Chapter 2

No Economy-Wide Trade-Off

In 1998, 137 million people held paying jobs in the United States. That year, the average unemployment rate dipped as low as 4.3 percent, which meant that in any given week around six million people nationwide were looking for work. Since the U.S. economy was at the peak of a business cycle, most of those people were classified as frictionally unemployed, or between jobs on a short-term basis. Given this, there was much talk in the business press about labor shortages. “Scrambling For Workers,” read a front-page headline in the Cleveland Plain Dealer.

Of course, this low nationwide average disguised some regional differences. In dozens of pockets ranging from rural upstate New York, downstate to the Bronx, parts of Detroit, some rural Mississippi counties, and the extreme eastern half of Oregon, unemployment was still over 10 percent. But these stubborn and persistent examples of structural unemployment were not much on the national mind. Most media reports on the economy were rosy; stories of hardship were rare.

However, if we turn back the clock to late 1991, when the last recessionary trough of the business cycle occurred, we find a different mood. Nationwide the unemployment rate was 7.5 percent. In communities that faced underlying structural unemployment as well as frictional unemployment, rates of over 15 percent were not uncommon. The overall average unemployment rate in the state of West Virginia reached 13 percent. With an extra four million people nationwide looking for jobs,
all unemployed workers were having a much harder time finding work. With labor markets so competitive, pay raises largely disappeared. Stories about the hardships of unemployment were common in the media. Jobs became the defining focus of the Bush–Clinton presidential campaigns. A famous sign hung in candidate Clinton’s office urged focus on one simple campaign message: “It’s the Economy, Stupid.”

The point is that cyclical unemployment, which leads to high rates of joblessness both regionally and nationwide, is the economic beast that frightens most of us. And in the midst of a recession, environmental regulation becomes an easy scapegoat for more fundamental economic problems. It was in the teeth of the recession of the late 1980s and early 1990s, for example, that West Virginia coal miners protested acid-rain legislation, and citizens in the Northwest were bitterly polarized over protection of the spotted owl. If environmental regulation were somehow to be implicated in the creation or aggravation of cyclical unemployment, then jobs–environment trade-offs would be serious indeed.

Fortunately, environmental regulation does not have this effect. At the economy-wide level, regulation does not increase unemployment. It leads instead to a gradual shifting of the types of jobs Americans hold. In 1970, U.S. firms, consumers, and federal, state, and local governments spent about $36 billion on environmental protection measures. This was a little less than 1 percent of total U.S. output of final goods and services, or gross domestic product (GDP), that year. These expenditures financed, among many other things, the installation of pollution-control equipment in factories, government inspections of these efforts, catalytic converters in cars, laboratory testing of new pesticides, the construction of municipal sewage plants, and the disposal of household garbage. By the year 2000, this amount is expected to rise to $219 billion, or 2.8 percent of GDP.2

Spending means jobs. From 1977 to 1991—the last year for which the Environmental Protection Agency (EPA) made the calculations—total employment from spending on environmental clean up climbed from 1,267,000 to 1,965,000. This 55 percent increase makes environmentally related employment one of the most dynamic growth sectors in the U.S. economy.3 Of course if we weren’t spending this money on environmental protection, we would be spending it on something else, such as health care, consumer items, or education, which would create jobs in those sectors. But it is this kind of job shifting—and not job destruction—that regulation-induced spending on the environment generates.
That there is no fundamental conflict between job growth and a cleaner environment is a conclusion that has strong consensus support in the economics profession. This was emphasized in a joint appearance at the National Press Club of Washington, D.C., by Robert Hahn of the conservative American Enterprise Institute and Paul Portney, who is president of the nation's premier environmental economics think tank, Resources for the Future. "There's no question that we can have job growth simultaneous with improved environmental protection," said Hahn. "The proof is in the last twenty years, when we've had economic growth and, in general, a lot of improved environmental quality—for instance, getting rid of a very serious pollutant, lead, in our cities' air." Portney also agreed with Hahn that if the government was managing to stimulate economic growth through its macroeconomic policies, then total job growth should not suffer from tighter environmental regulations. If new environmental protection rules cause some short-term job loss, Portney noted, "in an actively growing economy those people will be absorbed." 

The no trade-off conclusion has even been turned around to attack advocates of the job-creation benefits of regulation. Writing in a paper sponsored by the American Petroleum Institute, Dr. Thomas Hopkins of the Rochester Institute of Technology argues that: "If compliance with regulations spawns more jobs in pollution-control equipment firms, then such jobs are not a net benefit of the regulation. They essentially are a reshuffling of society's workforce, one that may proceed smoothly and conceivably yield higher average salaries, but not likely one that can be given credit for reducing the nation's unemployment rate."

That there has been no economy-wide trade-off between environmental protection and jobs is the consensus view among ideologically disparate economists. But most people are not economists. For that reason, the bulk of this chapter will lay out both the basic argument and the evidence that supports the no trade-off claim.

First, recent experience clearly shows that during boom times, environmental regulation does not place any restrictions on job growth. During the sustained business-cycle peak of the 1990s, and despite the United States devoting an increasing share of GDP to environmental protection, U.S. policy makers were actually worried that employment was growing too fast. Inflationary fears led officials at the central bank to raise interest rates to slow down what was perceived as overheated job growth.

What about during recessions? Does regulation aggravate downturns
in the economy? Here too the answer is “no.” Evidence from both macromodeling and input–output exercises finds little support for declines in employment, and in fact suggests the possibility of modest employment gains from regulatory-induced spending.

This chapter ends with a discussion of the emerging environmental-protection sector of the economy. What types of jobs are being created by this long-run shift in the economy? Surprisingly, jobs that depend on environmental spending are disproportionately concentrated in traditional blue-collar sectors; in fact, 31 percent of environmentally related employment is in construction and manufacturing, compared to 20 percent for the economy as a whole.

**IS REGULATION CONSTRAINING U.S. JOB GROWTH?**

The easy way to answer this question is to simply look at the economic record from recent years. From the trough of the recession in 1991 through 1998, the U.S. economy added about fourteen million jobs. In fact, by 1995, the Federal Reserve (the Fed) was concerned that job growth was too high. Alan Greenspan, chairman of the Fed, was worried that the economy was close to experiencing “greater than full employment.” This, he feared, would fuel inflationary pressure in the economy. Greenspan’s concern stemmed from the theory that once cyclical unemployment is eliminated, only frictional—largely voluntary or short-term—unemployment is left behind. Under these circumstances, employers can only attract new workers by offering higher wages (or more generous benefits). But, at some point, higher wages can lead to higher prices, as firms try to maintain profit margins. Under this scenario, an inflationary “wage–price spiral” might be triggered.

The Fed is charged by U.S. law to try to maintain both price stability and full employment. It does this by either raising or lowering interest rates. The Fed fights inflation essentially by putting people out of work. Increased interest rates mean that consumers can borrow less to build houses and buy big ticket items, such as cars or television sets. Also, higher interest rates discourage firms from undertaking new investment in plant and equipment. This decreased demand results in slower employment growth, less overtime, and actual layoffs in interest-sensitive industries, such as construction and automobile manufacturing. This direct impact then works its way through the economy via a multiplier effect as falling incomes for workers in hard-hit industries (e.g., automotive and construction) reduce their demand for other goods and services. With lowered demand across the economy, inflation subsides.
In contrast, when the economy is in a slump, the Fed tries to reverse the process by lowering interest rates. Lower rates are designed to stimulate job growth by encouraging businesses and consumers to borrow and spend.

In 1994 and 1995, in spite of spending $180 billion per year on environmental protection, the U.S. economy was growing too fast from the Fed's point of view. Too many people were employed in the United States, which was raising the specter of inflation. As a result, the Fed's Board of Governors voted several times to raise interest rates in an attempt to cool the economy down, which, in the process, meant raising unemployment rates. From 1995 to 1998, the Fed kept interest rates steady, but indicated clearly that it would not tolerate job growth that would lead to unemployment rates lower than the 4.3 percent or so experienced in 1998. Put another way, in the mid- to late 1990s, the slowing of job growth was not the result of excessive environmental regulation, but rather the firm hand of the Fed. (Some economists [myself included] would characterize it as the “excessively firm” hand of the Fed, but that is another book.)

In the 1990s, the United States was devoting a substantial portion of its economic output to environmental protection—about 2.5 percent of GDP, which was up from less than 1 percent in 1970. Also in the 1990s, one area in which the U.S. economy has excelled has been job creation. The quality of those jobs, the security that they provide, and the incomes that they pay are other issues that I will take up later in the book. The point here, however, is that at a nationwide level, unemployment rates ultimately depend on the health of the macroeconomy, which has not been impaired by environmental regulation.

**Does Environmental Regulation Deepen Recession**?

When the sun is shining and the economy is in a boom period, the economy-wide jobs–environment question becomes irrelevant. Under these conditions, as discussed earlier, the economy is already creating jobs as fast as the inflation-fearing Fed will tolerate. But what about when the macroeconomic weather is stormier and the economy is in a recession? Will greater environmental spending retard—or promote—job growth?

The argument for a negative trade-off runs like this: First, regulation will raise the price of goods and services, often in key sectors such as the automotive or electric industries, thereby reducing the quantity that consumers demand. Second, if domestic prices rise relative to imports, consumers may turn to imported products, and foreign buyers will be less
interested in U.S. exports. Third, regulation will make new investment less profitable, which will lead to a reduction in new business spending. Finally, if higher prices lead to a generalized inflation, the Fed might raise interest rates. These combined factors will depress three important components of “aggregate demand”: consumer demand, net export (exports minus imports) demand, and business investment demand. This reduction in demand, in turn, will cause recessions to last longer than they would if regulations, and environmental spending, were scaled back.

On the other hand (President Harry Truman once said that he wished he could find a one-handed economist to be his advisor), regulatory-induced environmental spending might actually diminish job loss in a recession. Environmental spending that occurs during a recession—either by the government or by firms—can increase employment growth by pumping up demand. For example, in the United States during the last recession of the late 1980s and early 1990s, federal, state, and local governments combined spent some $10 billion per year on the construction of new sewage-treatment facilities. To the extent that these expenditures were financed by borrowing and not higher taxes, they represented new demand in the economy.

For back-of-the-envelope calculations, economists assume that $1 billion of injections of new spending will employ, in the short run, 14,000 workers. If we assume that (1) all of the government money spent on the construction of new sewage-treatment facilities was borrowed and (2) no “crowding out” of private investment as a consequence of government borrowing, conventional analysis would suggest an additional 140,000 jobs as a short-run consequence of this government spending on new sewage facilities.

One study pursued this line of argument more rigorously in the case of Greece. During the recession of the early 1980s, the Greek government borrowed a substantial amount of money to pay for projects such as municipal wastewater facilities and to improve solid-waste collection and disposal. The study found that this stimulus to aggregate demand reduced the unemployment rate in Greece by about 1 percent, bringing it down from 8.7 percent to 7.7 percent.

Government-mandated private-sector spending on environmental protection may play a similar, counter-recessionary role. In a simple Keynesian view of the business cycle, recessions are driven by autonomous reductions in consumer or investment spending; once the animal spirits are in a bearish mood, the economy spirals downward. However, because environmental investment is mandated by law, firms cannot reduce such spending as much as they cut back on general investment in plant and
equipment. Thus, one might hypothesize that aggregate investment spending falls less in a recession than it would in the absence of environmental regulation and that, therefore, the recession would be less severe.

During the recession of 1990–1991, for example, private-sector pollution abatement and control expenditures in the United States were around $69 billion, which represents a $34 billion increase in real terms since 1972. Even if half of this $34 billion in spending constituted a net addition to business demand, the direct, short-term employment effect of regulation would be quite substantial. Of course it might not be an addition to demand. As outlined earlier, critics of regulation argue that regulation-induced environmental spending that is produced by raising costs reduces other kinds of investment, as well as consumer and export demand for U.S. products.

How can we sort out these opposing theoretical views? I will address this issue in the section that follows. However, a bit of empirical evidence can be derived from two studies conducted by Stephen Meyer at the Massachusetts Institute of Technology. Meyer’s analysis relied on the fact that pollution laws and enforcement efforts can vary significantly among each state. California, New Jersey, and Minnesota devote much more attention to clean up than states such as Louisiana, Idaho, or Alabama. Meyer examined data from all fifty states and found no correlation at all between environmental regulation and job growth in general. He also found a persistent, positive, and significant correlation between growth in construction employment and the strength of statewide environmental-regulatory efforts. This may reflect spending on construction-intensive pollution-control measures, such as sewage facilities. Meyer interprets his results in the following way: “Stronger environmental regulations have not limited the pace of economic growth and development among the states over the past twenty years.”

**Macromodels—Tonic or Depressant?**

One way to quantify the impact of environmental spending on unemployment over the business cycle is to use macroeconomic forecasting models. These models rely on systems of interrelated equations to predict the path of key economic variables, such as employment, inflation, and GDP growth. While adhering to some central tenets of economic theory, macroeconomic forecasting is as much art as it is science. This means, first, that even results from independent researchers must be treated skeptically. And, second, when in the hands of hired economic consultants, a few well-placed assumptions can easily drive the result in a client’s preferred direction.
TABLE 2.1. Macromodels of the environment–employment link

<table>
<thead>
<tr>
<th>Author</th>
<th>Type of study</th>
<th>Employment impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haveman (1978)</td>
<td>Summary of macromodel studies</td>
<td>Positive</td>
</tr>
<tr>
<td>Müller (1981)</td>
<td>Summary of 3 macromodel studies</td>
<td>2 Positive, 1 mixed*</td>
</tr>
</tbody>
</table>

* Positive short run, negative long run.

Recall we are trying to weigh the strength of competing hypotheses. Does regulation, by forcing government and private investment in environmental clean up, boost aggregate demand? Or does regulation-induced spending prolong a recession by raising costs and thus slowing down activity in key sectors, such as the automotive industry? Macroeconomic models try to sort out this on-the-one-hand, on-the-other-hand argument, as well as to predict a net effect. The macroeconomic-simulation approach was popular among environmental economists in the late 1970s and early 1980s. Table 2.1 summarizes the results of the macromodeling studies from that period, which were sponsored by relatively independent sources—either government agencies or in the academy.

Of these studies, which were conducted either in the United States or Europe, all but one suggest small positive impacts of environmental spending on job growth. The Müller study found positive short-run, but negative long-run employment implications. A 1984 summary by the Organization for Economic Cooperation and Development (OECD) characterized the results as follows: “In every case, those [employment] effects, whether positive or negative, appear to be a very small percentage of total employment.”

NATIONAL ASSOCIATION OF MANUFACTURERS AND ACID RAIN

By the mid-1980s, scientific analysts in the academy and in government largely abandoned macromodeling of the employment impacts of regulation. The model results were consistently suggesting that the employment effects of regulation were more or less a wash (and, if anything, slightly positive) and that not much more could be learned.

Enter the National Association of Manufacturers (NAM). In 1987, NAM paid Data Resources, Inc. (DRI, which is now DRI/McGraw-Hill), who had done earlier macrosimulations for the EPA, to evaluate
proposed acid-rain-control legislation. The resulting predictions were dire indeed:

On a cumulative basis, acid-rain legislation would cause serious and lasting damage to the economy. The causes of this damage have to do primarily with the effects of higher energy costs.

First, since energy is an important input to production and a major component of production costs, there are severe output losses and employment reductions in energy-intensive sectors. The most adverse impact is in durable manufacturing and metal industries.

Second, because energy prices feed through into final product prices, there are increases both in retail energy costs and the overall inflation rate.

Third, because of higher inflation, interest rates increase. The rise in interest rates causes a major decline in housing starts. The result is a serious reduction in output and an increase in unemployment in housing-related industries such as construction materials. Thus, in the final analysis, a substantial share of the population will experience losses in employment opportunities, higher housing costs as reflected in higher mortgage interest rates, and higher utility bills.$^{13}$

In conclusion, the report boldly declared:

Initiatives such as the acid-rain legislation would, in this respect, achieve only the dubious distinction of moving the United States towards the status of a second-class industrial power by the end of the century.

Fast forward to the end of the century. Acid-rain-control legislation passed in 1990 and is now well under way. Electric utilities have reduced emissions of the acid-rain precursor sulfur-dioxide by more than half.$^{14}$ At the same time, the U.S. economy has been in a sustained upswing since the early 1990s. Unemployment rates hit their lowest level since the 1960s. In the mid-1990s, the Federal Reserve board did indeed raise interest rates, but only to put the brakes on what they considered to be an overheated economy. None of the DRI predictions have come to pass.

The NAM/DRI study represents a breed of hybrid creature, which
unfortunately has come to play a dominant role in the jobs–environment debate. Economic consulting firms, featuring Ph.D. economists, are hired to produce job-loss or, less frequently, job-gain estimates. The underlying tool—in this case, a macromodel of the economy—is often legitimate enough when used in scholarly analysis or business forecasting. But when used in the realm of politics, the usefulness of the modeling exercise becomes questionable at best.

Economic models are suggestive, never conclusive. A single model tells very little, because most predictions are assumption driven. Economists make progress in understanding how the economy works by examining many different models, their underlying assumptions, and their predictions. Economists have the greatest confidence in predictions either when many different types of models yield the same general conclusions or when the results from a given model are not sensitive to plausible changes in the underlying assumptions. The problem with interest-group-sponsored research is that the focus departs from a scholarly exercise concentrated on transparency of method and assumption to the bottom line—predictions.

Did DRI tailor the assumptions of their model to generate results that pleased the client? This of course will never be known. However, what is more than likely is that if the DRI results had not gone the way the NAM wanted, they would never have seen the light of day. But what is clearly evident in the NAM/DRI report is complete disrespect for the limitations of the macroforecasting model they employed. Based on a single modeling exercise, no scholarly analyst would engage in the kind of rhetorical hyperbole (e.g., predictions of the U.S. as a “second-class industrial power”) found in the report.

IGNORING INNOVATION

Macromodels operated for hire by private consulting firms have reemerged with a vengeance as players in the greenhouse debate. In fact, DRI, which is one of the big three consulting firms, is currently under contract to the coal industry and the United Mineworkers Union. I will discuss their global-warming predictions later in chapter 6. However, here it is worth emphasizing how utterly, completely, and dismally wrong DRI was on the macroeconomic consequences of acid-rain control. Also, since we will look at the model again, it is important to think a little about how it works.

In the DRI simulation during the early years of regulation, nation-
wide employment actually rose due to increased spending by electric utilities on sulfur scrubbers and other pollution-control equipment. However, as the summary quote of the NAM report mentioned earlier predicts, long-term increases in energy prices would result in decreasing economic growth in the long run, and thus slower recovery from a recession. Why was this supposed to have happened? Increased energy prices, the model assumed, would be passed on to consumers, which would lead to inflation. To fight inflation, the Fed would have to raise interest rates. This in turn would lead to reduced sales and layoffs in industries such as construction and automobile manufacturing. The result would be a sustained economic stagnation and higher unemployment.

One definition of an economist is someone who can give you a very good reason today why the prediction he/she made yesterday was wrong. In DRI's defense, the actual acid-rain bill that passed was predicted to be a bit less costly than the one they analyzed. DRI assumed that all electric power plants would have to reduce their emissions by a set amount. Instead, Congress adopted an innovative "marketable permit" system. A total nationwide cap was set on sulfur-dioxide emissions, and firms were issued a share of this allowed limit in the form of permits, whereby companies could then either pollute up to their permitted limit, buy permits and pollute more, or sell permits and pollute less. This added flexibility was predicted by the EPA (before the program began) to reduce the costs of the acid-rain program by between 20 and 30 percent. Would this updating of DRI's assumptions have brought their predictions more in line with reality? Possibly.

Having defended NAM/DRI, let me return to reproaching them: Rather than recognize even the possibility that their assumed costs might be too high, the final paragraph of the executive summary of the report reads:

It is to be emphasized in this context that the estimates here are conservative. They are based, as noted earlier, on government studies of the costs of this legislation. It is entirely conceivable that if the inputs to the DRI model had been based on estimates compiled by the private sector, the results would have emerged as even more deleterious. Consequently, the results of this study should not be viewed as unduly pessimistic. Rather they represent minimum estimates of the costs of the economy.
Minimum, meaning absolutely as low as possible. This kind of language is designed to reassure journalists, not persuade scientists.

Furthermore, the report was wrong again. As it turned out, the control costs for the tradeable-permit program have turned out to be much, much less than anyone—industry or the EPA—predicted. Recall that the innovative feature of the program is that the sulfur-dioxide permits are tradeable—they can be bought and sold. Given this, permit prices roughly reflect per-ton pollution-control costs. This is true because a firm generally wouldn’t buy an extra permit if the cost of doing so exceeded the cost of reducing sulfur emissions by a ton in the first place.

When the tradeable-permits market was being designed in the early 1990s, credible industry estimates of permit prices (and thus control costs) were $1,500 per ton. The EPA was predicting $750 per ton. In 1997, permits were in fact selling for around $100 apiece. Part of the current low permit price is due to a higher than expected initial supply of permits, however, real compliance costs have in fact been two to four times lower than the EPA expected, as well as four to eight times below industry estimates. Add this on to the EPA’s 20 to 30 percent expected cost savings over the acid-rain-control costs used by DRI, and one can begin to see at least one reason why their predictions of macroeconomic disaster failed to materialize.

The acid-rain example, in which the actual monetary costs of a proposed environmental regulation were grossly overestimated, reflects a persistent pattern. In a study completed in 1997, a coauthor and I tracked down every case we could find in which credible researchers had either calculated actual regulatory costs or engaged in multiple-cost forecasts and then compared the later figures to initial cost predictions. In addition to the sulfur-dioxide trading program, we uncovered eleven such efforts, ranging from A (asbestos) to V (vinyl chloride). As table 2.2 shows, the initial estimates were at least double the actual costs in all cases but one. In the exceptional case, costs were still overestimated by 41 percent.

It is no surprise that industry lobbyists wildly overestimate the overall compliance costs of proposed environmental regulations. What is less expected is that academic and government economists consistently do the same and for an equally surprising reason. When forecasting the costs of new environmental regulations, economic analysts have routinely ignored a primary economic lesson: Markets will cut costs through innovation.

For example, the much lower than expected costs for the acid-rain program can be explained in retrospect by the increased flexibility that firms were given to achieve their mandated reductions in sulfur-dioxide
Table 2.2. Predicted costs versus actual costs for environmental regulations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Initial estimate</th>
<th>Actual cost or revised estimate</th>
<th>Overestimationa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>$150 million (total for manufacturing and insulation sectors)</td>
<td>$75 million</td>
<td>100%</td>
</tr>
<tr>
<td>Benzene</td>
<td>$350,000 per plant</td>
<td>Approx. $0 per plant</td>
<td>Infinite</td>
</tr>
<tr>
<td>CFCs</td>
<td>1988 estimate to reduce emissions by 50% within 10 years; $2.7 billion</td>
<td>1992 estimate to phase out CFCs within 8 years; $3.8 billion</td>
<td>41%</td>
</tr>
<tr>
<td>CFCs—Auto air conditioning</td>
<td>$650–$1,200 per new car</td>
<td>$40–$400 per new car</td>
<td>63%–2,900%</td>
</tr>
<tr>
<td>Coke oven emissions</td>
<td>$400 million–$1 billion</td>
<td>$160 million</td>
<td>29%–525%</td>
</tr>
<tr>
<td>OSHA 1970s</td>
<td>$4 billion</td>
<td>$250–$400 million</td>
<td>900%–1,500%</td>
</tr>
<tr>
<td>Coke oven emissions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPA 1980s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton dust</td>
<td>$700 million per year</td>
<td>$205 million per year</td>
<td>241%</td>
</tr>
<tr>
<td>1989: phase-out not possible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>$4–$5 billion</td>
<td>$4.1 billion</td>
<td>159%</td>
</tr>
<tr>
<td>Surface mining</td>
<td>$6–$12 per ton of coal</td>
<td>$0.50–$1 per ton</td>
<td>100%–300%</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>$109 million per year</td>
<td>$20 million per year</td>
<td>500–2,300%</td>
</tr>
</tbody>
</table>

a Column 2 divided by column 3.

Source: Goodstein and Hodges (1997) and Hodges (1997).

emissions. Rather than install expensive scrubbers (or buy extra permits), many more firms than expected have met their SO₂ targets by switching to low-sulfur coal or by developing new fuel-blending techniques. Railroad deregulation, along with economies of scale in rail transport, led to an unexpected decline in low-sulfur coal prices. And with the increased competition from this coal, scrubber manufacturers cut their prices in half from 1990 to 1995. All of this is easy to see after the fact, but would have been very hard to predict.
In summary, one explanation for the DRI model’s disastrous performance is that it used government cost estimates for acid-rain control, which, in retrospect, turned out to be much too high. This is not unusual—both government and academic economists have tended to substantially overestimate compliance costs when evaluating new regulations. These facts should be kept in mind when we turn later to cost and job-loss predictions for global warming.

While regulation often costs much less than predicted, environmental regulation is not without cost. Rather, the point here is that spending on the environment creates new jobs, which leads to a gradual shift in the types of employment found in the economy. Macromodels should balance the dampening effect on aggregate demand from higher prices in regulated sectors against the direct stimulus effect of government and firm spending on environmental-protection measures. The conclusion from the academic literature is that so far these effects basically cancel each other out; if anything, the evidence suggests small employment gains during recessions.

The NAM/DRI case, by contrast, illustrates that on paper it is possible to create a macromodeling scenario in which regulation is so costly that it leads to job losses via a slowdown in economic growth or even a recession. Higher energy prices in the DRI model lead to inflation and, ultimately, higher interest rates and an economic slowdown. In the acid-rain case, DRI was very wrong on the magnitude of the actual cost increases. But suppose costs to electricity producers had gone up as much as DRI assumed. Would the model have broken down somewhere else in the lengthy assumption chain? Is the economy really that sensitive to cost increases in the energy sector? These are issues that will reemerge when we return to the discussion of the employment effects of fighting global warming.

For now, NAM/DRI’s acid-rain predictions stand as a humorous monument to the failures of industry-sponsored predictions of job loss based on macroforecasting. Again, this is not to cast aspersions on the scholarly use of macromodels, which under less partisan conditions have been a useful tool for examining the “on-the-one-hand, on-the-other-hand” job impacts of environmental protection. However, since the mid-1980s, macromodeling has unfortunately become a highly politicized and lucrative private exercise. This issue is discussed further in chapter 6, where we will see that industry-sponsored macromodels uniformly predict large job losses from reducing greenhouse gas emissions.
Chapter 2. No Economy-Wide Trade-Off

**INPUT–OUTPUT MODELS—HOW MANY JOBS PER DOLLAR?**

Macromodels provide one way to think about the economy-wide effects of regulation. There is, however, another view that focuses on the employment impacts of different kinds of spending in the economy. As I noted earlier, as a back-of-the-envelope assumption, $1 billion in spending will support around 14,000 jobs. However, this aggregate figure disguises some important differences that may explain how regulation-induced spending on the environment could help reduce unemployment in recessions. Is it possible that $1 billion of spending on environmental protection creates more jobs than $1 billion spent elsewhere? The answer is “yes,” assuming one of two things. If environmental spending requires goods and services that are directly and indirectly more labor-intensive and/or more “domestic-content”-intensive, then more U.S. jobs will be created for a given dollar amount of final demand.

First, some terminology. Direct employment from regulation-induced spending means people who are employed by the environmental expenditure itself (e.g., recycling truck drivers, workers in plants who manufacture sulfur-dioxide scrubbers, lab technicians who test new pesticides, and EPA water-pollution inspectors). Indirect employment supported by this first round of environmental spending would include workers in steel, automotive, chemical, and rubber plants who make the equipment that the “direct” environmental employees require. Taking it back one step, indirect employment would also include the miners and shippers who transported the coal and iron ore that are necessary to make the equipment that the direct environmental employees need. And going back yet another step, we also count as indirect employment the workers needed to make the equipment that is required to mine and transport the raw materials that are necessary to make the equipment that is needed directly in the environmental sector. This chain of jobs stretches ever backwards, ad infinitum. To evaluate whether environmental spending supports more jobs than the alternative, both direct and indirect jobs must be counted.

How can one possibly keep track of this infinite backwards chain of jobs? Economists do this by using so-called input–output models. Pioneered by Nobel Prize-winning economist Wassily Leontief, these models divide up final demand—spending by consumers, firms, governments, and foreigners—into a number of different categories. The models can then trace the quite complicated direct and indirect job impacts of a given amount of spending, as well as determine the total number of jobs required to produce a specified amount of product.
For example, a recent study done for the Department of Sanitation in New York City found that by boosting the percentage of waste that was recycled from 6 percent to 25 percent, while reducing the percentage incinerated from 76 percent to 57 percent, would result in a permanent net increase in local employment of around 400 jobs per year. This was true even when accounting for the higher taxes necessary to pay for the somewhat higher cost per ton for the recycling option. The increase in jobs arose first because recycling is labor- rather than capital-intensive, which led to a higher local payroll that created bigger indirect employment effects in the city. Second, New York City produces little of the equipment necessary to manufacture incinerators, therefore, incineration had a low “domestic” content.18

This input–output approach was used back in the late 1980s to study the same proposed acid-rain reduction regulations evaluated by NAM/DRI. (Again, it was a more flexible and less costly set of acid-rain regulations that actually became law as part of the Clean Air Act Amendments of 1990.) The authors found that some 95 percent of the direct expenditures on acid-rain pollution-control equipment, products, and processes—such as sulfur-dioxide scrubbers—would accrue to U.S. firms. As a result, a net increase in jobs was foreseen from the acid-rain-control policies they analyzed. Gradual job losses in high-sulfur coal mining and in electric-utility and electricity-intensive sectors would be more than balanced by pollution-control jobs that would gradually be created from the expenditure of several billion dollars per year.19

In these two cases, spending to improve environmental quality was predicted to increase employment either because the environmental product under consideration (e.g., recycling or sulfur-dioxide scrubbers) was either more labor- and/or domestic-content-intensive than the alternative. Is there any reason to believe that environmental spending will always win out on these fronts? In general, no. Indeed, in the case of recycling, the predicted difference of 400 jobs is not overwhelming in a city the size of New York. Moreover, it is probably within the margin of error for the model.

However, there is one area in which environmental spending will almost always create more jobs per $1 billion than the alternative, and that is investments in energy efficiency. The conventional energy sectors—coal, oil, and gas extraction, fuel refining, and gas utilities—have relatively low labor intensity compared to other sectors of the economy. In 1990, for example, oil and gas extraction supported seven jobs (both direct and indirect) per $1 million of expenditure, and coal mining thir-
teen. Retail trade, on the other hand, supported thirty-two, and con-
struction twenty. Moreover, much of our oil—well over 50 percent—is
imported. By investing in energy efficiency, savings on fuel expendi-
tures can be switched over to more labor-intensive and domestic-content-
tensive sectors. (I should note here that labor-intensive sectors tend to
pay less than capital-intensive ones. This is one but not the only or most
important reason why a given amount of spending supports more jobs.
For more on this issue see chapter 5.)

One input–output study, which was done for the American Council
for an Energy Efficient Economy (ACEEE), argued dramatically that
large-scale investments of $46 billion per year in energy efficiency could
lead to over a million new jobs by 2010. A number of other studies have
drawn qualitatively similar conclusions, providing strong evidence that
from a jobs-per-dollar perspective, energy efficiency will almost always
win out.

Counting jobs using input–output models is informative, however, the
approach suffers from some analytical difficulties. Economy-wide
input–output studies ask a very big question: Suppose that instead of
spending tens of billions of dollars where we are already spending it, we
spent it somewhere else. Then—assuming that the plant, equipment,
trained workers, and transportation infrastructure are all in place to make
the new stuff—how many more jobs will be created? This can be a very big
assumption. For example, in the case of acid rain, the authors implicitly
assumed that all the workers needed for the new scrubber industries were
already living by the plants, ready and waiting for a new job. In general,
input–output studies abstract away potentially large and important adjust-
ment costs. Thus, job estimates that flow from them should be treated, at
best, as upward bounds. Moreover, input–output studies are not always
subject to rigorous peer review, and, as with the ACEEE study cited above,
are often funded by advocacy groups, both on the environmental and
industry sides. Therefore, their results should be approached with caution.

That said, the basic underlying message of input–output studies is
sound. If environmental spending supports more labor-intensive produc-
tion or requires fewer imports, it will, holding everything else constant,
tend to boost economy-wide employment in the short run. Again, this
holds true only if the economy is growing slowly and there are as a result
cyclically unemployed workers who are generally available. Try to add a
million jobs from energy-efficiency measures into a full-employment
economy and you wouldn’t get very far; the Federal Reserve, fearing infla-
tion would raise interest rates, eliminating a million jobs somewhere else.
NO ECONOMY-WIDE TRADE-OFF

In summary, here is the evidence supporting the consensus view that at the economy-wide level there simply is no trade-off between environmental protection and jobs. First, and most telling, it is clear that the long-term health of the U.S. macroeconomy has not been harmed by the imposition of significant environmental regulation over the last twenty years. Since 1970, annual, nationwide spending on the environment has risen to more than $180 billion. Yet, through the late 1990s the Fed’s Board of Governors kept a foot on the interest rate brake in an attempt to slow down job growth.

If environmental regulation does not prevent an economy from achieving full employment, will it somehow deepen a recession? The weight of evidence says no. First, there is no correlation between environmental regulation and employment growth across the states. Second, virtually all of the disinterested macromodeling exercises have found small positive employment impacts from environmental spending. And, finally, input–output studies suggest that greater environmental spending, either because it is labor-intensive or domestic-content-intensive, can lead to higher short-run employment levels. This is especially true for energy-efficiency investments.

At the economy-wide level, environmental-protection legislation leads to greater spending on the environment and less spending on other things. This in turn generates a long-run shift in the types of jobs in the economy, not a reduction in employment. But what kind of jobs are being created? And for whom?

As an environmental economist, I owe my own job to the growth of the environmental-protection industry. Environmental economists as a distinct category didn’t exist before 1970, and the market has grown tremendously over the last twenty-five years. My job is to train students to understand and participate in the process of environmental clean up, and I have also been employed as a consultant to do benefit-costs studies that evaluate proposed government regulations. Is my situation a typical one? Are the good jobs that are supported by environmental dollars exclusively high-end, white-collar jobs (e.g., lawyers, regulatory bureaucrats, or college professors)?

This is an important question. In chapter 1, I discussed the growth of the “80–20 society,” in which the top fifth of the income distribution is flourishing, while the majority of families struggle to maintain their income level. While I have established in this chapter that on net environmental regulation is basically job neutral at the economy-wide level,
these days any factor that promotes greater income inequality in the United States would not be welcome. Is regulation yet another factor putting the squeeze on the middle class, further closing the door to decent-paying jobs for less-skilled workers?

THE ENVIRONMENTAL-PROTECTION INDUSTRY

Until recently, there has been little official data gathered on the scope and composition of the environmental-protection industry. In an attempt to correct this gap, in 1998, the U.S. Commerce Department, in concert with the EPA, issued the first-ever “Survey of Environmental Products and Services.” The government sent out surveys to 10,000 firms who were identified as likely producers of goods and services used in supplying the clean-up market. The breakdown of the businesses was made up of around 3,000 manufacturing plants, 6,350 service firms, and 650 construction companies. Plant managers were asked to estimate the value of the goods and services they produced that fit the following descriptions:

- the manufacture of products, performance of services, and the construction of projects used, or that could potentially be used, for measuring, preventing, limiting, or correcting environmental damage to air, water, and soil[,] . . . [as well as] . . . services related to the removal, transportation, storage, or abatement of waste, noise, and other contaminants.

The government used this survey data to estimate that nationwide, production in the environmental-protection industry was valued at about $102 billion in 1995. Of this amount, at least 17 percent was in the construction sector, which was more than double the economy-wide level of construction spending.\(^{21}\)

Given this, it is perhaps not surprising that a more than proportionate share of the jobs created by environmental clean-up spending is in the traditional blue-collar sectors of the economy: construction and manufacturing. Researchers at the EPA have calculated both the direct and indirect employment generated by environmental spending for the year 1991. For example, the EPA estimated that around 4,000 people that year were directly employed in the manufacturing of electrical machinery used in environmental clean-up activities. But the agency also calculated that an additional 21,500 workers in the industry indirectly owed their jobs to environmental spending. This number included people who built
electrical machinery that in turn was used to manufacture and transport items such as steel pipe for sewer systems, photocopying machines for environmental service companies, or trucks used to recycle solid waste. Again, economists use input–output models to keep track of these chains of job interdependencies.

Figure 2.1 illustrates how jobs related to the environmental-protection industry as calculated by the EPA breakdown across different sectors of the economy, and provides a comparison to overall U.S. employment. Environmental spending generates more than twice the average percentage number of jobs in construction (11 percent as compared to 4 percent) and one-fourth greater a proportion in manufacturing (20 percent as compared to 16 percent).

Environmental protection also induces, in relative terms, somewhat more employment in the mining and service sectors. Lawyers and professors—and most other white-collar environmental jobs—fall into this

![Bar chart showing sectoral distribution of jobs created by environmental spending](chart)

**FIGURE 2.1.** Sectoral distribution of jobs created by environmental spending (1991, direct and indirect jobs).

*Transportation, utilities, and communication

**Finance, insurance, and real estate

Source: Author’s calculations from data generated by the input–output model used in U.S. EPA (1995). Results that confirm the blue-collar employment intensity of environmental spending, using data from a different input–output model, are reported in Goodstein (1994).
latter category. On the other hand, environmental spending creates relatively few jobs in agriculture, wholesale and retail trade, and the financial sector of the economy.

How can we account for these results? Environmental protection is a largely industrial business. In 1991, the year of the EPA study, the private sector spent $22 billion on pollution-control plants and equipment, and $43 billion on pollution-control operations, which ranged from sewage and solid-waste disposal to the purchase and maintenance of air-pollution-control devices on smokestacks and in vehicles. Federal, state, and local governments spent around $12 billion on the construction of municipal sewage facilities. These dollars, not surprisingly, supported a disproportionate number of construction and manufacturing jobs.

Perhaps the biggest surprise found in figure 2.1 is in the last column. In spite of criticisms that environmental regulation only creates jobs for pencil-pushing regulators, less than 12 percent of environmentally induced employment was at the government level, as compared to an economy-wide government employment rate of 16.5 percent. This again reflects the fact that most environmental spending occurs in the private sector. In 1991, only 2 percent of all environmental costs went to support the government’s direct regulation and monitoring establishment. The EPA’s total budget, including subcontracts, was less than 4 percent of all environmental spending.2 This is not to say that environmental spending creates only high-quality, high-paying jobs. But it is clear that cleanup dollars do support more than their share of jobs in traditional blue-collar industries.

Even in heavily regulated manufacturing industries, overall job losses due to environmental regulation have been quite small. Recently, researchers at Resources for the Future, a well-known environmental economics think tank, conducted a study of the steel, petroleum, plastics, and pulp and paper industries. The analysis weighed the job losses from higher costs and reduced demand against the jobs created by direct spending on environmental protection within these industries, ignoring indirect job gains in other sectors. On balance, the net job losses in the heavily regulated industries were tiny. Extrapolating their results to the manufacturing sector as a whole, the authors found that between 1984 and 1994, on average, environmental regulation may have directly reduced employment in all regulated industries nationwide by about 470 jobs per year. The study concluded that “these results cast considerable doubt on the existence of a jobs versus the environment trade-off. While environmental spending clearly has consequences for business and labor,
the idea that such spending reduces employment in key industries is at odds with the data.23

Economy-wide, environmental spending has provided a boost to manufacturing and construction employment. And even in the most heavily regulated industries, this increase in demand has largely offset layoffs due to higher costs. These are important facts. One of the explanations for the widespread “deindustrialization” that the United States has been experiencing over the last few decades has been a steady shift away from manufacturing into services, trade, and finance. However, as the data in this section have made clear, this trend has not been aggravated by the direct effect of increased environmental spending. Because legally mandated clean up has been construction- and manufacturing-intensive, regulation appears to have actually slowed the deindustrialization tide and created a disproportionate share of good jobs for the bottom 80 percent of workers.

In this chapter, I have presented the reasons why economists agree that environmental regulation has not aggravated cyclical unemployment in the United States. Because environmental clean-up spending has neither caused nor deepened recessions, at the economy-wide level there has simply been no trade-off between jobs and the environment. Moreover, the job-shifting process that accompanies regulation has not been one leading from a blue-collar to a white- or pink-collar economy.

However, the focus on economy-wide effects may be misleading. Even if, on net, job losses and gains cancel out, have widespread, regulation-induced layoffs at manufacturing plants and mines increased structural unemployment? Moreover, even granting that regulatory spending is construction- and manufacturing-intensive, hasn’t regulation nevertheless contributed to the decline of the blue-collar economy? This could happen either if “dirty” manufacturing plants were forced to shut down on a large scale, or, barring that, if regulation promoted new investment to relocate overseas where environmental regulations were less stringent. I turn to these issues in the next chapter.

NOTES


3. U.S. EPA (1995: Table 4). These figures include both direct and indirect employment. These terms are defined later on in this chapter.
6. Author’s calculations from U.S. Bureau of Labor Statistics data.
7. I address this issue from the point of view of macroforecasting models and input–output analysis. There is another theoretical approach concerned with the impact of regulation on long-run growth, but not unemployment over the business cycle. General equilibrium models such as Hollenbeck (1978), Jorgenson and Wilcoxen (1990), and Hazilla and Kopp (1991) generally find that regulation slows down growth over the long run. [For a critique of this conclusion, see Goodstein (1998b).] However, these models all assume full employment and so can tell us nothing about business-cycle effects.
9. Lekakis (1991); see Müller (1981) for an overview of this debate.
11. See Meyer (1992) and (1993). Meyer (1992) also found a positive correlation between total employment and environmental regulation, however, this relationship was insignificant when the presence of extractive industry was considered in a framework taking into consideration multiple explanations for employment growth.
13. NAM (1987). The quotes that follow are on page 4 and 5, respectively.
14. Among utility facilities affected by the first phase of Title IV, emissions were reduced from a 1990 level of 10 million tons to 5.3 million tons in 1995. Burtraw (personal communication).
17. Goodstein and Hodges (1997), Hodges (1997), and Harrington et al. (1999). This is true for emission-reduction regulation. By contrast, legislation such as the Superfund, which mandates clean up of already-polluted areas, is generally much more expensive than predicted.
18. Breslow et al. (1992). Because recycling also requires capital spending on “imported” equipment, the two options did not in fact differ by a considerable amount in either their labor intensity or “domestic” content. However, the differences were large enough to translate into a net employment advantage for recycling.
19. The author’s findings are based on the input–output model that is described in Wendling and Bezdek (1989). They analyze two acid-rain-control bills that were introduced in the 99th Congress, which differ somewhat from the final legislation that was passed in 1990. The authors predict net job gains of
between 100,000 and 200,000 jobs, more than 25,000 net jobs for each $1 billion spent on pollution control. These figures are almost certainly on the high side, since they assume a cost-free reassignment of resources and a ready supply of workers with the available skills. In addition, U.S. EPA (1993) found that 79 percent, rather than 95 percent, of the air-pollution-control equipment that is used in the United States is produced domestically. Finally, the acid-rain legislation that actually passed generated more fuel switching and less reliance on U.S.-made scrubbers than the one analyzed.

22. The data in this and the preceding paragraphs are from Rutledge and Leonard (1992), with monetary values in 1990 dollars.