMPENDING SHORTAGE IS A SHORTAGE OF BAD NEWS

Julian L. Simon

Newsweek, September 19, 1977: "[M]ore than 100,000 West Africans perished of hunger" in the Sahel between 1968 and 1973 due to drought. Upon inquiry, writer Peter Gwynne informed me that the estimate came from Kurt Waldheim's message to the United Nations' Desertification Conference. I therefore wrote to Waldheim asking for the source of the estimate.

Three mutually contradictory documents came back from the United Nations' Public Inquiries Unit: (1) Waldheim's message, saying, "Who can forget the horror of millions of men, women and children starving, with more than 100,00 dying, because of an ecological calamity that turned grazing land and farms into bleak desert?" (2) A two-page excerpt from a memo by the UN Sahelian Office, dated November 8, 1974, saying, "[I]t is not possible to calculate the present and future impact of this tragedy, on the populations...Although precise figures are not available, indeed unobtainable...certainly there has been an extensive and tragic loss of life...". (3) Making nonsense of the other two documents was one page by Helen Ware, a respected Australian expert on African demography and a visiting fellow at the University of Ibadan in March, 1975, when the memo was written specifically for the UN. Based on calculations of the normal death rate for the area, together with "the highest death rate in any group of nomads" during the drought, she figured that "At an absolute, and most improbable, upper limit a

hundred thousand...Even as a maximum [this estimate] represents an unreal limit." (Ware's private reaction is: "The problem with deaths in the Sahel is precisely that there was so little evidence of them--rather like the photograph of the dead cow which kept turning up in illustration to every newspaper story.) (1)

To repeat, Ware's statement, which flatly contradicts Waldheim's well-publicized assessment, was on page one of a document written for the UN, well before the UN Desertification Conference and Waldheim's message. Apparently, it was the only calculation the UN had. But it was totally ignored.

More recently, the UN press releases have retreated to the more modest--but assertion that "tens of thousands" died. (2) But even this assertion is undocumented and of doubtful propriety. A recent summary of the scientific evidence on the drought's effects by John Caldwell--a leading demographer of Africa who was familiar with the area prior to the drought, and spent 1973 there--found: "[O]ne cannot certainly identify the existence of the drought in the vital statistics...nutritional levels, although poor, were similar to those found before the drought in other parts of Africa. The only possible exception was that of very young children." (3)

This is just one example of a common phenomenon: False bad news about population growth, natural resources, and the environment, based on flimsy evidence or no evidence at all, is published widely in the face of solid, contradictory evidence, as I shall show in this article.

Another example comes from the same Newsweek piece: "More than one-third of all the land is desert or near-desert. And deserts are

spreading inexorably, turning arable land into stony waste or heaps of drifting sand...annually destroying twelve million to seventeen million acres." The headline on the front-page story in the New York Times said, "14 Million Acres a Year Vanishing as Deserts Spread Around Globe." (4)

Some arable areas surely are deteriorating. But these news stories--probably originating from the book Losing Ground (5) by Erik Eckholm of Worldwatch Institute--clearly imply a more general proposition: that the world's supply of arable land is decreasing. And the truth is exactly the opposite: Joginder Kumar made a careful, country-by-country survey of the changes in arable land from 1950 to 1960. (6) His finding: There was nine percent more total arable land in 1960 than in 1950, in the 87 countries for which he could find data (accounting for 73 percent of the total world land area)--a gain of almost one percent per year (Columns 1 and 2 of Table 1). And the more recent FAO data show a rise in "arable and permanent cropland" from 1,403 to 1,507 million hectares in the world as a whole from 1961-65 to 1974, an annual increase of .7 percent for the roughly-eleven year period. In the developing countries the area increased by 1.1 percent annually over the 1960-1970 decade. (7)

The increase in the quantity of land that is cultivated rose even faster than 1 percent per year--from 8.9 percent of the total area to 9.9 percent during 1950-1960 (Columns 5 and 6 of Table 1). And the increase in effective crop area was greater yet, because of the increase in multiple cropping in Asia and elsewhere. In some places the extension of cultivation has caused decreased quality of land, of course; but in other places the process has improved the quality of land.

But does not a larger population necessarily mean "more pressure" on the land, until each of us is nightmarishly scratching out three skimpy meals from 18 hours of work a day, on a plot the size of a window box? This is indeed an accurate description of the trend in countries that have not yet entered into modernization and industrialization. Stys (8) and Myers (9) have shown, for example, how farm size declined in Poland and China as their populations increased from 1787 to 1937, and from 1870 to 1930, respectively.

But hard as it may be to believe, the more general trend points in the opposite direction. In all the higher-income industrialized, developed countries in Europe and North America, as well as Japan, a smaller absolute (not just relative, but absolute) number of farmers are producing much more food and feeding much larger total populations than in the past. An extrapolation of this benign trend, carried to the same absurdity as the nightmare above, would suggest that eventually one person will be farming all of the US cropland and feeding everyone else. The less-developed countries have not begun this trend, though the relative proportions of the populations that are in agriculture are falling rapidly in those poor countries. As they get richer, we can expect those countries to show the same trend--smaller absolute numbers of persons doing the farming for larger populations, on ever-larger farm units.

SOME OTHER MYTHS ABOUT POPULATION AND RESOURCES

Here are some other examples of publicized, false, bad news and the unpublicized, good-news truth:

Statement: The food situation in less-developed countries is worsening. "Serious World Food Gap Is Seen Over the Long Run..." is the typical New York Times headline. Children's textbooks repeat the Malthusian proposition bluntly and unequivocally.

> [P]opulations increase geometrically--that is, they double (2, 4, 8, 16, 32, etc.). Food supplies, in contrast, increase only arithmetically, a much slower process (2, 4, 6, 8, 10, 12, etc.)....
>
> If the population continues to explode, many people will starve. About half of the world's population is underfed now, with many approaching starvation. (10)

The Environmental Fund paid for a full-page advertisement in leading newspapers, signed by such dignitaries as author Isaac Asimov, now-Presidential adviser Zbigniew Brzezinski, author Malcolm Cowley, ecologist Paul Ehrlich, editor Clifton Fadiman, oilman J. Paul Getty, Time Inc. executive Henry Luce, poet Archibald MacLeish, Nobel prize winner Albert Szent-Gyorgyi, Reader's Digest founder DeWitt Wallace, UAW President Leonard Woodcock, and many others, saying:

> The world as we know it will likely be ruined before the year 2,000 and the reason for this will be its inhabitants' failure to comprehend two facts. These facts are:
>
> 1. World food production cannot keep pace with the galloping growth of population.
> 2. "Family planning" cannot and will not, in the foreseeable future, check this runaway growth. (11)

The School of Public Affairs of Princeton offers a course on "Problems of World Hunger" based on the premise that "Hunger...has never been known on such a world-wide scale as today." (12) Perhaps most influential was Paul Ehrlich's best-selling book, The Population Bomb. The first lines were: "The battle to feed all of humanity is over. In the 1970's the world will undergo famines--hundreds of millions of people are going to starve to death." (13)

Many writers view the situation as so threatening that they call for strong measures to restrict population growth: "[C]ompulsion if voluntary methods fail," as Ehrlich put it. (14) Some, such as the 1967 book, Famine-1975!, find in these assertions the warrant for such policies as "triage--letting the least fit die in order to save the more robust victims of hunger. (15) ...My own opinion as the triage classification of these sample nations is:

Haiti	Can't-be-saved
Egypt	Can't-be-saved
The Gambia	Walking Wounded
Tunisia	Should Receive Food
Libya	Walking Wounded
India	Can't-be-saved
Pakistan	Should Receive Food" (16)

Fact: Per-capita food production has been increasing at roughly one percent yearly--25 percent during the last quarter century. Even in less developed countries food production has increased substantially (see Table 2). World food stocks are high now, and even India has large amounts of food in storage.

Individual countries have done far worse than the average, and even had declining production, some because of war or political upheaval. And progress in food production has not been steady. But there has been no year, or series of years, so bad as to support a conclusion of long-term retrogression. I emphasize this because I am now writing at a time (October, 1978) when harvests have been particularly good. Last year and again this year the headlines say "Corn, bean yields again set records," "Wheat—there's too much despite drought, deluge," and "World food supplies are just below record level." Grain prices have fallen so sharply that U.S. farmers are again complaining of disaster—from too much food. Some readers might wonder whether my assertions are overly influenced by recent events. But the first draft of this material, for publication in my technical book, (17) was written in 1971 and 1972, when food production was having its worst time in recent decades.

People sometimes ask: "What about the data the other fellows quote to support their worried forecasts?" In simple fact there are no other basic data. The data shown in Table 2 were published by the UN, collected from the individual countries. Of course the data are far less reliable then one would like; economic data usually are. But these are the only "official" data, and no one quotes any other data because data that would show a worsening trend in recent decades simply do not exist.

Statement: The danger of famine is increasing. The UN Economic and Social Commission for Asia and the Pacific predicts "500 million starvation deaths in Asia between 1980 and 2025." (18)

Fact: The course of famines is difficult to measure quantitatively. But a leading agricultural economist who has studied the history of famines intensively, Gale Johnson, estimates that since World War II there has been

a "dramatic decline" in famines. Only a tenth as many people died of famine in the third quarter of the 20th century as in the last quarter of the 19th century--despite the much larger population now. (19)

A key cause of the decline in famine deaths has been the improvements in road systems, which allow food to be moved from regions of plenty to regions of shortage. The road-system improvements are themselves a product of increased population density (20) as well as of improvements in technology.

Statement: Higher population growth implies lower per-capita economic growth. This is gospel for the World Bank, the U.S. State Department's AID, and other international development agencies.

Fact: Empirical studies by Nobel-prize winner Simon Kuznets and others show no statistical correlation between countries' population growth and their per-capita economic growth, either over the long run or in recent decades.

Figures 1a and 1b show decadal growth rates of population and output per capita for those countries where long-run data are available. No strong relationship appears. Contemporary cross-national comparisons of current rates of population growth and economic growth are another source of evidence. Many such studies have been done by now, and they agree that population growth does not have a negative effect upon economic growth in either more-developed or less-developed countries. (21)

These overlapping empirical studies do not show that fast population growth increases per capita income. But they certainly imply that one should not confidently assert that population growth decreases economic growth.

Statement: Sophisticated computer models show that for the next thirty years an increase in population causes a decrease in per capita income.

Phyllis Piotrow (24) documented the decisive impact upon the late-1960's policy of USAID and the UN's FPA that was exerted by the first of these models,created in 1958 by Ansley Coale and Edgar Hoover. (25) Largely founded on the Coale-Hoover simulation, the belief that population growth in less-developed countries is bad for the world led the State Department to greatly increase its spending for fertility reduction in poor countries, hand-in-hand with relatively lower spending on international death reduction and other health programs, as seen in Table 3. (26) Along with the hundreds of millions of dollars for fertility reduction, the U.S. has put pressure on foreign governments to adopt fertility reduction programs.

Fact: At the heart of all these models is simply an arithmetical truth: When there is one more child sharing the same amount of goods, there is less to go around. As Wilfred Beckerman remarked, the instant a calf is born, per-capita income and wealth go up, but the second a child is born, per-capita income and wealth go down. This truth was well recognized by Coale and Hoover: "The inauspicious showing of the high-fertility case...in levels of living is traceable entirely to the accelerated growth in the number of consumers." The point was crystal-clear to Malthus even without a complex model. He noted that an increase in population "increases the number of people before the means of subsistence are increased. The food therefore which before supported eleven millions, must now be divided among eleven millions and a half." (27)

Once the children grow up, however, and become producers as well as consumers, the impact on per-capita income reverses. Eventually the

income of other people is higher because of the additional children, as my own technical work has shown. But this takes more than the 25 or 30 years covered by the well-known models.

The main new element in my model for more-developed countries (MDC's) is the contribution of additional people to increasing productivity. (28) This occurs partly through larger markets and economies of scale. But more important are an additional person's contributions to increased knowledge and technical progress. People bring not only mouths and hands into the world, but also heads and minds, too. That is, the source of improvements in productivity is the human mind, and the human mind is seldom found apart from the human body. This is an old idea, going back at least as far as William Petty in 1682:

> "As for the Arts of Delight and Ornament, they are best promoted by the greatest number of emulators. And it is more likely that one ingenious curious man may rather be found among 4 million than 400 persons...And for the propagation and improvement of useful learning, the same may be said concerning it as above-said concerning...the Arts of Delight and Ornaments..." (29)

Instead of population growth and productivity increases being independent forces running a "race", additional persons cause technological advances by inventing, adapting, and diffusing new productive knowledge.

Technical progress--which is the main source of long-run economic growth in MDC's--arises partly from organized scientific R&D, and partly from people who are not especially educated and do not work in

science--the taxi dispatcher who develops a slightly better way of deploying his ten-taxi fleet, the supermarket manager who finds a way to display more merchandise in a given space, the supermarket clerk who finds a quicker way to stamp the prices on cans, the market researcher who experiments to find more efficient and cheaper means of advertising the store's prices and sale items, and so on. This is the "learning by doing" phenomenon which has been all-important in raising our standard of living from what it was 20 years ago, 200 years ago, 20,000 years ago, to what it is now. The aggregate economic importance of the technological knowledge factor has clearly emerged in two well-known studies, one by Robert Solow and the other by Edward Denison. (30)

I have added this effect of additional people in productivity to a standard economic model in two different ways, as seen in Figure 2. The result is that instead of additional persons being a permanent drag, they lead to an <u>increase</u> in per-worker output starting 30-70 years after birth--that is, 10-50 years after entry into labor force. This positive outcome of added persons means that economics can be a cheerful science rather than the dismal science Malthus thought it to be.

Babies don't create knowledge and improve productivity while still in their cradles. And though the family bears most of the cost, society must also unpurse to bring the baby to productive adulthood. This means that if you do not look as far as the next twenty-five years, the knowledge benefits of someone else's baby born today do not interest you, and that baby is therefore a poor social investment for your taxes. But if you feel some interest in,an/obligation for, the longer-run future--perhaps because you yourself are today enjoying the fruits of the investment that someone paid for 25 or 50 or 100 years ago, or because you have

children whose future is important to you--then the knowledge produced by today's children will be seen by you to be of great positive benefit to you. (31)

The mechanism is different in less-developed countries (LDC's). Offsetting the negative capital-dilution effects of more people, there are positive effects through increased work done by parents, extra stimulus to agricultural and industrial investment, increased social infra-structure, and other economies of scale. When all these forces are combined into my LDC simulation model, an additional child comes to have a positive effect on the general standard of living after the better part of a century. But the positive effect then comes to be much larger than the negative effect early on. (32) Once again, most of the cost is borne by the immediate family rather than the rest of the society. And the immediate family apparently feels that the benefits from the additional child outweigh the costs in the early years.

In short, economic theory that includes key elements left out of previous models, together with the empirical data, suggests that additional children have positive long-run effects upon the standard of living.

It is true that the long run—30 to 80 years--is far from now, and therefore is of less importance to us than is the short run. But our long run will be someone's else's short run, just as our short run was someone's else's long run. Some measure of unselfishness should impel us to keep this in mind as we make our decisions about population policy.

Statement: Urban sprawl is paving over the United States, including much "prime agricultural land" and recreational areas.

Fact: All the land used for urban areas plus roadways totals less than 3 percent of the United States area. And the increase over the half century starting in 1920 was only a fortieth of a percent of total land annually. (33) The United States Department of Agriculture says: "...we are in no danger of running out of farmland." (34)

More new crop land is being created in the U.S.—1.25 million acres are converted to efficient crop land each year, from drained swamps and irrigated deserts—than the .9 million acres of land converted to urban and transportation use. The rest of the 2.2 million acres of rural land which goes out of use yearly is abandoned not because of "paving over" but because it has "low soil fertility and a terrain unsuited to efficient use of modern machinery." (35) A million acres yearly goes into wilderness recreation acres and wildlife refuges, and another 300,000 acres goes for reservoirs and flood control. (36) The danger to agriculture from "paving over" is another bogeyman.

About wildlife areas, state and national parks: the area rose from eight million acres in 1920 to 73 million acres in 1974, and is still rising. (37) The number of people who visit these recreation areas has risen sharply due to improved transportation and increased income. In the 1946-1960 period, for example, visits increased from 780 to 2184 per thousand people.

Statement: We are running out of natural resources and raw materials. "Entering an age of scarcity" is such a commonplace that it is simply assumed and asserted in public discussion by people ranging from B. F. Skinner to Solzenitsyn. (38)

Fact: The only meaningful measure of scarcity in peactime is the cost of the good. (39) And the cost trends of almost every natural

resource—whether measured in labor time required to produce the energy, in production costs, in the proportion of our incomes spent for energy, or even the price relative to other consumer goods--have been downward over the course of recorded history.

The prices of copper (a representative and important metal), wheat (as representative of food prices), and oil, relative to wages, are shown in Figures 3-5. An hour's work in the U.S. has bought increasingly more of these raw materials from 1800 to the present. And the same trend has almost surely held throughout human history. Calculations of expenditures for raw materials as a proportion of total family budgets make the same point even more strongly. These trends imply that the raw materials have been getting increasingly available and less scarce relative to the most important and most fundamental element of life, human work time.

The prices of raw materials have even been falling relative to consumer goods and the Consumer Price Index, as can be seen in Figures 6-8. All the items in the Consumer Price Index have been produced with increasing efficiency in terms of labor and capital over the years. But figures 6-8 show that the decrease in cost of raw materials has been <u>even greater than that of other goods</u>, a very strong demonstration of progressively decreasing scarcity and increasing availability of raw materials.

The relative fall in the prices of raw materials understates the positive trend, because as consumers we are interested in the <u>services</u> we get from the raw materials rather than the raw materials themselves. And we have learned to use less of given raw materials for given purposes, as well as to substitute cheaper materials to get the same

services, all of which makes raw material services even less scarce than Figures 3-8 suggest. Consider a long-ago copper pot for cooking. The consumer is interested in a container which can be put over the heat. After iron and aluminum were discovered, quite satisfactory cooking pots--almost as good as, or perhaps better than, pots of copper--can be made of these materials. The cost that interests us is the cost of providing the cooking service, rather than the cost of copper. If copper were used only for cooking pots, and if iron can be used quite satisfactorily for the purpose, it would not matter if the cost of copper rose sky high, as long as we had cheap iron.

A dramatic example of how the service that copper renders can be supplied much more cheaply by a substitute process: A single communications satellite in space provides intercontinental telephone connections that would otherwise require 100,000 tons of copper.

Statement: Energy is getting scarcer.

Fact: The facts about the cost of energy are much the same as the facts about other raw materials, as Figures 5 and 8 show. The new strength of the OPEC cartel to control oil price obscures the cost of production. But the production cost of a barrel of oil has not risen, and probably has fallen, in deflated dollars even since the most recent "oil crisis" came onto the scene in 1973—still $.05 to $.15 per barrel in the Persian Gulf, which is perhaps a hundredth of the market price. (41) It is reasonable to expect that eventually the price of oil will again return nearer its economic cost of production, and the long-run downward trend in the price of oil, as seen in Figures 5 and 8, will resume its course.

The price of electricity is an interesting measure of the consumer cost of energy, and it is largely unaffected by cartels and politics

(though the price of electricity did rise post-1973 because all energy sources, including coal and uranium, jumped in price when the price of oil went up, due to the improved market power of coal and uranium suppliers). In Figure 9 we see that the long-run cost of electricity clearly has been downward.

In short, the data show that energy has not been getting scarcer in basic economic terms, but rather has been getting more plentiful.

Statement: The supplies of natural resources are finite. This apparently self-evident propostion is the starting point and the all-determining assumption of such models as The Limits to Growth and much popular discussion.

Fact: Incredible as it may seem at first, the term "finite" is not only inappropriate but is downright misleading in the context of natural resources, from both the practical and philosophical points of view. As with so many of the important arguments in this world, this one is "just semantic." Yet the semantics of resource scarcity muddle public discussion and brings about wrong-headed policy decisions.

A definition of resource quantity must be operational to be useful. It must tell us how the quantity of the resource that might be available in the future could be calculated. But the future quantities of a natural resource such as copper cannot be calculated even in principle, because of new lodes, new methods of mining copper, variations in grades of copper lodes; because copper can be made from other metals; and because of the vagueness of the boundaries within which copper might be found--including the sea, and other planets. Even less possible is a reasonable calculation of the amount of future services of the sort

that we are now accustomed to get from copper, because of recycling and because of the substitution of other materials for copper, as in the case of the communications satellite.

Even the total weight of the earth is not a theoretical limit to the amount of copper that might be available to earthlings in the future. Only the total weight of the universe--if that term has a useful meaning here—would be such a theoretical limit, and I don't think anyone would like to argue the meaningfulness of "finite" in that context.

With respect to energy, it is particularly obvious that the earth does not bound the quantity available to us; our sun (and perhaps other suns) is our basic source of energy in the long run, from vegetation (including fossilized vegetation) as well as from solar energy.

As to the practical finiteness and scarcity of resources--that bring us back to cost and price, and by these measures history shows progressively decreasing rather than increasing scarcity.

Why does the word "finite" catch us up? That is an interesting question in psychology, education, and philosophy; unfortunately there is no space to explore it here.

In summary, because we find new lodes, invent better production methods, and discover new substitutes, the ultimate constraint upon our capacity to enjoy unlimited raw materials at acceptable prices is knowledge. And the source of knowledge is the human mind. Ultimately, then, the key constraint is human imagination and the exercise of educated skills. Hence an increase of human beings constitutes an addition to the crucial stock of resources, along with causing additional consumption of resources.

Statement: The old trends no longer apply. We are at a moment of discontinuity now.

Fact: One cannot logically dispute assertions about present or impending discontinuity. And one can find mathematical techniques suggesting discontinuities that will be consistent with any trend data. To illustrate this point, my co-worker Douglas Love fitted third-degree polynomials to the price data for copper, wheat, and oil. Figures 10-12 seem to imply an upward tendency for all these prices.

My own judgment is that the long-run monotonic trends in Figures 3-8 are the more meaningful, but this is only one person's judgment. We can say scientifically, however, that if in the past one had acted on the belief that the long-run price trend was upwards rather than downwards, one would have lost money on the average.

When a person feels that another person is talking without taking responsibility for the results, he says, "Put your money where your mouth is". I'm prepared to take the consequences of my words. This is a public offer to stake $10,000, in separate transactions of $1000 or $100 each, on my belief that the cost of non-government-controlled raw materials (including grains and oil) will not rise in the long run. If you will pay me the current market price of $1000 or $100 worth of any standard mineral or other extractive product you name, and specify any date more than a year away, I will contract to pay you the then-current market price of the material--a standard commodity-market agreement. How about it, doomsayers and catastrophists? First come, first served.

Statement: The Nation's "overall environmental well-being" is declining, according to the Environmental Quality Index.

Fact: This widely-reported "index" is, according to the National Wildlife Federation which prepares and disseminates it, "a subjective analysis . . . judgment [which] represents collective thinking of the editors of the National Wildlife Federation Staff." That is, the EQI represents casual observation rather than hard statistical facts. It includes such subjective judgments as that the trend of "living space" is "down . . . vast stretches of America are lost to development yearly." (42)

Yet the objective statistical facts indicate that the environment is getting better. Earlier we saw that "living space" is not declining, and recreational areas are increasing rapidly. The official Council on Environmental Quality's data on major air pollutants show sharp improvements in the last decade (Figure 13). With respect to water, "major improvements in the quality of polluted streams have been documented" with hard data, says the Council. (43) (See Figure 14.) The fish catch in Lake Erie, long ago said to be "dead" by Barry Commoner, has been increasing. The most important indicator of environmental quality is life expectancy; it continues to rise--and at increasing rate: a gain of 2.1 years from 1970-1976, compared to a gain of only 0.8 years in the entire decade of the 1960's. (44)

Statement: Increased population density leads to psychological and social pathology.

Fact: The statement is sheer myth, based on faulty analogies to animal behavior. Social surveys show that density has no general ill effects on such measures of welfare as longevity of life, crime rate, mental illness rates, and recreational facilities. (45)

The most ambitious experimental tests, by psychologist Jonathan Freedman who started out as an associate of Paul Ehrlich believing that density is pathological, found that though "Everyone knows that crowding is bad . . . Intuitions, speculations, political and philosophical theory appear to be wrong in this respect . . . People who live under crowded conditions do not suffer from being crowded. Other things being equal, they are no worse off than other people . . . It took me and other psychologists working in this area many years to be convinced, but eventually the weight of the evidence overcame our doubts and preconceptions." (46)

Statement: Bringing immigrants from a poor country into a rich country is an act of generous charity which throws citizens out of jobs, and drains welfare and social service funds.

Fact: Studies of the United Kingdom, Canada and the U.S. show that immigrants put more into the tax coffers than they take out, while there is no evidence that they increase overall unemployment rates. (47) Illegal immigrants from Mexico and elsewhere are the best deal of all for the U.S. taxpayers. Two California experiments show that few U.S. citizens will take the jobs that illegal Mexican immigrants fill. And while the illegals are in the U.S., three-fourths pay Social Security and income taxes through payroll deductions. (48) But lack of citizenship prevents illegals from getting most social benefits even though they pay taxes; less than 5% use public hospital services, collect any unemployment insurance, or have children in school; and, perhaps one percent get food stamps or welfare payments. (49) Villalpando calculated a ratio of $24

in taxes paid by illegals for each $1 of social services used in San Diego County. (50)

Statement: In 1972 the Club of Rome asserted that economic and population growth must cease, and disaster from resource exhaustion is imminent.

Fact: In 1976 the Club of Rome "reversed its position" and "came out for more growth."

> The Club's founder, Italian Industrialist Aurelio Peccei, says that Limits was intended to jolt people from the comfortable idea that present growth trends could continue indefinitely. That done, he says, the Club could then seek ways to close the widening gap between rich and poor nations--inequities that, if they continue, could all too easily lead to famine, pollution and war. The Club's startling shift, Peccei says, is thus not so much a turnabout as part of an evolving strategy. (51)

In other words, the Club of Rome sponsored and disseminated untruths in an attempt to scare us. Now having scared us by lying to us, the Club of Rome can tell people the real truth that we are now ready to hear.

Of course it is possible that the Club of Rome did not really practice the deceitful "evolving strategy" that is now says it did. Maybe they simply realized at last that the 1972 Limits to Growth study was scientifically worthless. If so, the Club of Rome is now lying about what it really did, in order to save face. From the outside we have no way of knowing which of these ugly possible untruths is the real "truth".

Surely this is one of the more curious scientific episodes of recent years. Those who wrote The Limits to Growth study have not recanted, to my knowledge, even though their sponsors have. But neither did the writers confront and contradict their sponsors when the sponsors recanted. The whole matter seems to have passed with little notice, and The Limits to Growth continues to be cited as an authority--though it has been damned as foolishness or fraud by almost every reviewer including a forceful early editorial in Science. (52) If the shoe were on the other foot, we would surely hear plenty from such organizations as ZPG.

Another curiosum: The Club of Rome continues to sponsor research reports which it expects people to accept as valid science--and it finds researchers to accept Club of Rome support.

Statement: "[E]ven if the family size drops gradually--to the two-child average--there will be no year in the next two decades in which the absolute number of births will be less than in 1970," said the President's Commission on Population Growth, 1972. (53)

Fact: In 1971—the year before this forecast by the President's Commission was transmitted to the President and then published--the absolute number of births (not the birth rate) was less than in 1970. By 1975, the absolute number of births was barely higher than in 1920, and the number of white births was actually lower than in most years from 1914 to 1924.

This scientific fiasco shows how flimsy are the demographic forecasts upon which arguments about growth policy are based. In this case the Commission did not even backcast correctly, let alone forecast well.

Another peculiar forecasting episode: Between 1969 and 1978, UN and other standard estimates of the world's population in the year 2000 fell from around 7.5 billion to around 5.5 billion. This is a difference of two billion people--equal to about half the world's present population--for a date only thirty years or less in the future.

There is also grave disagreement even among estimates of current magnitudes. An important example is the population growth rate of China--a fifth of the entire world population: 2.4% per year according to the Environmental Fund, and 0.8% per year according to USAID; these estimates correspond to doubling times of about 30 years and about 90 years, respectively, estimates with entirely different implications. (54)

WHY DO WE HEAR PHONEY BAD NEWS?

Why do false statements of bad news dominate public discussion of these topics? Here are some speculations:

(1) There is a funding incentive for scholars and institutions to produce bad news about population, resources, and the environment. USAID and the UN's Fund for Population Activities disburse hundreds of millions of dollars each year to bring about fertility decline. Much of this money goes to studies and publications that show why fertility decline is a good thing. There are no organizations that fund studies having the opposite aim. It should be no surprise, then, when an organization such as Worldwatch Institute--whose statement of purpose is "to identify and to focus attention on global problems", and which gets support from AID and the UNFPA--"identifies" impending disasters whether backed by statistical evidence or not.

(2) Bad news sells books, newspapers and magazines; good news is not half so interesting. Is it a wonder that there are lots of bad-news bestsellers warning about pollution, population growth and natural-resource depletion, but none telling us the facts about improvement?

(3) Pure individual selfishness is another reason for spreading bad news. For example, in the short run more children mean more visitors to wild-life areas, and it makes sense in terms of Daniel Boone-like self-interest for the Environmental Fund and related organizations to try to convince people that population growth is a bad thing—though in the long run a larger population may well build and protect new and better recreation areas.

(4) There are a host of possible psychological explanations for this phenomenon about which I am reluctant to speculate. But these two seem reasonably sure: (a) Many people have a propensity to compare the present and the future with an ideal state of affairs rather than with the past or with some other feasible state; the present and future inevitably look bad in such a comparison. (b) The accumulative nature of exponential growth models has the power to seduce and bewitch.

(5) Some publicize dire predictions in the idealistic belief that such warnings can mobilize institutions and individuals to make things even better, figuring that nothing bad can come of them. But we should not shrug off false bad news as harmless exaggeration. The piper will be paid--in loss of credibility for real threats as they arise, because of the "wolf" cries, and in loss of public trust in debased public communication. As Philip Handler, President of the National Academy of Science testified to Congressmen in the midst of the environmental panic in 1970:

"The nations of the world may yet pay a dreadful price for the public behavior of scientists who depart from . . . fact to indulge . . . in hyperbole. (55)

The question, then, is: Who will tell us the good-and-true-news? How will it be published for people to learn?

POSTSCRIPT ABOUT VALUES

Personal values heavily influence attitudes about population and resources. Many of those who are most outspoken on these subjects implicitly or explicitly hold the value that more people are not a good thing in and of themselves. They are downright gleeful at the notion that billions of human lives will never be lived that might be lived. An example is this statement in a mass-circulation magazine by X, one of the world's great demographers, when referring to the 23 million person increase in the U.S. during the 1960's: "I have never been able to get anyone to tell me why we needed those 23 million." (56) Paul Ehrlich expressed the same idea: "I can't think of any reason for having more than one hundred fifty million people (in the U.S.), and no one has ever raised one to me." (57)

Gentlemen, may I be the first to suggest a few reasons? Least-interesting but not unimportant is that a larger population now probably means a better standard of living for our grandchildren and great-grandchildren. A more interesting reason that Ehrlich and X have not discovered is that "we"--whoever "we" is--need another person for the same reasons "we" need X and Ehrlich. That is, just as the Ehrlichs are of value to the rest of us, just so will the average "additional" person born be of value to the rest of us.

The most interesting reason for additional people, however, is that if the Ehrlichs say that their lives are of value to themselves--and if the rest of us honor that claim and say that human life is of value for its own sake--then in the same manner the lives of additional people are of value to those additional people, and hence to the rest of us.

If Ehrlich or X were to ask those 23 million Americans born between 1960 and 1970 whether it was a good thing that they were born, many of them would be able to think of a reason or two. Some of them might also be unkind enough to add: "Yes, it's true that you gentlemen do not personally need any of us for your welfare. But then, gentlemen, do you think that we have greater need of you for our welfare?"

What is most astonishing is that these simple ideas--which would immediately spring to the mind of many people who have not been to school—have never even come into the heads of famous scientists such as Ehrlich, by their own admission! But the Ehrlichs have access to the media, and the will to use it. Who will express other values and points of view? Will it take a catastrophe to bring them forth?

SUMMARY

False bad news about population growth, natural resources, and the environment is published widely in the face of solid contradictory evidence. For example, the world supply of arable land has been increasing, the scarcity of natural resources including food and energy has been decreasing, and basic measures of U.S. environmental quality have positive trends. The aggregate data show no long run negative effect of population growth upon the standard of living, and my models that embody forces omitted in the past--especially the influence of population size upon productivity increase--suggest a long run positive effect. There are various possible reasons why the false bad news dominates the true good news. Personal values are certainly a key factor.

best available sources. The different figures you have obtained are of course disturbing. But all we can say at this point is that we will add this information to our files and take it into account in future stories.

We appreciate the concern that prompted you to write to Newsweek.

Sincerely,

Ray Sawhill

For the Editors

9. W. Stys. "The Influence of Economic Conditions on the Fertility of Peasant Women." Population Studies Vol. 11, 1957, pp. 136-148; Ramon H. Myers, The Chinese Peasant Economy (Cambridge: Harvard, 1970), originally from Buck, Statistics, p. 288.
10. George S. Fichter, The Golden Stamp Book of Earth and Ecology (Racine, WI.: Western Publishing, 1972).
11. Wall Street Journal, October 30, 1975.
12. Wall Street Journal, December 13, 1976, editorial page.
13. Paul Ehrlich, The Population Bomb (New York: Ballantine, 1968, p. xi).
14. Ibid.
15. Newsweek, November 11, 1974, p. 16.
16. Paul and William Paddock, Famine, 1975 (New York: Little, Brown, 1967) p. 222.
17. Julian L. Simon, The Economics of Population Growth (Princeton: Princeton University Press, 1977).

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1. Letter from Helen Ware, March 20, 1978.

2. Associated Press, in Champaign-Urbana News Gazette, January 10, 1978, p. A-5.

3. "Demographic Aspects of Drought: An Examination of the African Drought of 1970-74", in David Dalby, R. J. Harrison Church and Fatima Bezzaz (eds.), Drought in Africa No. 2, African Environment Special Report No. 6, International African Institute in association with the Environment Training Programme, UNEP-IDEP-SIDA, London, 1977, pp. 93-100. For a full and judicious assessment of the situation and the area see Caldwell's The Sahelian Drought and Its Demographic Implications (Washington: Overseas Liason Committee, American Council on Education, December 1975).

4. Newsweek, September 19, 1977; New York Times, August 28, 1977, p. 1.

5. Erik P. Eckholm. Losing Ground: Environmental Stress and World Food Prospects (New York: W. W. Norton and Company, 1976).

6. Joginder Kumar. Population and Land in World Agriculture (Berkeley: University of California Press, 1973).

7. United Nations FAO Production Yearbook, Vol. 29, 1975, p. 3 and USDA, Foreign Agricultural Economic Report 98.

8. When I submitted a letter to the editor containing these facts, Newsweek did not print it but replied:

   Dear Mr. Simon:

   We can only say that, in preparing the Sept. 19, 1977 story to which you refer, we used what we thought were the

18. Associate Press, February 12, 1975.

19. D. Gale Johnson, "Population, Food, and Economic Adjustment," American Statistician, Vol. 28, 1974, pp. 89-93. For more details, see Johnson's article on "Famine" in the Encyclopedia Brittanica, 1973 Edition.

20. "The Effect of Population Density Upon Infrastructure: The Case of Roadbuilding," Economic Development and Cultural Change, Vol. 23, No. 3, April 1975.

21. Summarized in Simon, 1977, pp. 139-140. To ensure that earlier studies were not flawed by employing only population growth as an independent variable, Roy Gobin and I regressed the economic growth rate in various cross-sections of LDC's from 1950 to 1970 on population density and population size together with population growth. Population growth continued to show no effect. Interestingly, however, population density shows a pronounced positive influence on economic growth. See Simon and Gobin, "The Relationship Between Population and Economic Growth in LDC's," in J. Simon and J. DaVanzo (eds.), Research in Population Economics, Vol. II (Greenwich: JAI Press, 1979).

22. Simon Kuznets, Economic Growth of Nations (New York: Norton, 1971) pp. 11-14.

23. Ibid.

24. Phyllis Piotrow, World Population Crisis: The United States Response (New York: Praeger, 1973).

25. Coale, Ansley J. and Edgar M. Hoover. Population Growth and Economic Development in Low-Income Countries (Princeton: Princeton University Press, 1958).

26. Ehrlich caught the spirit of this policy thusly: "[W]e should see that the majority of federal support of bio-medical research goes into the broad areas of population regulation, environmental sciences and behavioral sciences, rather than into short-sighted programs of death control," in "World Population: Is the Battle Lost?" Reader's Digest, Vol. 94, 1969, pp. 137-140. Or as an economist of the Coale-Hoover School put it, "To diminish mortality and morbidity... where underemployment of labor is the critical characteristic... serves markedly to retard rates of general economic growth" quoted in William Petersen, Population, 2nd ed., (New York: Macmillan, 1969), p. 572.

27. Malthus, Thomas R., An Essay on the principle of population, or a view of its past and present effects on human happiness (London: J. Johnson, A new edition, very thick, enlarged, 1803).

28. This model and the empirical elements in its construction are described in Chapters 4-6 of Simon, 1977.

29. William Petty. Another Essay in Political Arithmetic (1682), in Charles H. Hull (ed), The Economic Writings of Sir William Petty (Cambridge: CUP, 1899), p. 474.

30. Robert Solow, "Technical Change and the Aggregate Production Function," The Review of Economics and Statistics 39, 1957, p. 312-320; Denison, Edward F. The Sources of Economic Growth in the United States and the Alternatives Before Us, (New York: CED, 1962).

31. An interesting and comprehensive relevant discussion is in Harold J. Barnett, "Population Problems: Myths and Realities," Economic Development and Cultural Change, Vol. 19, July, 1971, pp. 545-559.

32. See chapters 7-13 of Simon, 1977, for more details.

33. Raleigh Barlowe. Land Resource Economics: The Economics of Real Property, 3rd ed., (Englewood Cliffs: Prentice-Hall, 1978), p. 50.

34. U.S.D.A., Economic Research Service. Our Land and Water Resources: Current and Prospective Supplies and Uses. Miscellaneous Publication No. 1290, Economic Research Service, U.S.D.A., May, 1974, p. vi.
H. Thomas Frey, Cropland for Today and Tomorrow, Economic Research Service, U.S.D.A., Agricultural Economic Report No. 291, 1975.
H. Thomas Frey, Major Uses of Land in the United States: Summary for 1969, U.S.D.A. Econ. Report 247 (Washington, D.C.: G.P.O., 1973).

35. M. L. Cotner, M. D. Skold, and O. Krause, Farmland: Will There Be Enough? (Washington: U.S.D.A. Economic Research Service, ERS 584, 1975, p. 10).

36. See reference 34 for the data in the paragraph.

37. Barlowe, p. 50.

38. George Homans, "I Am Not a Dangerous Man. It Is My Ideas That Are Said to be Dangerous," Harvard Magazine, July-August, 1977, p. 58; Alexander Solzhenitsyn, quoted in Newsweek, March 18, 1974, p. 122.

39. The book Scarcity and Growth by Harold J. Barnett and Chandler Morse (Baltimore: Johns Hopkins, 1963) is the classic argument for this point of view, accompanied by a wealth of data. My discussion was inspired by their treatment and follows in their spirit, which in turn has roots in the Paley Commission of the early 1950's, and in Joseph S. Davis, "The Population Upsurge and the American Economy, 1945-80," Journal of Political Economy, Vol. 61, 1953, pp. 369-88.

The data in Scarcity and Growth cover 1870-1957. Barnett has recently extended his analysis from 1957 to 1970, and found that the downward trends in real costs of extractive materials continue. "Scarcity and Growth: Revisited," in V. K. Smith (ed)., Scarcity and Growth Reconsidered, (Resources for the Future, Washington, forthcoming).

A provocative but convincing technologically-based argument for continuation of these downward cost trends for minerals is H. E. Goeller and Alvin M. Weinberg, "The Age of Substitutability," Science, Vol. 191, 20 February, 1976, 683-689.

40. Figures 3-11 were prepared by Douglas Love mostly from U.S. Historical Statistics, plus other standard sources.

41. Jerusalem Post, January 3, 1978, p. 5; Marvin Zonis, "Petroleum and Politics in the Persian Gulf," University of Chicago Magazine, March, 1976, p. 14 ff.

42. National Wildlife, "Environmental Quality Index," February, 1977.

43. Council on Environmental Quality, Environmental Quality - 1976, 7th Annual report, September, 1976, p. 285.

44. Metropolitan Insurance Company Statistical Bulletin, Vol. 58, May, 1977, p. 9.

45. Amos H. Hawley, "Population Density and the City," Demography, Vol. 9, 1972, p. 521-530, and Harvey M. Choldin, "Urban Density and Pathology," Annual Review of Sociology, Vol. 4, 1978, pp. 91-113, are representative summaries.

46. Jonathan L. Freedman, Crowding and Behavior (New York: The Viking Press, 1975).

47. Summarized in Julian L. Simon, "Immigrants Don't Cost, They Pay," paper given at Population Association of American, April, 1978.

48. M. Vic Villalpondo et al., A Study of the Socio-Economic Impact of Illegal Aliens, County of San Diego (San Diego: Human Resources Agency, County of San Diego, January, 1977).

49. David S. North and Marian F. Houston, The Characteristics and Role of Illegal Aliens in the U.S. Labor Market: An Exploratory Study (Washington: Linton and Company, March, 1976). Wayne A. Cornelius "Illegal Migration to the United States: Recent Research Findings, Policy Implications, and Research Priorities," mimeo, Center for International Studies, MIT, May, 1977.

50. Ibid.

51. Time, April 26, 1976, p. 56.

52. Philip Abelson, "Limits to Growth", editorial in Science Vol. 75, March 17, 1972.

53. Elliot R. Morss and Ritchie H. Reed, eds., Economic Aspects of Population Change (Washington, D.C. 1972), p. 4, as quoted by Larry Neal, Illinois Business Review, March 1978, Vol. 35, No. 2.

54. Roger Kramer and Samuel Baum. "Comparison of Recent Estimates of World Population Growth", presented at Population Association of America, 1978.

55. Philip Handler, Interview in U.S. News and World Report, January 18, 1971, pp. 30-34.

56. Reference on request to the author. X, though well-known, is not the public figure that Ehrlich is, and in my judgment deserves the opportunity to forget about this statement.

57. Saturday Review, March 11, 1972, p. 49.

58. I thank Stanley Friedman, Evelyn Satinoff, and Rita Simon for their useful comments. Douglas Love assisted me ably.

	Arable land as a percentage of of total area		Percent of arable that is cultivated		Cultivated land as a percentage of total land (1x3) and (2x4)		Agricultural arable plus pasture land as a percentage of total area	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1950	1960	1950	1960	1950	1960	1950	1960
Africa	14.27	15.30	32.21	47.72	5.2	6.5	46.50	59.02
Middle East	12.87	13.91	52.11	57.88	6.7	8.1	13.06	17.04
Asia	19.03	20.78	82.06	86.17	15.6	17.9	46.35	49.60
Frontier Countries (N. and S. America, USSR, Australia, New Zealand)	6.88	7.75	82.75	82.96	5.6	6.4	34.27	38.59
Europe	30.79	30.98	89.02	91.06	27.4	28.2	45.63	46.10
All Regions	10.73	11.73	82.75	83.99	8.9	9.9	37.35	41.07

Source: Kumar, p. 107 (see footnote 6).

TABLE 1

Changes in Land Use, 1950-1960

Per-Capita Food Production in the World

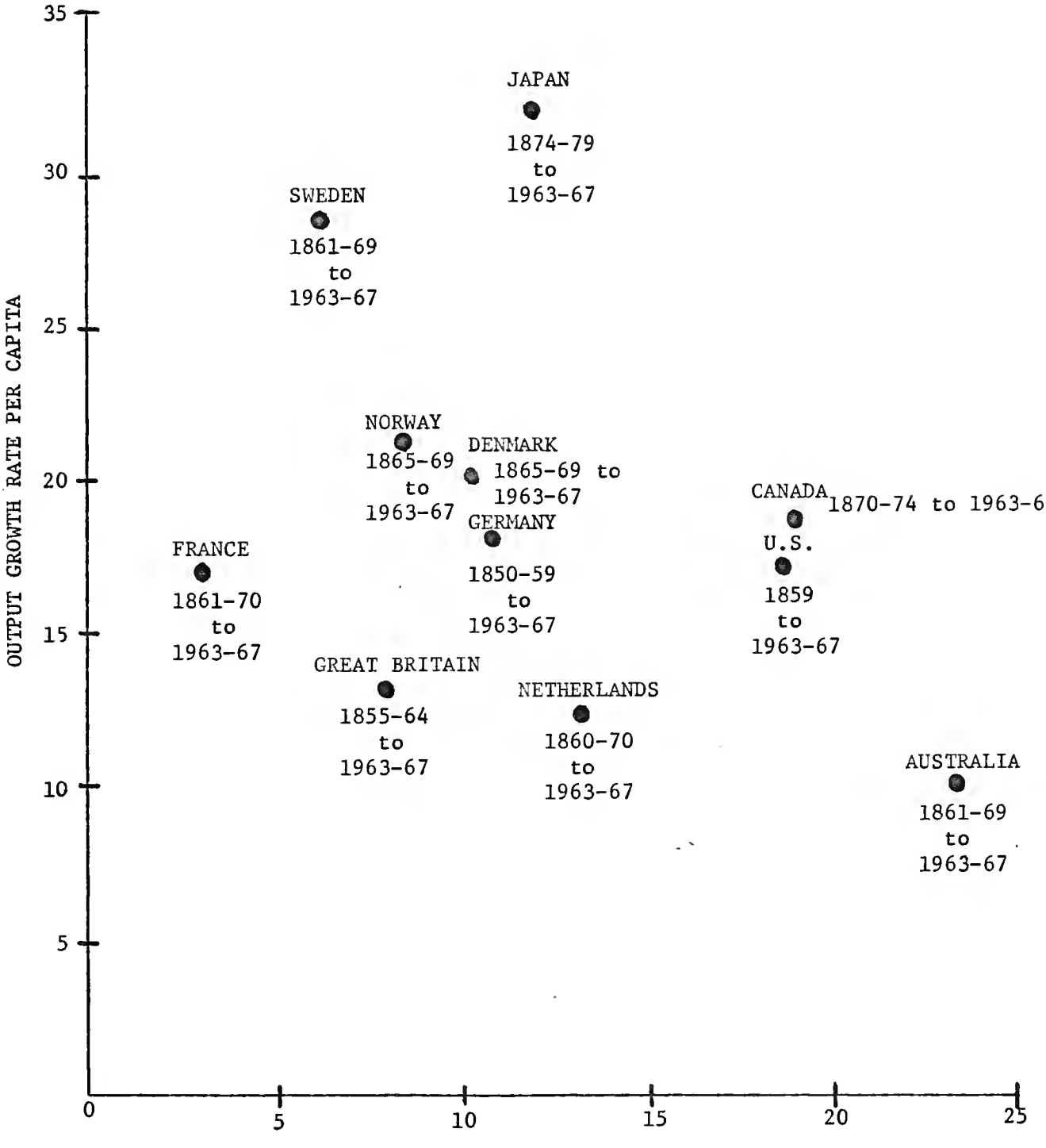
1948-1976

Year	World Excluding Mainland China (1952-1956=100) (1)	World Including Mainland China (1961-1965=100) (2)	Combined Index (1948-1952=100) (From 1 and 2)
1948-1952	93		100
1952	97		104
1953	100		108
1954	99		106
1955	101		109
1956	103		111
1957	102		110
1958	106		114
1959	106		114
1960	107		115
1961	106		114
1962	108		116
1963	108		116
1964	109	102	118
1965	108	100	116
1966	111	103	119
1967	113	105	121
1968		106	123
1969		105	119
1970		106	123

Year	(1)	(2)	(From 1 and 2)
1971		107	125
1972		104	120
1973		108	126
1974		107	125
1975		108	126
1976		110	128

Sources: United Nations FAO Production Yearbook, 1968, 1975, 1976.

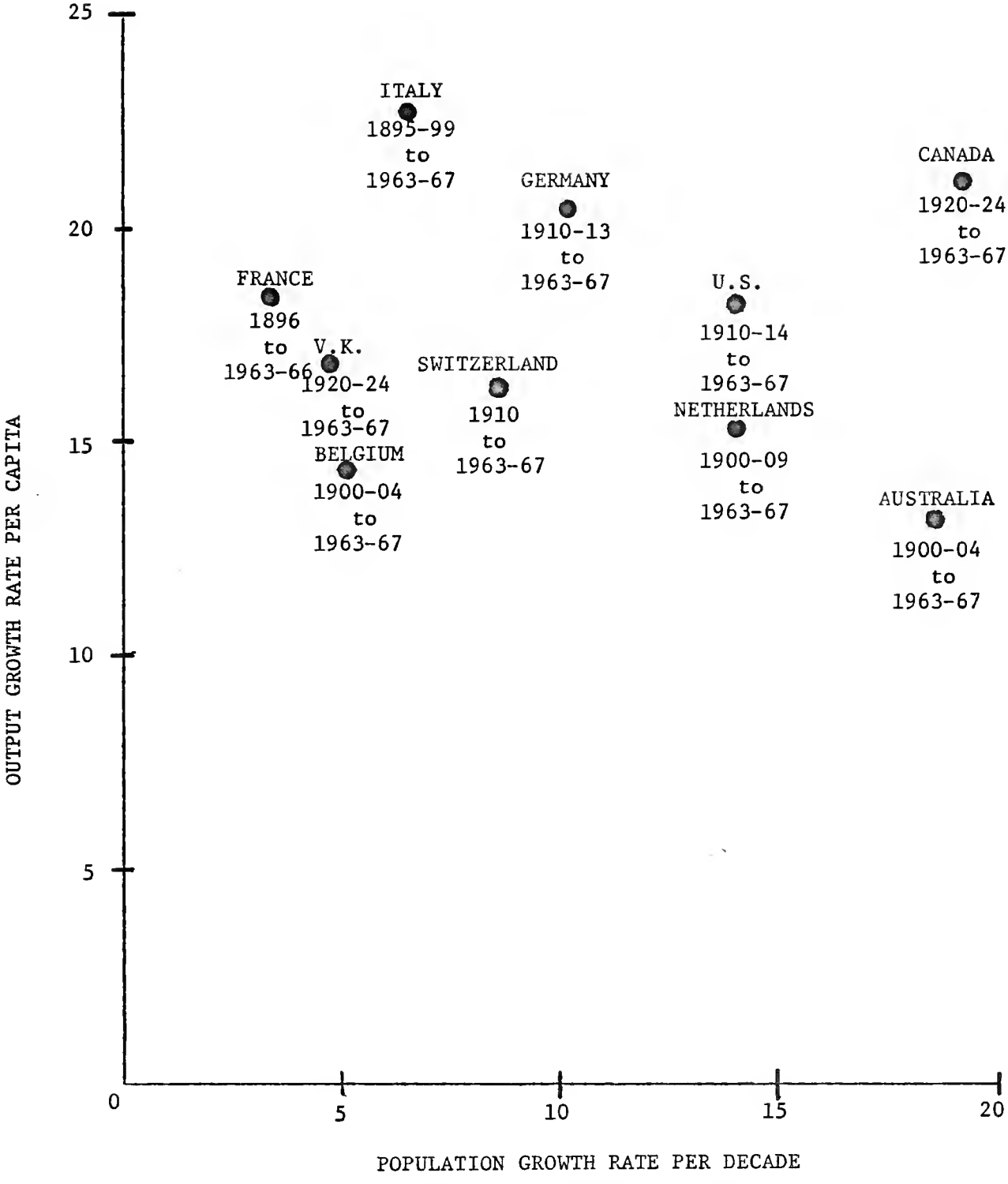
TABLE 2



POPULATION GROWTH AND OUTPUT GROWTH OVER A CENTURY IN CONTEMPORARY MORE DEVELOPED COUNTRIES

FIG. 1a

SOURCE: (22)



POPULATION GROWTH AND OUTPUT GROWTH OVER HALF A CENTURY
IN CONTEMPORARY MORE-DEVELOPED COUNTRIES

FIG. 1b

Source: (23)

TABLE 3

MONIES OBLIGATED (LOANS AND DISBURSEMENTS) FOR HEALTH AND POPULATION PROGRAMS BY THE AGENCY FOR INTERNATIONAL DEVELOPMENT (in millions of U.S. dollars), 1965-1977

Fiscal Year	Population	Health	Total
1965	1.9	32.4	34.3
1966	3.8	58.7	62.5
1967	4.3	98.1	102.4
1968	34.4	131.3	165.7
1969	43.9	38.3	82.0
1970	73.1	37.1	110.2
1971	94.0	57.7	151.7
1972	120.9	35.4	156.3
1973	121.7	42.9	164.6
1974	100.1	81.5	181.6
1975	100.0	54.5	154.5
1976	103.0	54.4	157.4
1977 (Est.)	143.4	93.6	237.0

Source: Lois E. Bradshaw, Don Pitty, and Cynthia P. Green, "A Guide to Sources of Family Planning Program Assistance," Population Reports, Series J, March, 1977, p. J272.

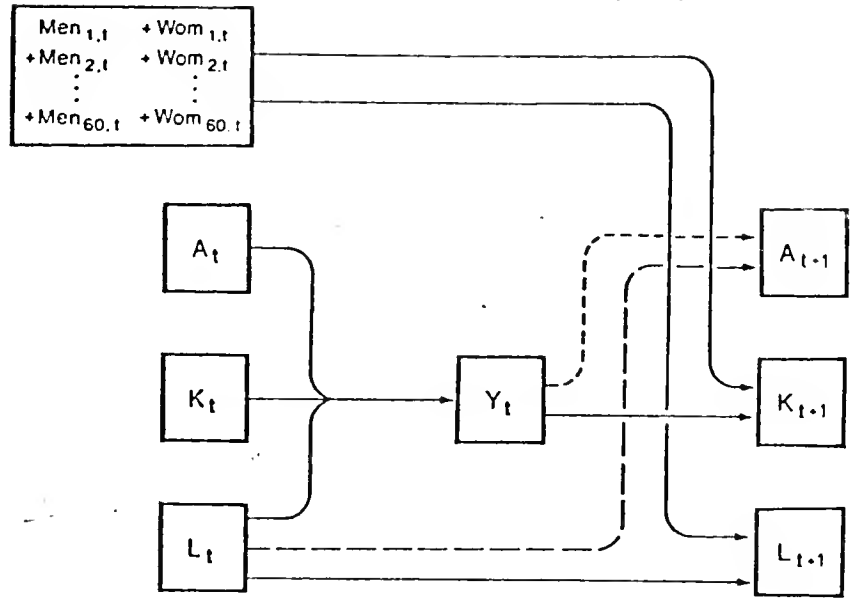


FIGURE 2. SCHEMATIC OF MDC MODEL: (Two Versions)

A_t = level of technology in year t

K_t = capital

L_t = labor

Y_t = national income

Note: The model is run for 160 periods, the output from each year t becoming the input for year t+1. The line with long dashes from L_t to A_{t+1} represents a version of the model in which the size of the labor force directly influences the level of technology through the quantity of inventions and adaptations. The line with the short dashes represents a version indirectly embodying a similar effect simulated by way of the effect of the size of the market on increases in productivity.

FIGURE 3

PRICE OF COPPER RELATIVE TO WAGES

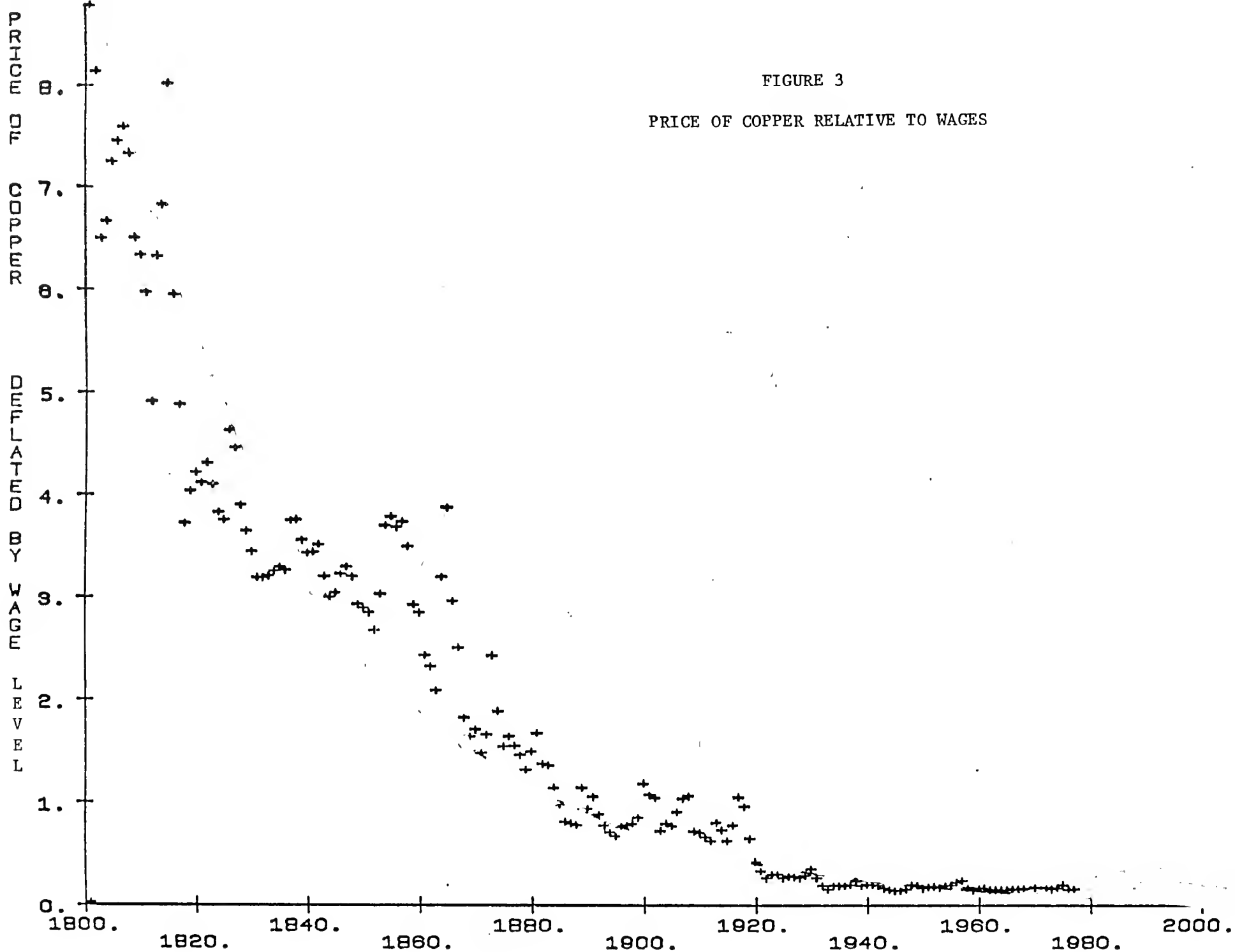


FIGURE 4

PRICE OF WHEAT RELATIVE TO WAGES

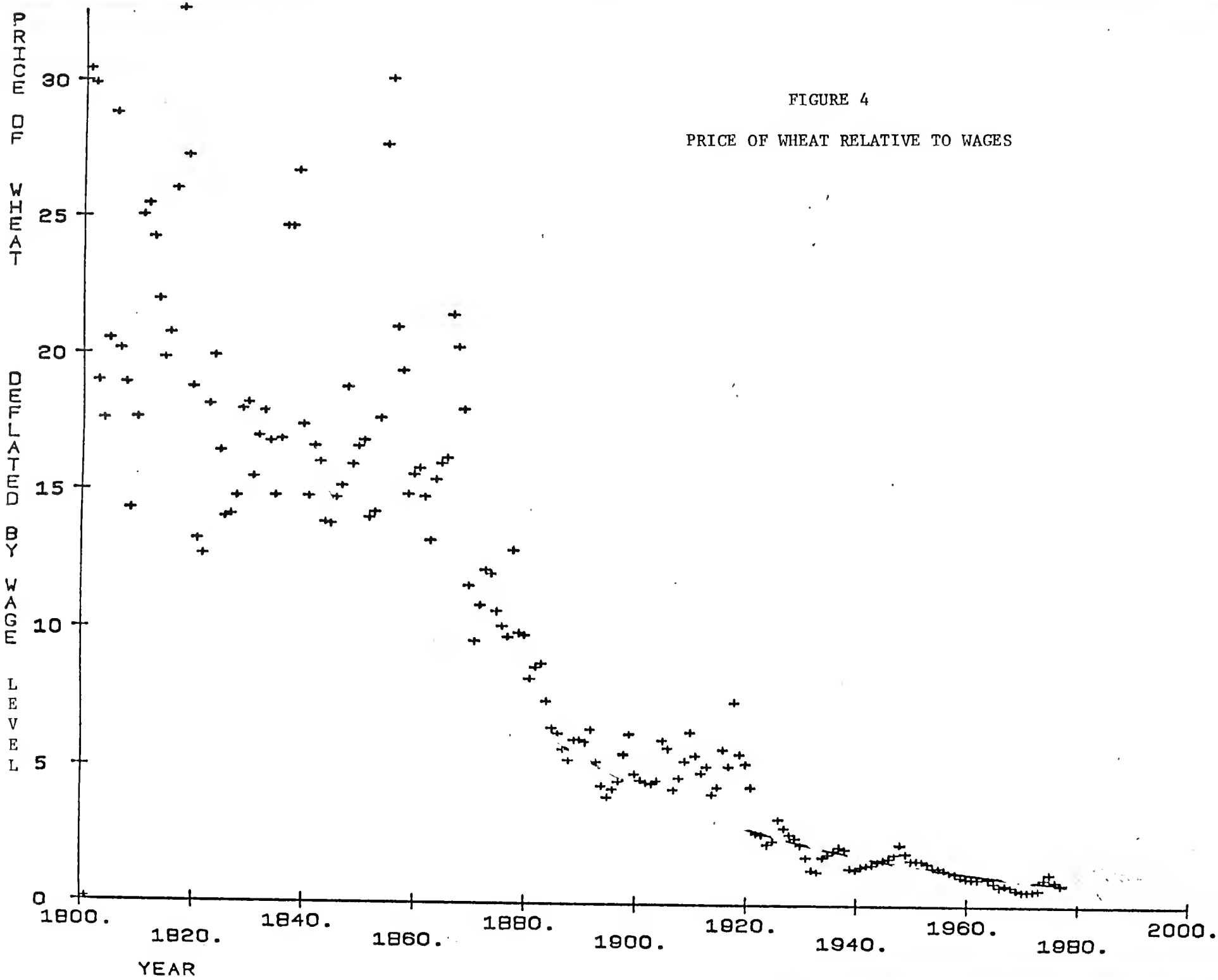


FIGURE 5

PRICE OF OIL RELATIVE TO WAGES

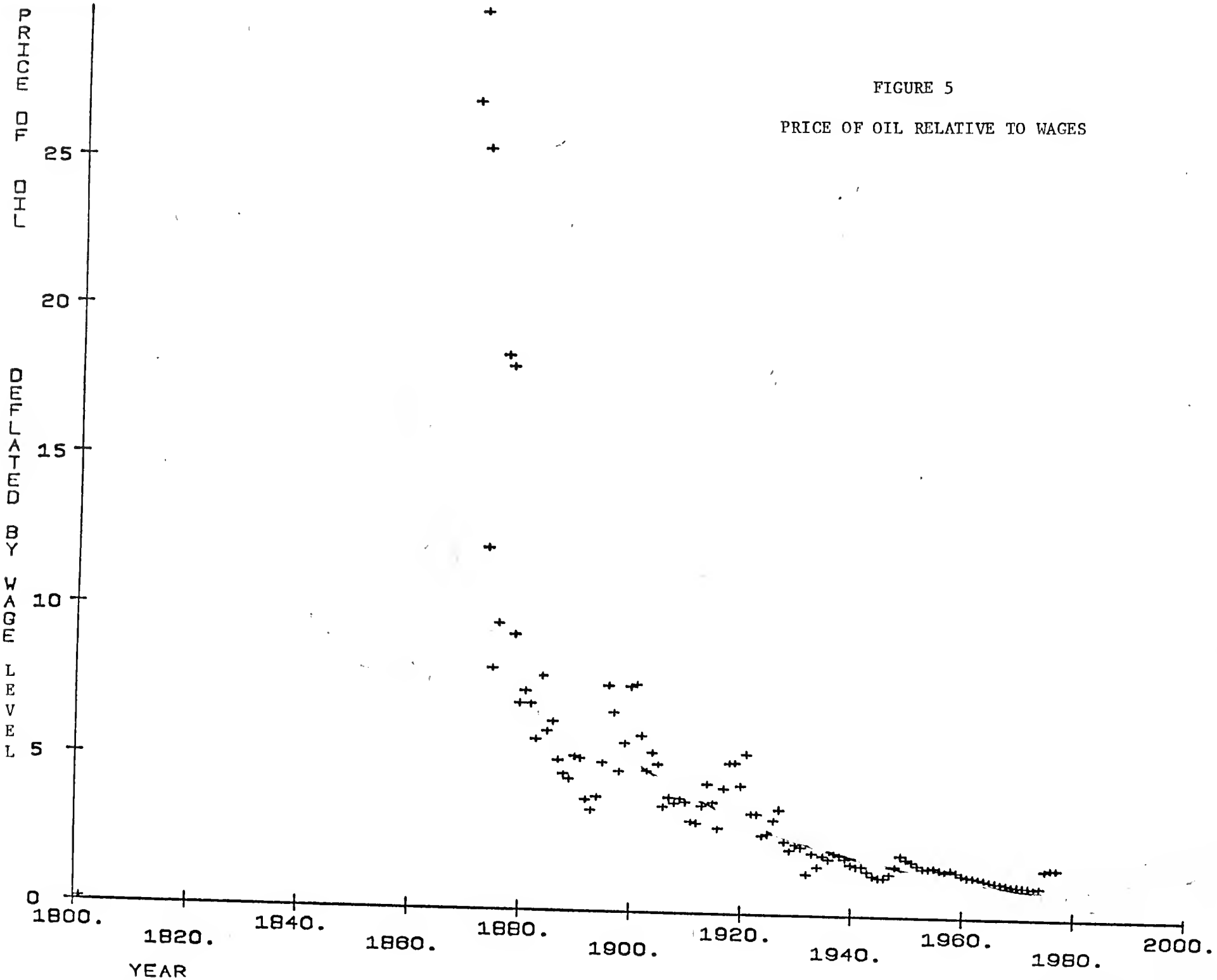


FIGURE 6

PRICE OF COPPER RELATIVE TO THE CONSUMER PRICE INDEX

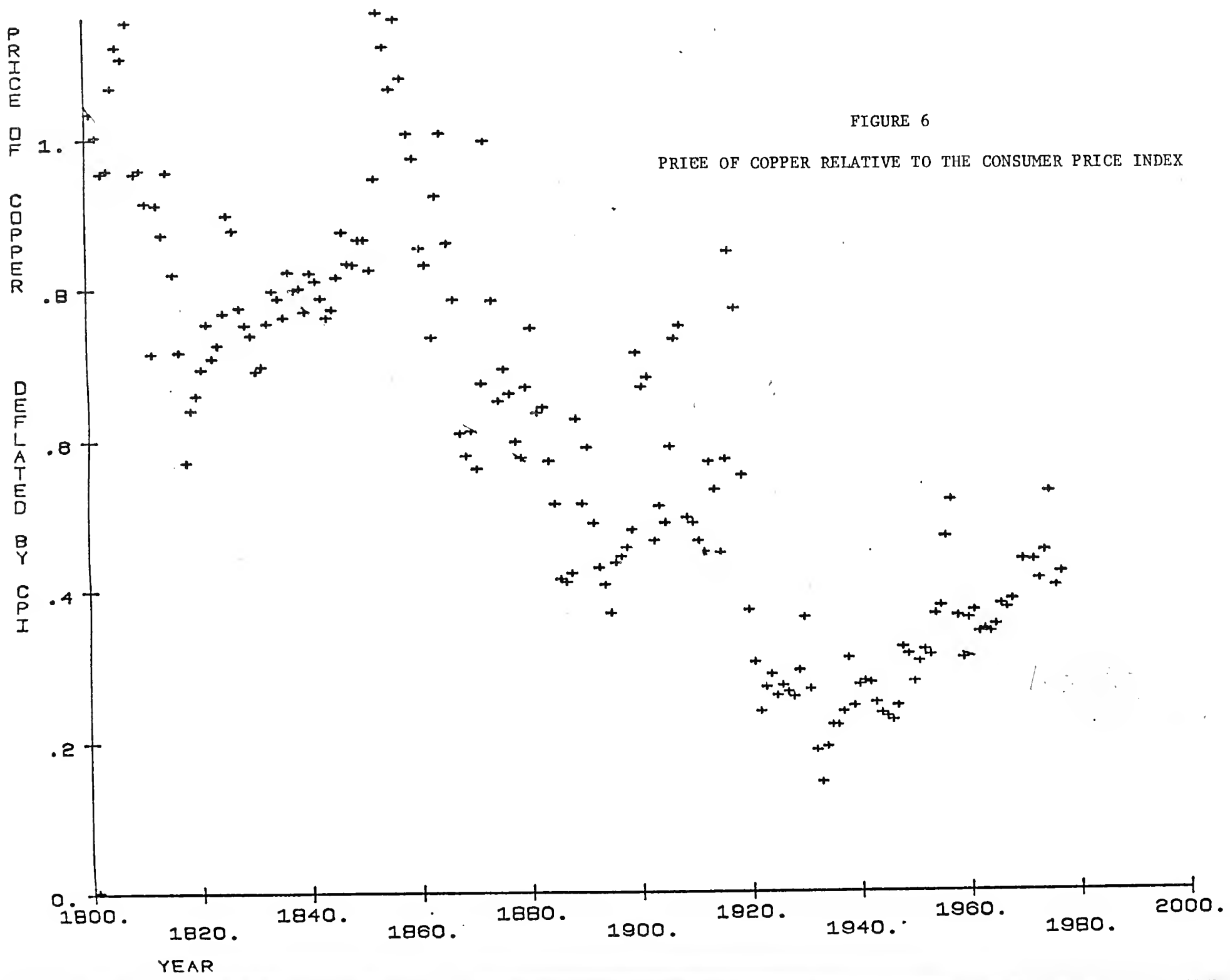


FIGURE 7

PRICE OF WHEAT RELATIVE TO THE CONSUMER PRICE INDEX

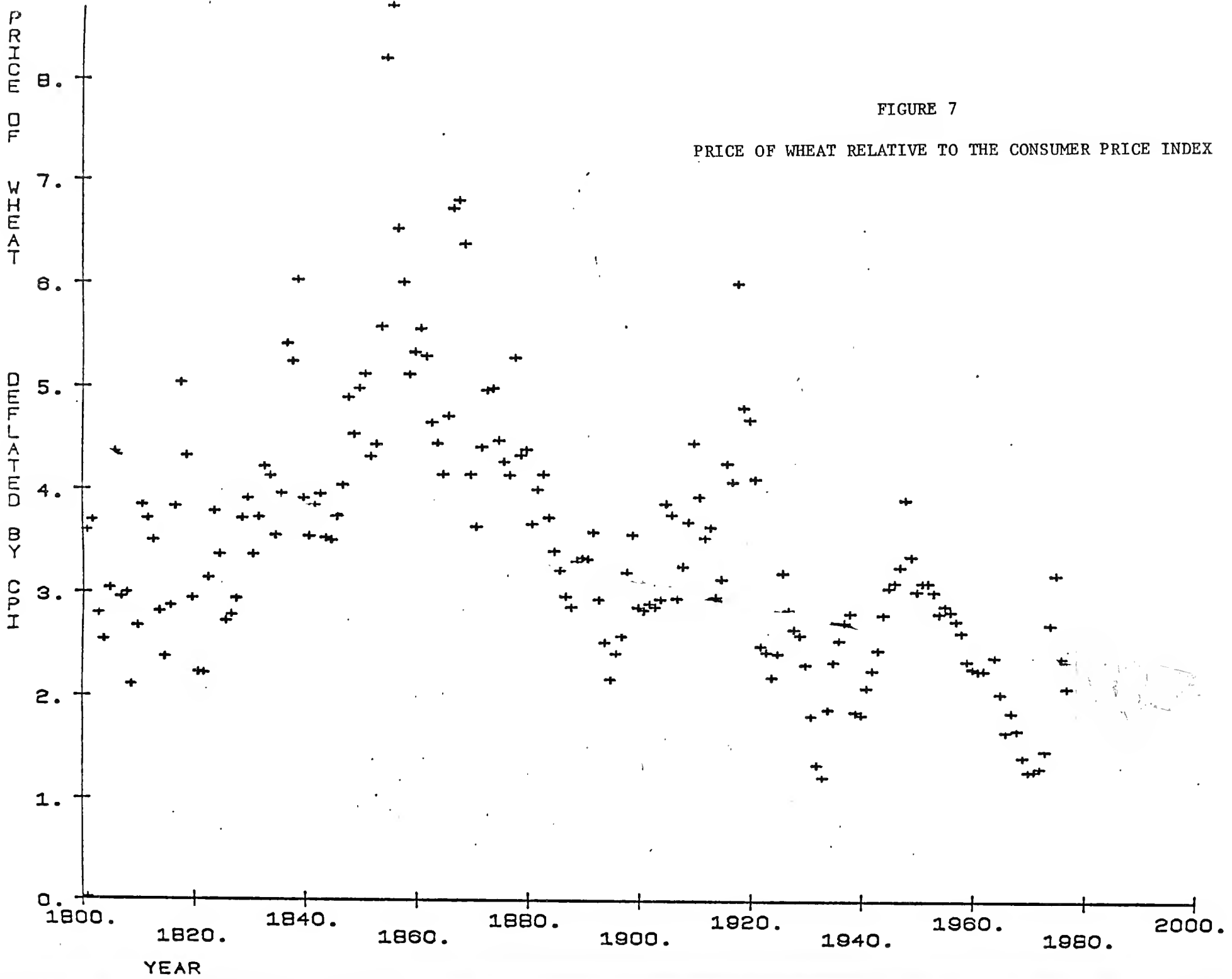


FIGURE 8

PRICE OF OIL RELATIVE TO THE CONSUMER PRICE INDEX

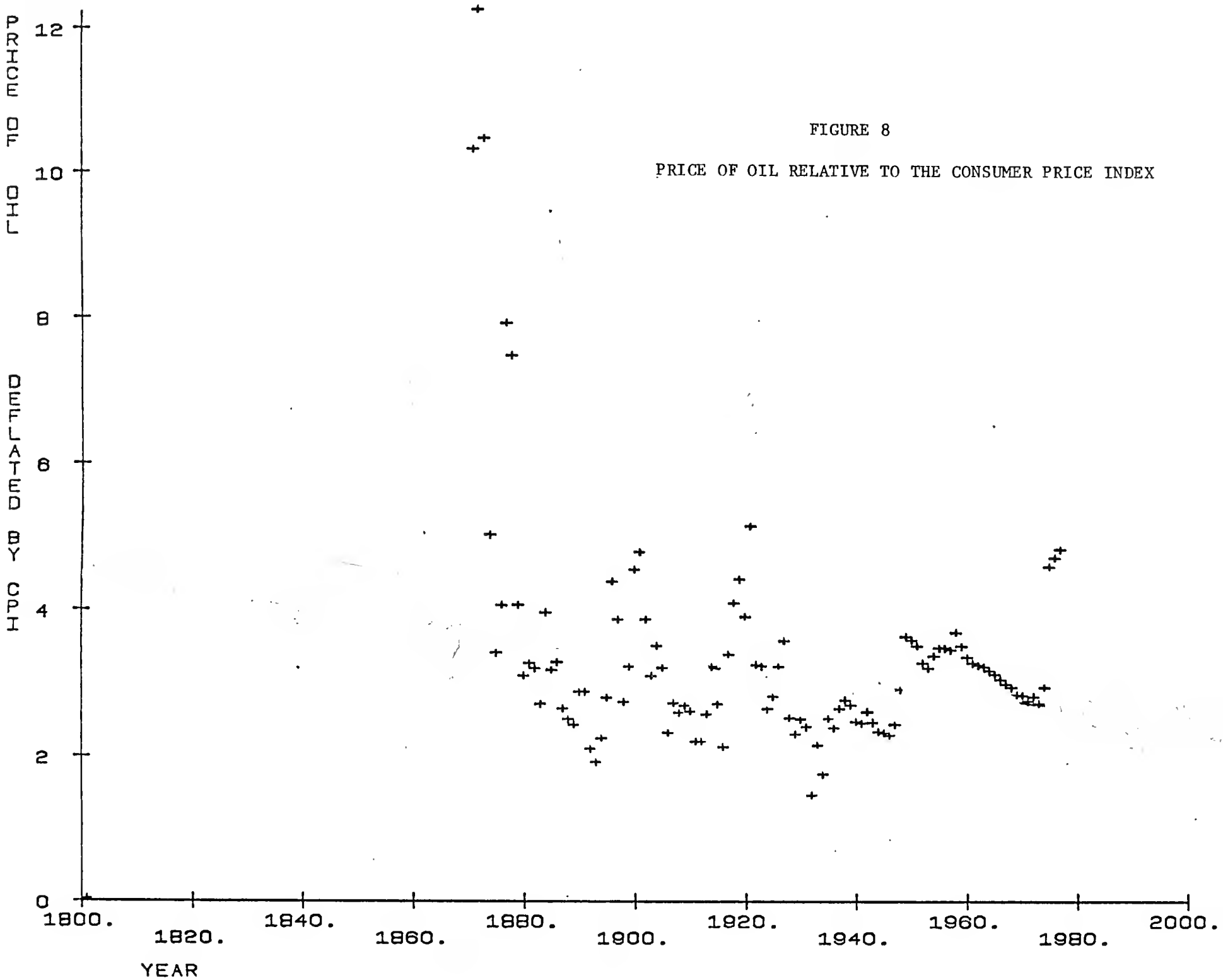


FIGURE 9

PRICE OF ELECTRICITY RELATIVE TO CONSUMER PRICE INDEX

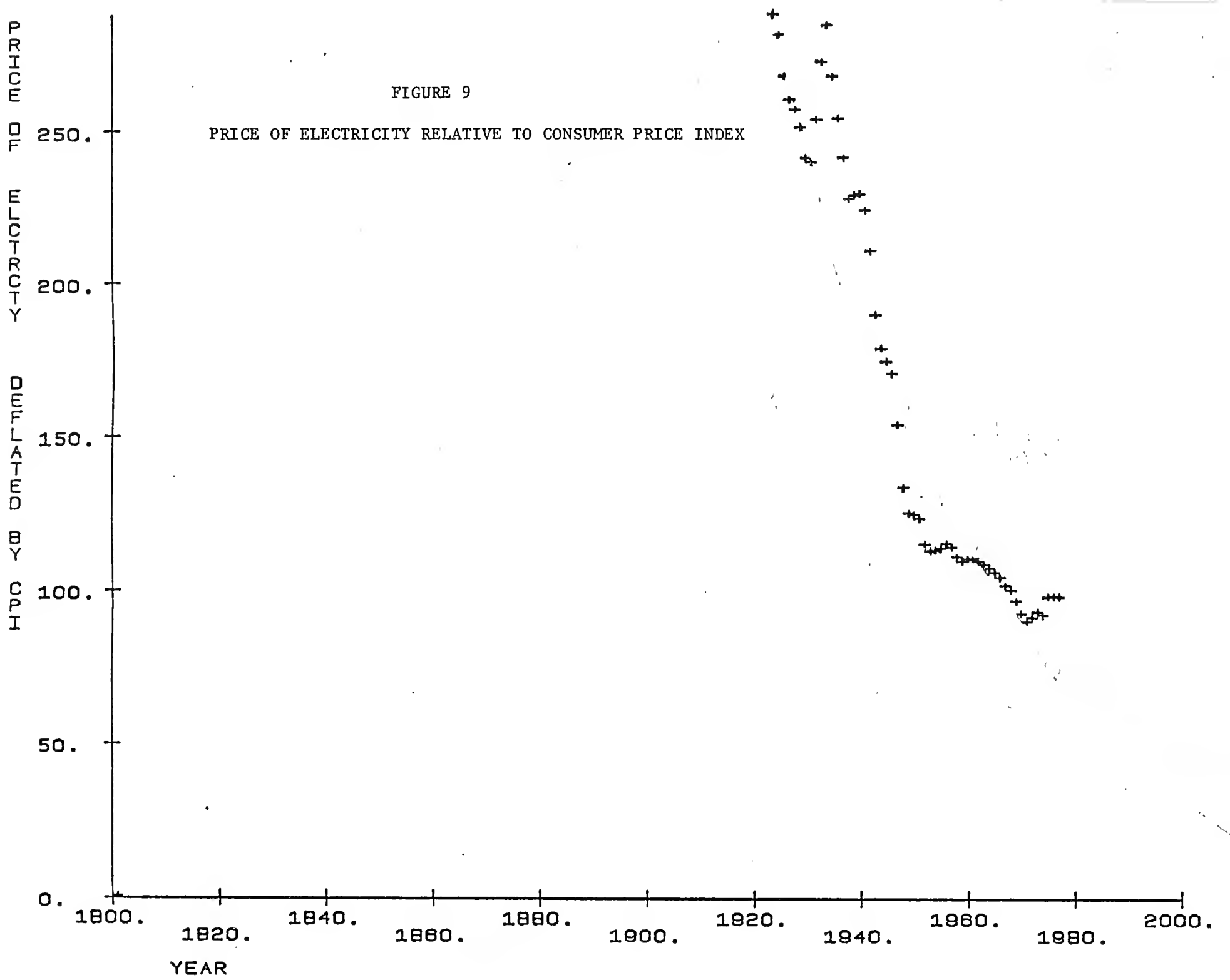


FIGURE 11

PRICE OF WHEAT RELATIVE TO THE CONSUMER PRICE INDEX

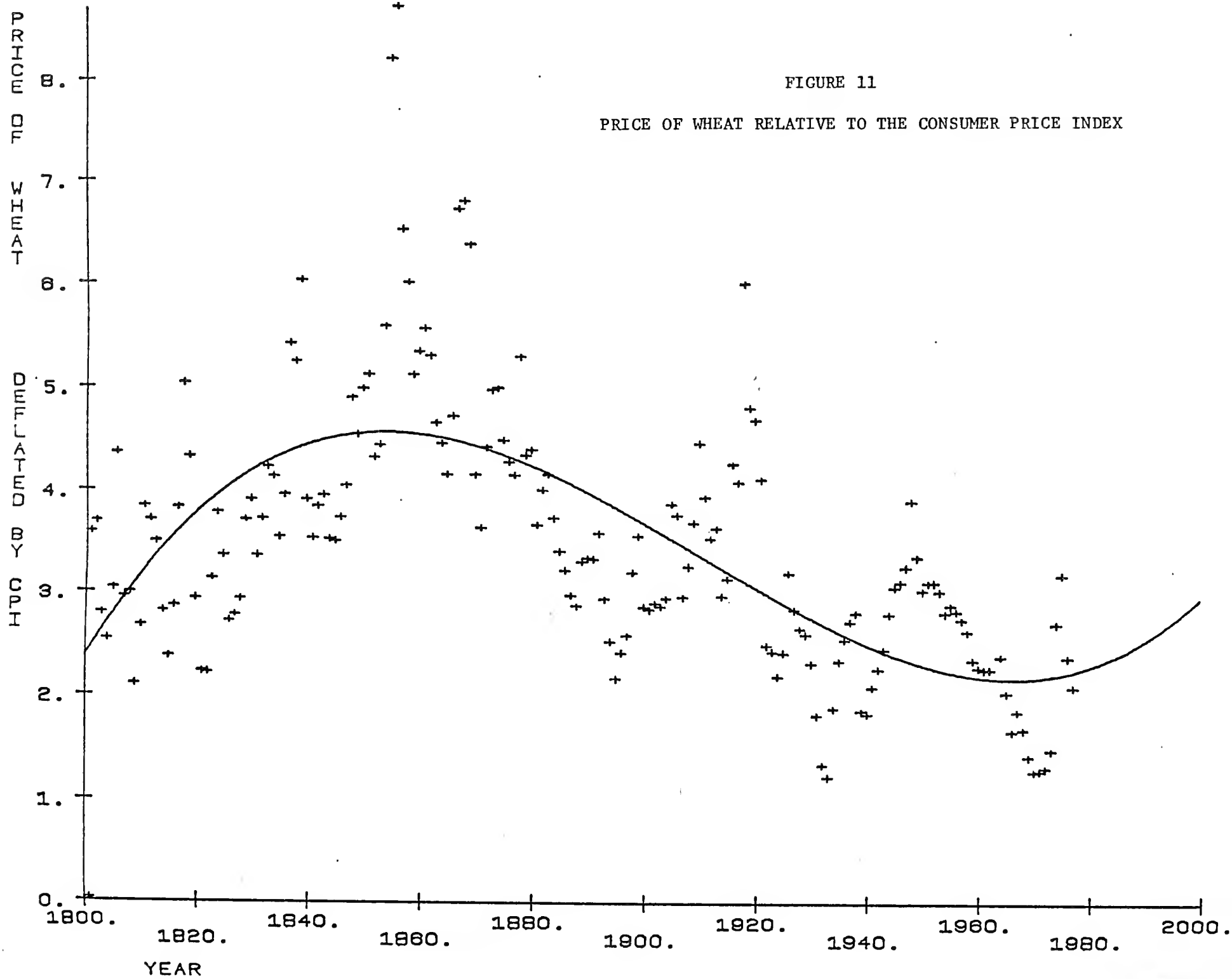
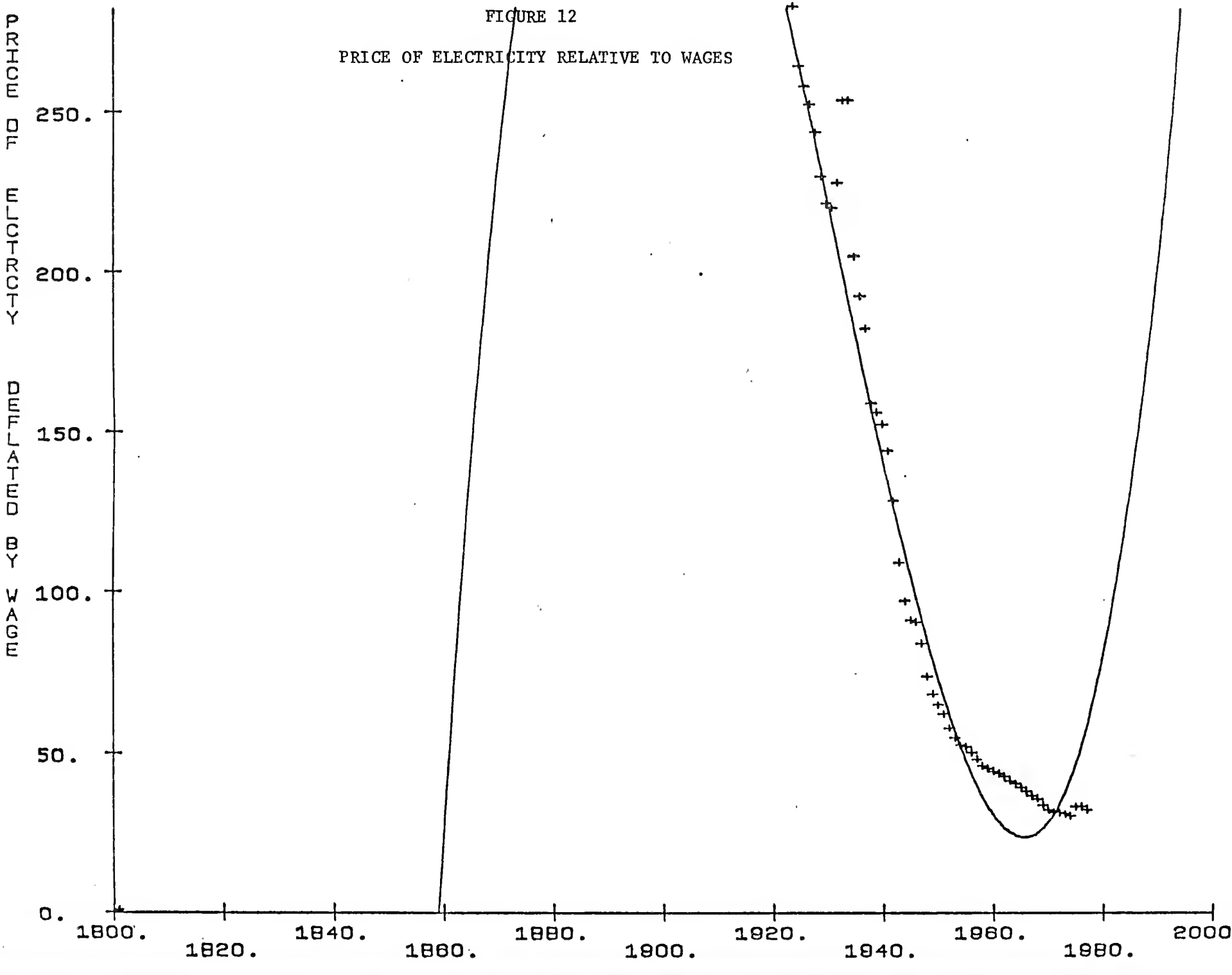


FIGURE 12

PRICE OF ELECTRICITY RELATIVE TO WAGES



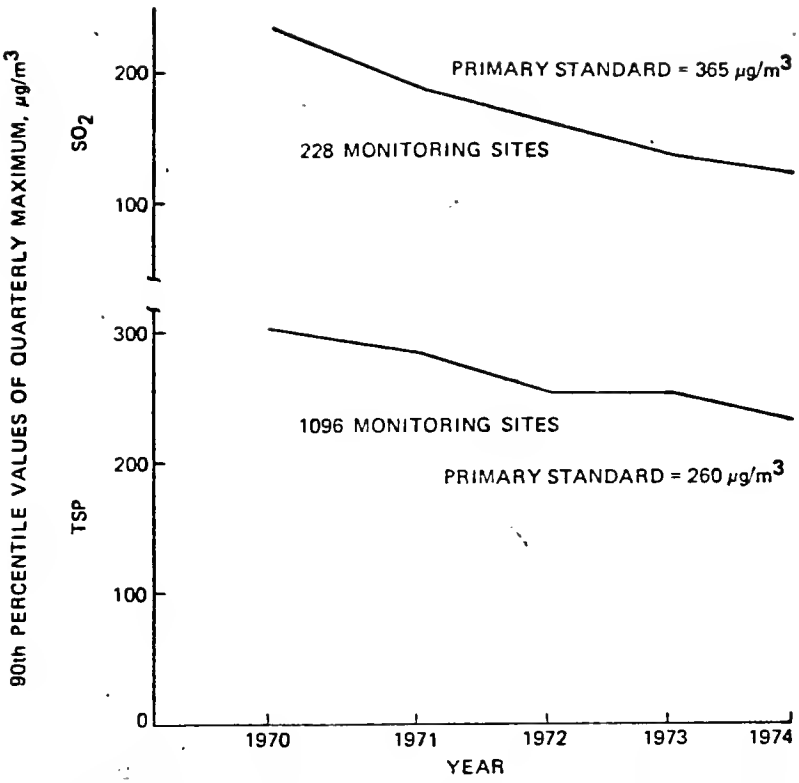
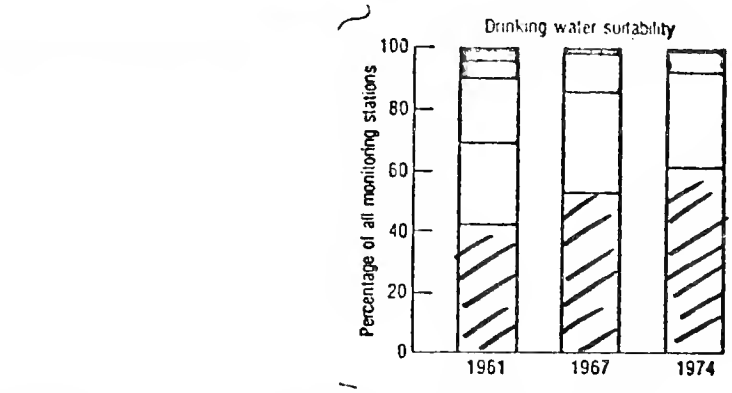


FIGURE 13 Overall national trends in daily observed levels of sulfur dioxide and total suspended particulates.

Reproduced from Council on Environmental Quality, Seventh Annual Report, 1976, p. 226, from U.S. Environmental Protection Agency data.

Figure 14

Summary of Water Quality Observations Related to [redacted] Drinking Water Suitability, 1961, 1967, and 1974[1]



Severe: 80-100 percent of all observed levels exceeded criteria or reference levels
Very poor: 60-80 percent of all observed levels exceeded criteria or reference levels
Poor: 40-60 percent of all observed levels exceeded criteria or reference levels
Fair: 20-40 percent of all observed levels exceeded criteria or reference levels
Good: 0-20 percent of all observed levels exceeded criteria or reference levels

Reproduced from Council on Environmental Quality, Sixth Annual Report-1975, p. 352, from U.S. Geological Survey data.