REDEFINING PROGRESS

MARK ANIELSKI AND JONATHAN ROWE

THE GENUINE PROGRESS INDICATOR — 1998 UPDATE

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REDEFINING PROGRESS
ONE KEARNY STREET, FOURTH FLOOR
SAN FRANCISCO, CA 94108

1.800.896.2100

TEL 415.781.1191
FAX 415.781.1198
E-MAIL info@rprogress.org
WEBSITE www.rprogress.org

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ACKNOWLEDGMENTS

This report constitutes the ongoing efforts of many dedicated people and institutions with a common goal of developing a new accounting system and indicators that would empower and facilitate America's moving toward a more sustainable and socially equitable world. The release of the 1998 U.S. Genuine Progress Indicator (GPI), first developed by Redefining Progress in 1995, represents our ongoing commitment to working towards a more honest accounting of genuine progress and the true well-being of our nation.

We would like to thank a number of individuals who shared their knowledge, wisdom, and spirit in updating the Genuine Progress Indicator for the year 1998. Most important, we are indebted to the original pioneers of the GPI, namely Cliff Cobb, Craig Rixford, Ted Halstead, and Jonathan Rowe in 1995.

In addition, we are grateful to those who provided input, comments, and wise counsel that made the 1998 GPI update possible, including: Cliff W. Cobb, Craig Rixford, Herman E. Daly, Robert Costanza, Ron Colman, Juliet Schor, Eric Rodenburg, Paul Portney, Dan Tunstall, Kirk Hamilton, Eric Neumayer, John Dixon, Christine Real de Azua, John M. Fitzgerald, Laura Leete, Kevin Fearn, Thomas McMullen, Pam Jakes, Chris Aman, Alan AtKisson, Richard Norgaard, Robert Eisner, Jared Bernstein, Joy Hecht, Susan Roxburgh, Suzanne Murphy, Maureen Kennedy, and many others who contributed to this effort.

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M.A.

J.R.

THE GPI COLUMN-BY-COLUMN SUMMARY

The following is a column-by-column explanation of the results of the 1998 Genuine Progress Indicator (GPI) accounting for the true well-being of the United States from 1950 to 1997. All values are expressed in constant (inflation-adjusted) chained 1992 dollars. The column references refer to the GPI account, table 1.

The 1998 GPI contains some revisions since the original was constructed in 1995. All parameters were updated for the years 1995, 1996, and 1997, including new physical and qualitative data and new value (cost or benefit) estimates. The major methodological changes include:

Price deflator | We now use the chain-type price deflators recently developed by the U.S. Department of Commerce to convert current dollar estimates into real dollars. All figures are now expressed in 1992 chained dollars. The original GPI was calculated in 1982 constant dollars using the consumer price index and GDP implicit price deflator.

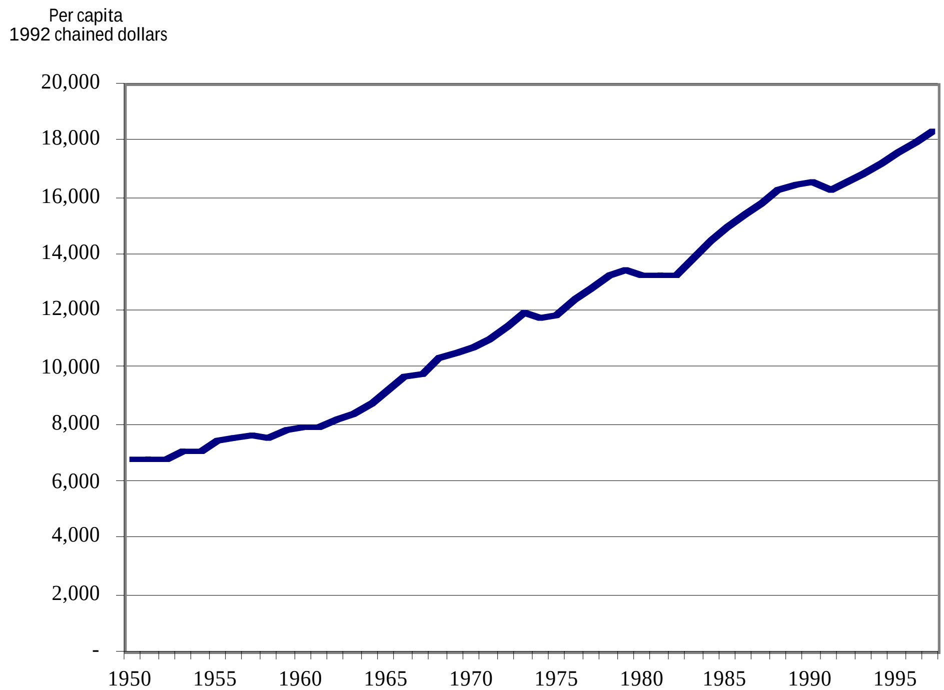
Income distribution | The income distribution index has been changed. The Gini coefficient, the conventional index for income inequality used by the U.S. Department of Commerce and other practitioners, is now used as the basis of income inequality measurement. The original GPI used a customized index reflecting the change in the share of national income received by the poorest 20 percent of households. The Gini coefficient measures relative income inequality across all income groups or quintiles. (This is explained in greater depth under column B.)

COLUMN A: PERSONAL CONSUMPTION

Personal consumption expenditures on goods and services is the key driver of the GDP. Accounting for roughly two-thirds of its total in the 1990s (largely unchanged since the 1950s), increasing consumer spending contributes more to GDP growth than business investment expenditures (roughly one-sixth) and government (federal, state, and local) expenditures on products and services (about one-sixth).

Spending more money for more goods and services each year is seen as a sign of a healthy economy and a well-to-do society—at least so the GDP account tells us. The fact that the GDP has risen relentlessly and per person personal consumption expenditures have almost tripled (see figure 1) since 1950 would suggest that America is becoming more prosperous. There is little doubt that we have achieved unprecedented material gains and improved living standards. Yet the GPI account indicates that while per capita personal consumption of goods and services continues to rise, average real hourly wages have declined, personal indebtedness has risen, personal savings rates have fallen, and quality time alone or with family has steadily eroded. Yet according to the key yardstick of the economy, the GDP, all is well with the households of the nation.

FIGURE 1: U.S. PERSONAL CONSUMPTION PER CAPITA



Despite spending more on goods and services each year, many Americans may be experiencing a kind of chronic work-consumption fatigue, where more material goods and services beyond some level of "enough" leaves us empty and devoid of some greater meaning of life. Fast foods, processed foods, diet foods, weight-loss programs, filtered water, gadgets, knickknacks, fashion clothing, lawyers' fees for our divorce, and advertising that we "consume" (and which businesses buy) are examples of goods and services that many of us might consider both needless and regrettable. Yet we are urged by relentless advertising to consume unhealthy foods and buy more overpackaged goods and services, many of which are manufactured with intentional obsolescence. The more businesses produce and the more consumers buy, the more the GDP rises, even if some of these expenditures are lamentable, unnecessary, or environmentally unsustainable. More spending and more consumption is necessary to register positive GDP growth and suggests the nation is better off. Zero or negative

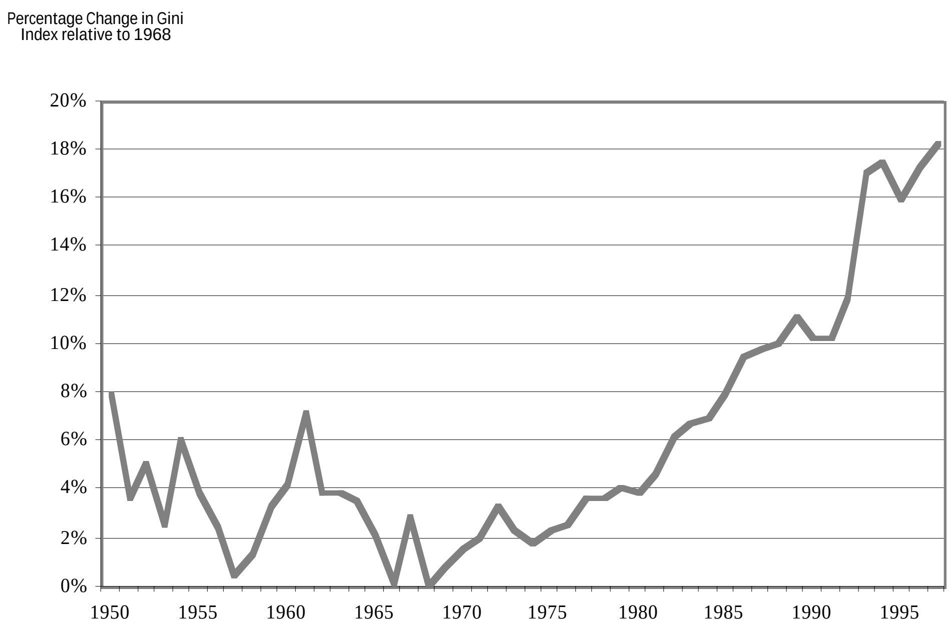
GDP growth is considered a bad omen, even if stagnating consumption led to a qualitative improvement in the collective lives of Americans.

In 1997, total U.S. personal consumption expenditures amounted to $4.9 trillion, compared with $1.0 trillion in 1950 (as a percentage of GDP, this represents an increase from 62.5 to 67 percent over the same time period). On a per capita basis, personal consumption expenditures[1] have risen steadily from roughly $6,800 per capita in 1950 to $18,360 per capita in 1997, an increase of 170 percent (Council of Economic Advisers 1998).

COLUMN B: INCOME DISTRIBUTION INDEX

Economist Paul Krugman noted that "most economists who study wages and income in the United States agree about the radical increase in inequality" (1996). As figure 2 shows, since 1968 (the lowest point of income inequality in the U.S. since 1950) the disparity between the rich and poor has grown by 18 percent. In fact, 1997 recorded the highest degree of income inequality in over 50 years of measurement.

FIGURE 2: CHANGE IN INCOME INEQUALITY RELATIVE TO 1968

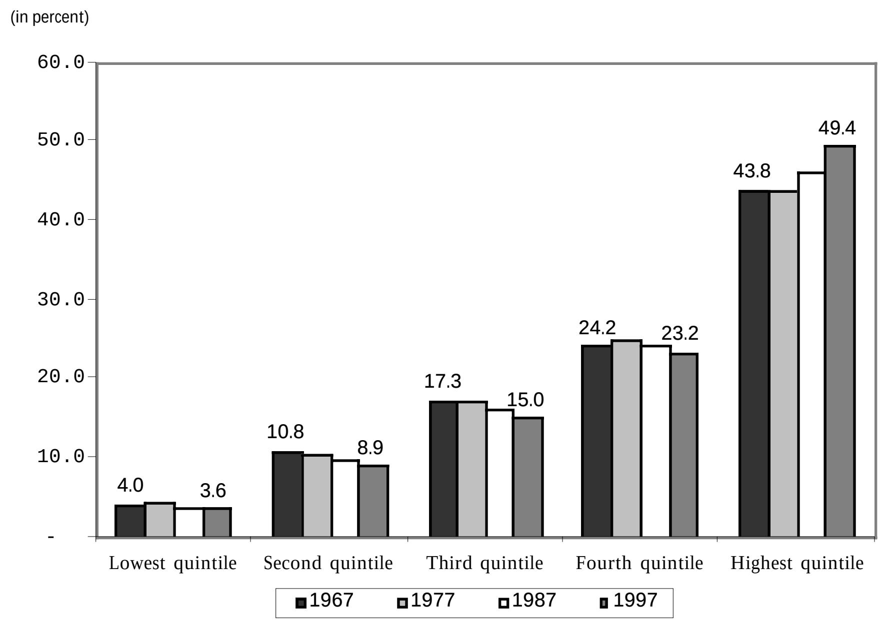


According to a study by Daniel H. Weinberg of the U.S. Census Bureau, "the most commonly used measure of income inequality, the Gini index (also known as the

1. Personal consumption expenditures (PCE) were taken from the National Income and Product Accounts (NIPAs), which are published on the Bureau of Economic Analysis website <http: / / www.bea.doc.gov / > and in its *Survey of Current Business.* They can also be obtained in the *Economic Report of the President* (CEA 1998).

index of income concentration), indicated a *decline* in family income *inequality* of 7.4 percent from 1947 to 1968. Since 1968, there has been an *increase* in income inequality, reaching its l947 level in 1982 and increasing further since then" (1996, 1).

FIGURE 3: SHARE OF HOUSEHOLD INCOME BY QUINTILE



As Paul Krugman (1996) notes, while the gap between the very rich and the poor has increased, the so-called middle class (families and households in the middle of the income spectrum) have also lost a share of the aggregate income to the richest households. This is illustrated in the above figure. In 1997 the top 20 percent of households earned 49.4 percent of total income (the top 5 percent of households earned 21.7 percent of aggregate income) while the lowest 20 percent earned only 3.6 percent. As the graph above shows, each of the lowest four quintiles has lost a share of their income to the top income quintile. This represents, as Krugman notes, "the statistical signature of a seismic shift in the character of our society" (1996).

The inequality in wealth distribution is even greater. According to the *State of Working America 1998–99*, a study by economists Lawrence Mishel, Jared Bernstein, and John Schmitt (1999) for the Economic Policy Institute, the distribution of wealth remains more concentrated at the top than distribution of income, with wealth inequality worsening in the 1990s. Their projections for 1997 indicate that the portion of wealth held by the richest 1 percent of American households has increased since 1989, from 37.4 percent to 39.1 percent of the national total, facilitated in large part by the stock market boom. They estimate that the net worth of the middle-class families (those in the middle fifth of the wealth distribution) fell by 2.9 percent from 1989 to 1997, due to a rise of indebtedness. In 1995 almost 60 percent of America's households owned no stocks in any form, while 90 percent of the value of stocks was in the hands of the wealthiest 10 percent of households. Mishel et al. also found that the wealthiest 1 percent of families has seen their tax bills fall by $36,710 since 1977 as a result of changes in tax law.

The growing gap between the super-rich and the very poor is epitomized in the growth in CEO salaries of Fortune 500 companies. Mishel et al. (1999) show that the average compensation for CEOs increased from $999,000 in 1983 to $3,565,000 in 1997 (in constant 1997 dollars) for a 3.5-fold increase. They show that in 1965 the typical CEO made 20 times more than the average production worker; in 1989, the ratio had tripled to 56 times; in 1997, relative CEO pay had more than doubled to 116 times the pay of the average worker. Another estimate shows that salary, bonus, and returns from stock plans of the average CEO has grown 100 percent between 1989 and 1997.

Weinberg has suggested that one of the reasons for increasing inequality is that "divorces and separations, births out of wedlock, and the increasing age at first marriage have led to a shift away from married-couple households and toward single-parent and nonfamily households, which typically have lower incomes" (1996, 4). Intuitively, one of the key factors for rising income inequality may be an increase in single-parent female households (as a result of divorce or births out of wedlock) where women typically have lower incomes than two-parent households. While there is no definitive answer to why income inequality has reached unprecedented levels, closer study of the socioeconomic factors driving inequality would enlighten the debate.

We have factored in income distribution on the assumption that inequality of income directly relates to the economic welfare and social cohesion of a society. By doing so, we are making an explicit ethical argument that growing income inequality represents a social cost. While economists tend to consider the issue of distributional equity to be important, they regard it as a separate issue from the magnitude of economic welfare (Daly and Cobb 1994). Yet we must ask ourselves whether or not the rising income inequality, and thus rising disparity in purchasing power between the rich and the rest of income groups (both poor and in the middle as the Gini coefficient indicates), imposes a real cost on societal well-being. There is little doubt that a growing gulf between those who have greater income capacity and purchasing power can and does lead to demoralization of the relatively "poor" by constraining their participation in the fruits of the nation's prosperity. Ultimately democracy and egalitarianism suffers, although empirical evidence of the cost to democracy is not always easy to discern. From the perspective of neoclassical economics, there is no answer to this issue, and the GDP and national income accounts simply ignore such potentially significant societal costs. While conceptually challenging, we nevertheless believe that accounting for income inequality is fundamental to an honest accounting of the nation's economic and societal welfare. Thus we have made a measure of income inequality an integral part of the GPI, estimating its "social cost" by using the Gini coefficient as a factor to weight personal consumption expenditures.

As previously mentioned, the revised 1998 GPI makes a departure from the 1995 estimates by adopting the more common measure of income inequality: the Gini coefficient or index. The Gini index (also known as the index of income concentration), is one of two methods used by the U.S. Department of Commerce to measure income inequality, the other being the share of aggregate income received by households or families.

The Gini index is the difference between actual distribution and equal distribution by income quintiles. The index ranges from 0.0, when every household has the same income, to 1.0, when one household has all the income. Thus the higher the Gini index the greater the income inequality, or the greater the portion of aggregate income earned by the top household income bracket. It incorporates detailed aggregate income shares data into a single statistic, which summarizes the dispersion across the entire income distribution. It compares current income distribution with an ideal equal distribution of aggregate income, giving equal weight to all income levels by calculating the square root of the sum of the squared differences of each quintile from a 20 percent share.

While the original GPI adopted the low income quintile index since it gives special weight to the plight of the poorest members of society, the use of the Gini index may be more appropriate since it reflects changes in the distribution of income across all income groups. It thus provides a basis for studying how growing income inequality between not only rich and poor but between the rich and the middle income groups can lead to the erosion of social cohesion in a society. Since one of the goals of the GPI is to assess how changes in equity may affect societal well-being, and indeed social cohesion, the use of the Gini coefficient is attractive.

COLUMN C: PERSONAL CONSUMPTION ADJUSTED FOR INCOME INEQUALITY

Weighted personal consumption is column A (personal consumption) divided by column B (index of distributional inequality) multiplied by 100. The reason for dividing rather than multiplying is that larger numbers in column B indicate greater inequality. Column C becomes the base number from which the remaining factors in the GPI are either added or subtracted. For 1997, personal consumption adjusted for income inequality is $4.2 trillion.

COLUMN D: VALUE OF HOUSEHOLD WORK AND PARENTING

Work performed in households is more essential than much of the work done in offices, factories, and stores. Yet most of this goes unaccounted for in the national income accounts. While the housework and parenting of the stay-at-home mom or dad counts for nothing in the GDP, commercial childcare in the monetized “service sector” adds to the GDP. Other unpaid household labor, such as the physical maintenance of the housing stock (from cleaning to light repairs), also constitutes valuable economic activity.

Despite all the “labor-saving” devices introduced during the past 80 years, the number of hours spent on housework has remained virtually unchanged. In the second decade of this century, homemakers spent an average of 56 hours per week doing such work. They were still spending about 53 hours per week from 1956 through 1966 (Cowan 1983, 63–64, 159). A study in the 1980s showed that women devoted 35 to 43 weekday hours to housework (depending on their employment), which suggests that average weekly hours are probably still in the neighborhood of 50 to 55 (Berk 1985).

Since hours spent on household work have not decreased as women have joined the paid workforce, they have suffered a decline in leisure, as shown in column J. In addition, Mishel et al. (1999) show that the typical married-couple family is working more hours per week (over six weeks per year more in 1996 than in 1989) thereby eroding their quality leisure and parenting time. This time-constrained and hurried lifestyle also gives rise to increased consumption of take-out food, fast food, and other conveniences which add to the GDP, while the erosion of time available for food preparation, parenting, and leisure go unaccounted for. This illustrates why it is essential to take both the household and the market sectors into account to assess how the economy actually affects people’s lives.

Ironically and regrettably, the Bureau of Economic Analysis, which prepares the GDP, does not gather data on the time spent on the management of the national households, nor does the BEA estimate the economic contribution of these nonmarket time and services. This would seem to imply that we have forgotten the original meaning of the word economy: the management of the household or state. Private research at the University of Maryland and University of Michigan has, to some extent, filled this accounting gap, at least regarding time spent on such tasks as cooking, cleaning, and child care (Juster and Stafford 1991; Robinson 1986). This work has become a standard reference point for U.S. studies that involve the value of housework.

The calculation of the value of household labor in the GPI is derived from the work of economist Robert Eisner, past president of the American Economics Association. Eisner first derived estimates of the annual hours spent performing relevant household tasks from time-use studies conducted by the Michigan Survey Research Center. He then treated the value of an hour of housework as equivalent to the amount that a family would have to pay to hire someone to do equivalent work in their home. This then yields an estimate of the total annual value of household work (Eisner 1985, 30).

The 1998 GPI account estimates the value of housework and parenting at $1.9 trillion. This represents the single most significant and positive adjustment to personal consumption expenditures. The value of housework and parenting was roughly 38 percent of personal consumption expenditures in 1997; in 1950 it was 58 percent. In part, this reflects our increasing reliance on the market to provide services formerly contributed by households.

COLUMN E: VALUE OF VOLUNTEER WORK

Much of the most important work in America is not done for pay. This includes not just the home, but also the broader realm of neighborhood and community. Work done here is the nation's informal safety net, the invisible social matrix on which a healthy market economy depends. Whether each additional lawyer, broker, or advertising account executive represents a net gain for the nation is arguable. But there is little question that workers in the underserved community and volunteer sectors—the churches and synagogues, civic associations and informal neighborly efforts—are doing work that is desperately needed.

Despite its crucial contribution, however, this work goes entirely untallied in the GDP. The GPI begins to correct this omission, much as it includes a rough estimate of work in the home. It is important to note that these estimates are conservative, because they do not include the informal neighborliness that does not involve a volunteer program or agency.

First we estimate the total number of hours volunteered each year. Then we multiply the total hours by the average real nonfarm wage rate from 1959 to 1997, or $11.20 per hour in 1992 dollars. As in the case of leisure, we assumed that the value of nonwork hours remained constant over time, regardless of changes in the real wage rate.[2]

To calculate the hours of volunteer activity each year, we relied primarily on three Current Population Surveys conducted in 1965, 1974, and 1989 (U.S. Department of Labor 1969, 1975, 1990). This was the only consistent time series available over the years in our study. Since the questions asked in each survey were

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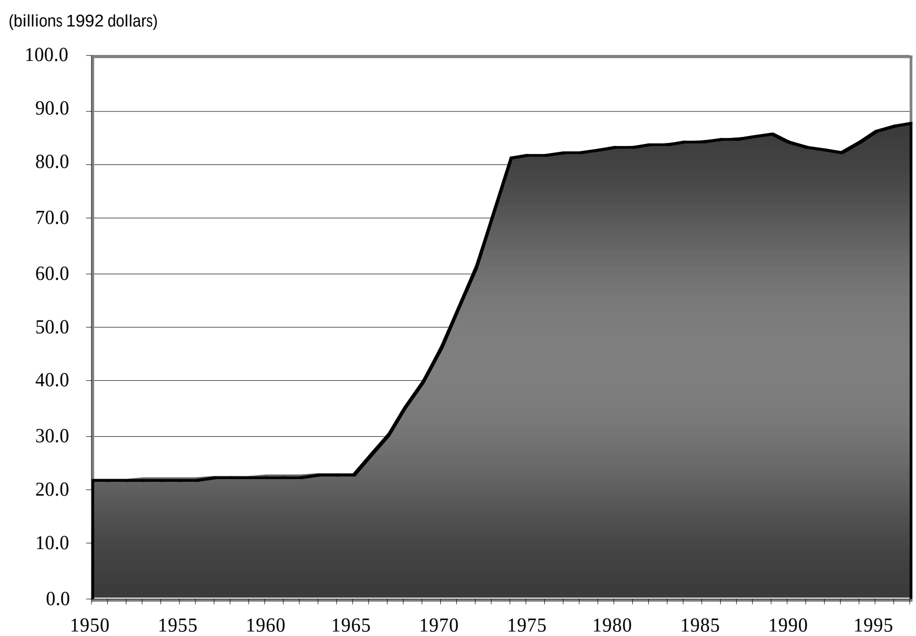
2. This treatment of the value of volunteer hours is debatable. Economists generally use the current wage rate as the opportunity cost of leisure or volunteer work. However, when trying to estimate the value of services performed, it may not be appropriate to assume that the value of volunteer work increases at the same rate as market-based work, given that there is no evidence to our knowledge of productivity increases in volunteer work performed for charities or churches, for example.

not exactly the same, there are some comparability problems. But the surveys are close enough to provide a workable estimate for the purposes of the GPI.[3]

Using the survey data, we estimate the total volunteer hours for each year by multiplying the total number of volunteer workers in a week by the average number of hours worked per week by the median weeks worked per year.[4] These statistics show that in 1965, 21.6 million volunteers worked 5.7 hours per week for 17 weeks out of the year for a total of 2,062 million hours. By 1974 an estimated 7,289 million hours were volunteered by 36 million volunteers who worked 9 hours per week over 22 weeks per year. And in 1989 there were an estimated 7,669 million hours worked by 38 million volunteers working 8 hours per week over 25 weeks of the year.

FIGURE 4: VALUE OF VOLUNTEER TIME



Since 1989 was the last year volunteer data were available from the BLS, we used other data sources to cover the period 1989 to 1997. The Independent Sector, which studies volunteer activity in the United States, conducts biennial volunteerism surveys. Because their estimates of the number of volunteers (excluding informal volunteerism) are irreconcilable with the Department of Labor statistics, we were

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3. A study by ACTION (1976) showed a tripling of the value (in constant dollars) of volunteer time in organized services from 1965 to 1974, which is approximately the same growth shown by the Current Population Surveys.

4. Since the median number of weeks worked per year was unavailable for 1965 and 1974, we estimated it as 52 times the ratio of volunteers in one week to volunteers in an entire year. In 1965, for example, about one-third of the total number of people who volunteered in the entire year were volunteering during the week of the survey. Thus, we assume that any given volunteer works around one-third of the year, or 17 weeks.

unable to use the actual Independent Sector data to extend our time series.[5] Instead we used the rate of change in volunteerism reported by the Independent Sector from 1987 to 1995 to extrapolate our estimate for 1989.

Their surveys indicate volunteerism has grown marginally by 0.77 percent per annum between 1987 and 1995. In 1987 there were an estimated 60.9 million volunteers (excluding informal volunteerism) who contributed an estimated 14.9 million volunteer hours. In 1989 there were 75.3 million volunteers providing 15.7 million hours. Then the hours decline to 15.2 million in 1991 and 15.0 million in 1993. By 1995 (the last survey data available) volunteerism rebounded to 72.7 million volunteers providing 15.8 million hours (Independent Sector 1994, 1996).

We estimate the value of volunteerism at $21.9 billion in 1950, $81.7 billion in 1975, and marginally higher at $87.7 billion in 1997. These figures are added to the GPI account.

COLUMN F: SERVICES OF HOUSEHOLD CAPITAL

The money spent on durable items, such as cars, refrigerators, and other appliances, is not a good measure of the actual value consumers receive from them. It is important to take account, as well, of how long the item lasts. For example, when you buy a furnace or a dishwasher, you do not "consume" it in one year. The appliance (or "consumer durable") provides service for a number of years. Often durables wear out faster than they probably should, requiring more frequent replacement than if they had been manufactured for longer service life. Both repairs and new purchases drive up the GDP; but the household would have been better off—that is, it would have gotten more value—if the appliance had been engineered for higher quality and a longer service life.[6]

The GPI treats the services of household capital as benefits and their initial purchase price as a cost. This column adds the annual services derived from consumer durables, which economic theory defines as the sum of the depreciation rate and the interest rate.

If a product lasts eight years, it depreciates at 12.5 percent per year and thus provides that much of its service each year. At the same time, if the interest rate is 5 percent, the purchaser of the product could have received that much interest by putting the money into the bank instead. Economists therefore regard the interest rate as part of the monetary value of the product to the consumer.

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5. For example, the Department of Labor (1990) estimated 38 million volunteers in 1989, while the Independent Sector (1994) estimated 75.3 million volunteers, or almost twice as many. These differences are likely due to sampling methods.

6. We have not attempted to estimate the potential cost of built-in obsolescence that some consumer durables may exhibit. Such a study would be a worthwhile albeit hypothetical inquiry.

Based on an assumed depreciation rate of 15 percent and an average interest rate of 7.5 percent, the value of services of household capital is estimated at 22.5 percent of the value of the net stock of cars, appliances, and furniture at the end of each year (BEA 1998c, table 1). To avoid double counting, we make an adjustment (column L) by subtracting out the actual expenditures on consumer durables. Focusing on the annual service that household appliances and equipment provide, rather than on the purchase price, corrects the way the GDP treats money spent as if it were the same as the value received from the durable good.

The value of services from consumer durables is treated as a benefit and is thus an addition to the GPI account. In 1997, the benefits from household capital amounted to $5.6 trillion.

COLUMN G: SERVICES OF HIGHWAYS AND STREETS

The GPI does not include most government expenditures since they are largely defensive in nature; they protect against erosions in the quality of life, rather than enhancing it (Leipert 1986, 1989). This is particularly true of the government's largest budgetary item, military spending.

On the other hand, some government activities, such as transit systems and sewer or water districts, provide services for a fee in a manner similar to private business. These fees show up in personal consumption figures in the national income accounts and thus are already included in column A. This leaves other government services that could be sold in theory, but are difficult to price with regard to individual users. Overwhelmingly, the largest item in that category is the use of streets and highways, which we include here as a separate category in the GPI.

The annual value of services from highways and streets is derived the Bureau of Economic Analysis figures of the net stock of federal, state, and local government streets and highways from 1950 to 1997 (BEA 1998b, tables 11KCU, 12KCQ). The annual value of services from streets and highways is estimated by taking 7.5 percent of the net stock value. This is based on the logic that around 10 percent of the net stock (2.5 percent for depreciation and 7.5 percent for average interest rates) is the estimated annual value of all services from streets and highways. However, since we assumed that 25 percent of all vehicle miles are for commuting (a defensive expenditure), this leaves 75 percent as net benefits. Thus the GPI assumes the net service value of streets and highways is 75 percent of 10 percent, or 7.5 percent of net stock.

In 1997 we estimate the value of services from streets and highways at $90.0 billion, an addition to the GPI account.

COLUMN H: COST OF CRIME

Crime exacts a large economic toll on society. Some of these costs are obvious, such as medical expenses and lost property. But others are more elusive, because they are psychological (the trauma of being violated) or are incurred in the form of lost opportunities, such as activities foregone because people fear the possibility of theft or violence.

The GPI uses the Bureau of Justice Statistics' National Crime Survey data, that is, the cost of crime to victims based on their out-of-pocket expenditures or the value of stolen property. Undoubtedly the full cost of crime is underestimated given the absence of estimates of the more elusive costs.

Other direct costs are defensive expenditures to prevent or avoid the impacts of crime, such as locks, burglar alarms, security devices, and security services. Most of us would not otherwise purchase these personal, household, or business security items. In the GPI we subtract these expenditures on crime prevention because they represent personal consumption that does not add to the well-being of our households but merely prevents its deterioration or violation.

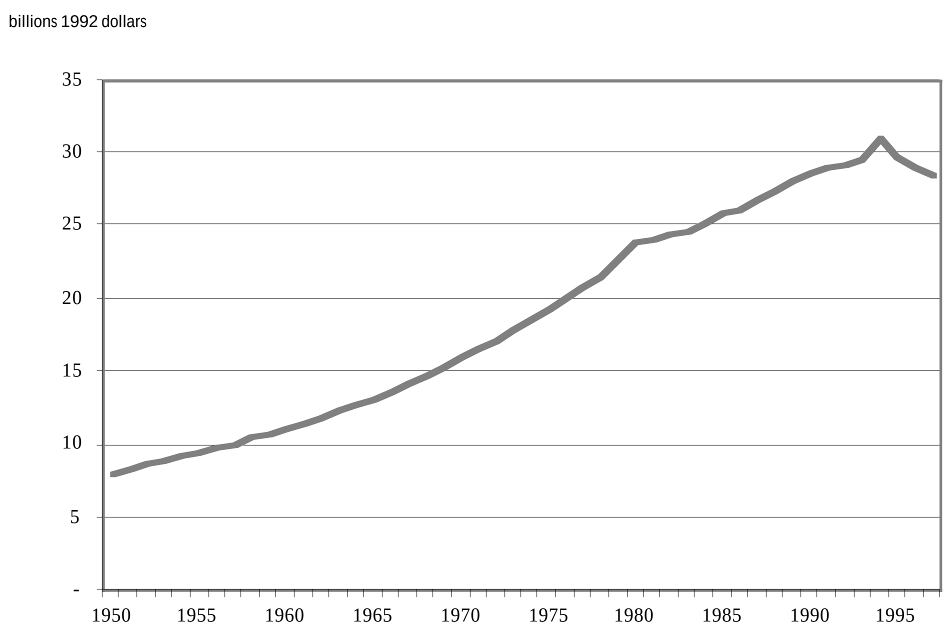
Much of the cost of crime is borne by government and business in the form of police services and security guards. We have excluded these expenditures since, in the case of business, such expenses are intermediate costs and thus show up ultimately in the price of consumer products and services. Similarly, we left out public spending on police and other security measures because our baseline—personal consumption—does not include government spending. Therefore, we only subtract household spending on crime prevention and the direct costs of crime to households.

The cost of crime to households, including direct costs to persons and household spending on crime prevention, has risen steadily since 1950. In 1994 we estimate the cost of crime peaked at $30.9 billion. Since then a decline in property crime rates (according to the Bureau of Justice Statistics) has apparently reversed a 45-year trend with a decline in cost of crime to households falling to an estimated $28.4 billion in 1997.

For estimates of the direct costs of crime to households we draw from previous studies by the Bureau of Justice Statistics (Klaus 1994; Shenk and Klaus 1984). For 1975, the estimated direct costs to households from crime was $13.9 billion in 1992 dollars. For 1980, it was $17.3 billion; for 1981, $17.1 billion; and for 1992, $17.6 billion. Klaus (1998) estimates figures of $19.6 billion for 1994; for 1995 $18.3 billion; and for 1996 $17.6 billion. These figures are based on the National Crime Survey, a questionnaire in which citizens are asked if they have been the victim of a crime in the previous six months and the extent of associated medical costs, and property theft and damage losses. In the absence of a more complete data set, we interpolated between 1950 and 1975, assuming constant dollar costs grew at the same rate they did between 1975 and 1980. We further assumed the growth rate since 1992 to be the same as the period from 1981 to 1992.

The data reveal that while the direct costs of crime to households was rising throughout the 1970s and 1980s, it peaked at $18.6 billion in 1994 and has since declined to an estimated $14.9 billion in 1997. This decline could be due to a general decline in the incidence of property crime.

FIGURE 5: COST OF CRIME TO HOUSEHOLDS



For household spending on crime prevention, the annual amount spent on locks, burglar alarms, and safe deposit boxes is used. For the combined value of locks and safe deposit boxes we have a single estimate of $4.6 billion for 1985, or $6.1 billion in 1992 dollars (Laband and Sophocleus 1992). Over half this amount was for safe deposit boxes. We assumed the cost of these protective devices increased by 2.8 percent per year from 1950 to 1994. This is based on our best guess considering, according to the *Statistical Abstract*, the total number of occupied housing units grew by 2 percent per year, the total number of passenger cars grew by 3 percent per year, and the total number of banking offices grew by 3 percent per year.

Expenditures on residential burglar alarms and electronic security systems were taken from the annual industry forecast issue of *Security Distribution and Marketing* magazine. According to this source, sales have more than doubled in ten years, growing from $6.3 billion in 1987 to $14.1 billion in 1997, in current dollars. We use these figures estimating the residential market at about 40 percent of the total industry sales. Without specific evidence, we assume that residential security systems constitute the same fraction of the market in later years as from 1982 to 1986. Furthermore, we assumed that the constant dollar value of household spending on electronic security systems rose from 1970 to 1981 at the same annual rate as the average growth rate from 1987 to 1991 (around 7.25 percent). From 1950 to 1970, we have assumed a growth of 5 percent per year. In 1997 we estimate the cost of household security systems and alarms at $5.0 billion in 1992 dollars. Therefore, the total cost of crime for 1997 is $28.4 billion.

COLUMN I: COST OF FAMILY BREAKDOWN

Probably the most important asset and "service sector" in America is the family. Yet its value to the nation is not accounted for in economic terms. The traditional role and functions of the family within households, beyond housework and parenting, has increasingly been displaced by other aspects of the market economy, such as take-out and fast food restaurants, shopping malls, and the television-babysitter . The basic household functions such as meal preparation, parenting, personal counseling, and good relationship-building are increasingly provided through monetized commerce rather than through healthy family and neighborly relations. Under the constant stress of a modern society in a game of keeping up with the Joneses, many families find themselves on a relentless treadmill working harder, consuming more, and increasing in debt. This no-win situation ultimately leads to stress and anxiety, thereby compromising the quality of time and life that many people lament they are lacking. Family bonds begin to fray for the lack of time spent with spouse, children, and extended families that would otherwise lead to more resilient and healthy households and national well-being.

The breakdown of families has an enormous impact on the social cohesion of the nation. When couples divorce, the GDP includes the expenditures on lawyers' fees, counseling, and setting up separate households. This does not include the opportunity costs of time that is wasted or lost due to the stress, struggle, and anguish that results from the dissolution of relationships. The impacts on children involved in divorce is perhaps the most tragic consequence. Yet the GDP does not account for the societal costs of divorce in these terms.

The increasing proportion of children with someone other than their biological parent is also on the rise. In 1960, only 25 percent of children faced the prospect of living with someone other than their biological parents; but by 1990, the proportion had risen to 44 percent. As Wade Horn, president of the National Fatherhood Initiative, has pointed out, "Across every income level, children—especially boys—who grow up without fathers in the home are much more at risk of juvenile delinquency and adult crime than children who grow up in intact families" (Whitmire 1995).

The GDP treats this erosion of the quality of life of the family as economic progress, because the functions of the family, which are not monetized, are shifted to the market and more money changes hands. The more family breakdown, the more anxiety, and the increased consumerism all add to GDP growth. Every time a fast food or take-out meal is purchased instead of preparing the meal at home, the GDP goes up. Every time the TV goes on to babysit the kids, the GDP goes up as more advertising and TV programs are viewed. Ultimately we all pay a huge price for the breakdown of family cohesion and resiliency.

Crime is the most extreme symptom of family breakdown. Broken families often lead to stress, anxiety, emotional disorders, and ill health for both parents and children. According to one large-scale study, children living with a single parent or with a parent and a step-parent were more likely than those living with their biological parents to be expelled from school, to receive counseling or other treatment for emotional problems, to have accidents, and to suffer from asthma (Dawson 1991). The long-term societal costs of children growing up in these conditions is undoubtedly enormous yet goes unaccounted for. A society that neglects the well-being and emotional health of children and allows family and community life to erode is a society that faces the prospect of economic decline and social disintegration.

Ideally, we could use the economic values and expenditures in the rising “service” and “entertainment” sectors as a proxy for the value of the displaced and depleted stock and value of “social capital,” similar to the way we estimate the capital depreciation and depletion of natural resources. But there are virtually no data on the “service” parents and other adults provide children in the process of growing up (not to mention the problems of trying to quantify such relationships in the first place). We are thus forced to adopt proxy measures that provide only indirect measures of the real costs of family breakdown.

We use two proxies: (1) divorce and its effects on children, and (2) the amount of time families spend watching television. Clearly this limited perspective grossly underestimates the true cost to the nation from the erosion of social capital resulting from family breakdown.

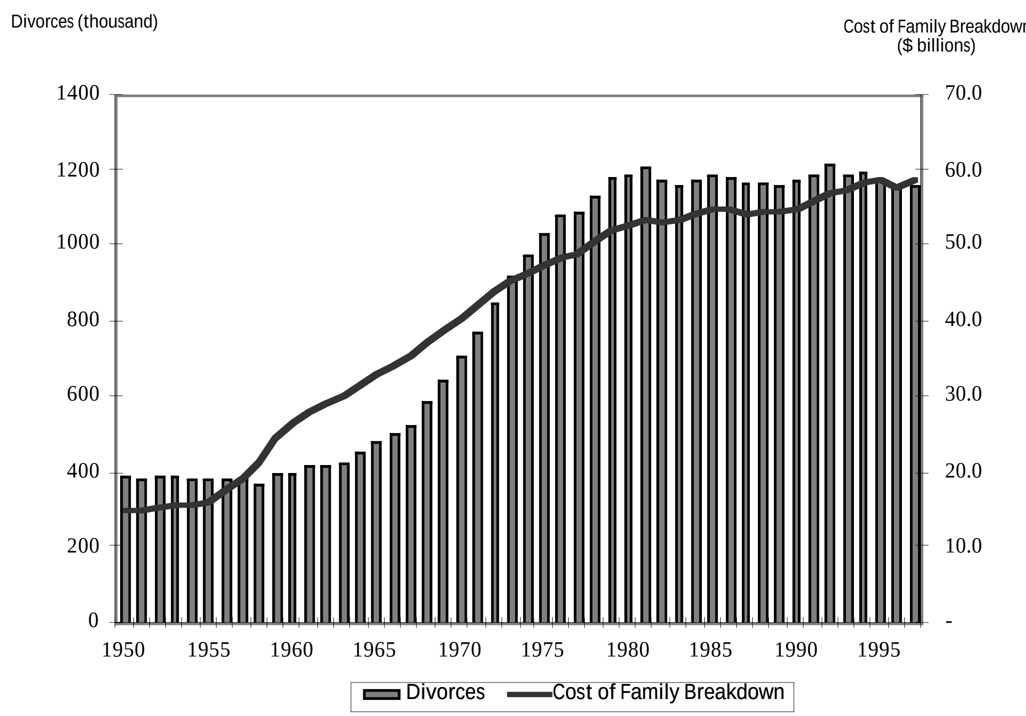
Divorce can have traumatic effects on both adults and children. These emotional and physical impacts translate into significant economic implications. Placing a monetary value on the costs of divorce to the well-being of individuals, households, and the nation is complex. Nevertheless, even a preliminary “back-of-the-envelope” assessment of these costs would enlighten us as to what price we as society are paying as a result of the breakdown of relations and family cohesion. Sadly, few such accounts and estimates exist.

We estimate the cost of divorce both in terms of the direct costs to the adults involved and an estimate of the costs to affected children. The cost to adults is based on an estimate of the out-of-pocket expenses for legal fees, counseling, and establishing separate residences, including appliances for these. We estimate the direct cost of divorce at the rate used in the original GPI estimates: in 1982 dollars, $5,000 per divorce, or $7,269 per divorce in 1992 dollars, which is then multiplied by the total number of divorces.

The cost of divorce to children was estimated in 1982 dollars at $7,500 per child affected by divorce, or $10, 904 per child in 1992 dollars. These are arbitrary and rough approximations of the lifetime damage incurred, including counseling, health costs, and the difficulties experienced at school, work, or in personal relationships. This cost is multiplied by the number of children affected by divorce. While our estimates are arbitrary, we believe they are very conservative.

As the following figure shows, the number of divorces rose significantly through the 1970s. It reached a plateau in the 1980s at roughly 1.1–1.2 million. The early 1990s seemed to show an increase in divorces; however, since 1995 that trend has reversed itself to the point where the number in 1997 is at the level it was ten years ago. According to the National Center for Health Statistics (NCHS 1998), roughly 43 percent of new marriages in 1988 were likely to end in divorce.

FIGURE 6: DIVORCE AND THE COST OF FAMILY BREAKDOWN

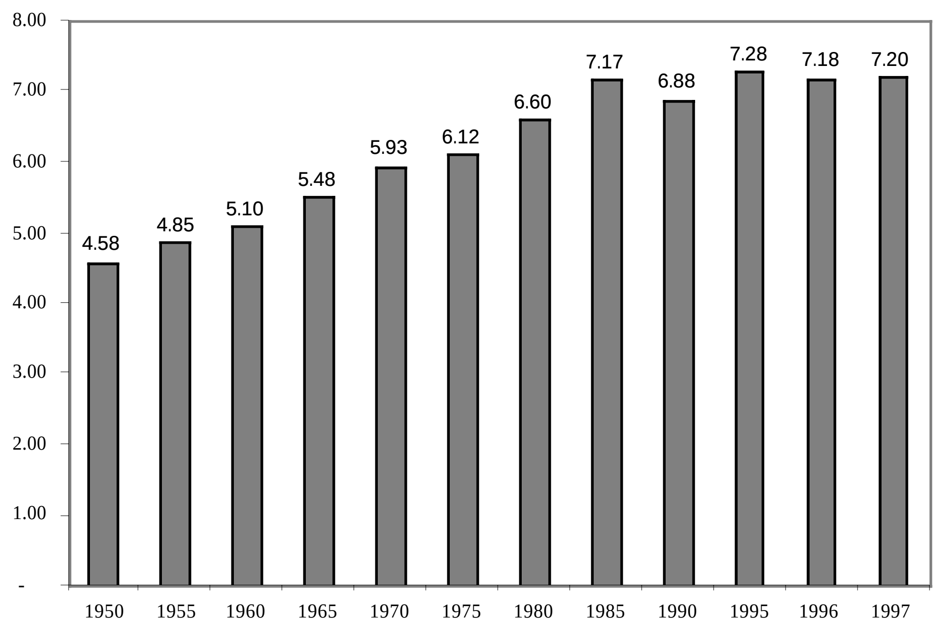


The number of children impacted by divorce generally rises with divorce numbers. Unfortunately, since 1991, the NCHS no longer reports the number of children impacted by divorce. We had to estimate these figures for 1989 to 1997 based on the 1988 ratio of children per divorce, or 0.89. The economic costs to children impacted by divorce takes the estimated cost per child times the number of children affected.

The second category of family breakdown is so pervasive that it is often called the "electronic babysitter." Television viewing may not be harmful per se, although the violence and sex can certainly make it so. But even if the program content were more defensible, the amount of time devoted to television would be a problem in itself.

The average household watched 7 hours and 12 minutes of television per day in 1997 (Television Bureau of Advertising 1998). This represents only 5 fewer minutes of TV viewing than the all-time high in 1995. Comparatively, households spent on average 4 hours and 35 minutes viewing TV in 1950, and 5 hours and 29 minutes in 1965. According to a Carnegie Council study in 1992, teenagers spend only 5 minutes per day with their fathers and 20 minutes with their mothers, but 3 hours per day watching television (cited in Vobejda 1992). Children are being raised more by television than by their parents.

FIGURE 7: HOURS OF TV VIEWING PER HOUSEHOLD PER DAY



We estimate the social cost of television viewing at roughly $0.44 per hour in 1992 dollars (converted from the original estimate of $0.30 per hour in 1982 dollars used in 1995 GPI). This would derive an estimate that would be about two-thirds as large as the cost of divorce in recent years. Since our concern is television watching in families with children, we value this social cost by taking time spent watching television by families (hours per day per household) times (365 days per year) times (number of households in the U.S.) times (the proportion of households with children) times ($0.44/hour). Based on these figures we estimate the social cost of TV watching in 1997 at $39.1 billion.

Including the cost of divorce, social cost impact of divorce on children, and the social costs of television watching by children, the estimated cost of family breakdown is estimated at $58.8 billion in 1997.

COLUMN J: LOSS OF LEISURE TIME

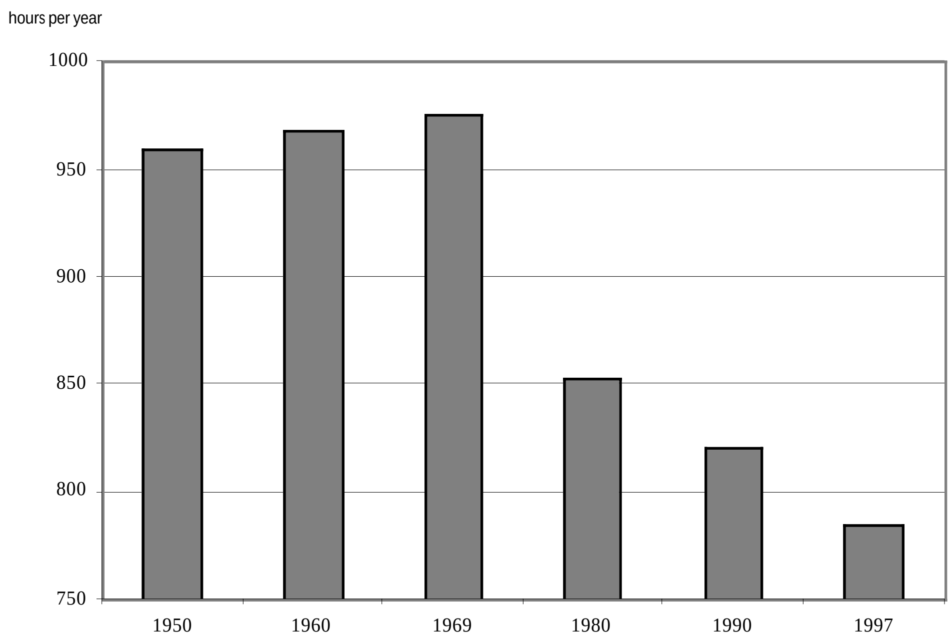
Many Americans find themselves on a treadmill of work and consumption that never seems to slow down. According to Bluestone and Rose (1997) "since the 1980s people have been saying they work 'too hard'—that they are spending too much time on the job, with too little left for family, chores, or leisure." They also show that while individuals may not be more overworked than before, families certainly are: married couples increased their annual market work by 32 hours per year through the 1970s and 1980s (a total increase of 684 hours or 4 months of full-time work). Intuitively we have a sense that the quality of our most precious commodity, time, is being eroded.

In a study of changing living standards of America's households, Lawrence Mishel, Jared Bernstein, and John Schmitt found that "the economic realities facing the typical American family over the 1990s include, increased hours of work, stagnant or falling income, and less secure jobs offering fewer benefits" (1999). They found that the typical married couple worked 247 more hours (more than six weeks) per year in 1996 than in 1989, despite an 8 percent growth in the economy's productive capacity over the same period. Bluestone and Rose (1997) report that from 1989 to 1996, the average work week has jumped to 41 hours and average overtime work reached a post–World War II peak of 4.7 hours per week in 1994. As Mishel et al. note, "American families are working harder to stay in the same place and are seeing little of the gains in the overall economy" (1999). Working harder means less time available for leisure and family.

Unfortunately, the decrease in quality leisure time is totally ignored in the GDP. Since free time is not traded in the market the way labor time is, it is invisible in our accounting systems. As Zolotas (1981) has noted "it was originally believed that economic growth (GDP and productivity gains) would eventually shorten working time" and free up more leisure time. For most even rudimentary measures of time, this has not materialized. The reason, Zolotas suggested, may be that "the growth in physical product, in the way it takes place in modern economies, is a source of constant stress and compels people to work harder in order to be able to afford the unending stream of 'new' goods being supplied by the system."

The GDP creates the illusion that the nation is getting richer, when in fact people are working harder to produce and buy more and to pay interest on mounting personal indebtedness. A more accurate measure of genuine progress and well-being would offset the loss of leisure that went along with the increased output. Accounting for the nation's well-being ought to include the value of leisure time lost or gained.

FIGURE 8: LOSS OF LEISURE HOURS



But how should free time be tallied? We could account for every nonworking hour (including hours spent sleeping), valued at the average wage rate. With 136 million people in the labor force in 1997 and each with 15 hours of potential leisure time per day and 24 hours per day on weekends, that amounts to around 870 billion hours of potential leisure for the working population alone. Valued at an average real wage of $11.20 per hour, their leisure would be worth about $9.7 trillion in 1997. If the leisure time of children, seniors, and others not in the labor force were included, the total would amount to at least $20 trillion, which is far greater than the 1997 GDP of $7.2 trillion.

In order to provide a reasonable estimate, the GPI includes only the value of the leisure lost in relation to 1969,[7] the year with the greatest leisure during the period of study. The number of leisure hours per year is taken from a study by Laura Leete-Guy and Juliet Schor that estimates the annual working hours (including housework) of labor force participants (Leete-Guy and Schor 1992). Estimates from 1969 to 1992

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7. Note that 1968 was the year with the lowest income inequality.

were derived from their figures. For 1950 to 1969, we estimated that annual hours of work declined by 0.3 percent per year.[8] For the period 1993 to 1997 we extrapolated the trend based on the work of Mishel et al. (1996) who estimate that annual hours of work have increased an average 5.2 hours per year between 1989 and 1994.

The number of work hours is then subtracted from 3,650 hours of discretionary time (10 hours per day) to arrive at an estimate of the total discretionary hours of leisure per person per year. (The term "discretionary" simply means time away from work minus time spent sleeping and kindred maintenance activities. We use 70 hours per week as the threshold; thus discretionary time is the amount less than 70 hours per week that people work.) The resulting figure for each year is subtracted from the amount in 1969 to derive an estimate of the hours of leisure per worker. The change since 1969 is the basis for estimating the loss of leisure time, which we value at $11.20 per hour in 1992 constant dollars (which is approximately the average real wage rate for the period 1950 to 1997).

The estimated economic cost of lost leisure time in 1997 was $263.6 billion.

COLUMN K: COST OF UNDEREMPLOYMENT

There is a strange contradiction in America's labor force between "a group of overworked and a growing segment of underemployed, who experience an abundance of involuntary leisure" (Schor 1997). While millions of new jobs have been created since the 1950s, the economy has not been able to create as much employment (especially full-time employment) as many members of the labor force would desire. Indeed, many people are forced to choose leisure when they would like to be fully employed. There is some evidence of a long-term rise in the percent of the labor force that would like to work more or are classified as underemployed.

Underemployment is a more inclusive concept than unemployment. It refers to persons who are either unemployed, discouraged (gave up looking for work), involuntary part-time (would prefer full-time work but are unable to find it), or constrained by other factors, such as lack of child care or transportation. The costs of underemployment fall on the discouraged workers and their families. But the community and society also pays a price when limited work opportunities may lead to frustration, suicide, violence, crime, mental illness, or alcoholism and other substance abuse.

The GPI does not deal with the effects of short-term and cyclical unemployment. Although such hardships are not without social consequences and costs, much of the financial hardship is mitigated by unemployment insurance benefits. The social

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8. According to Schor (1992, 2), "In the first two decades after 1948 . . . worktime did not fall appreciably. Annual hours per labor force participants fell only slightly."

distress and erosion of social cohesion resulting from unemployment is, however, a different order of magnitude. For example, Brenner (1984) found that an increase in the unemployment rate (from 4.9 percent to 5.6 percent) from 1973 to 1974 was associated with an additional 46,000 deaths, 270 suicides, 403 homicides, 7,000 assaults, and 8,400 admissions to mental hospitals, with many of these effects spread over a period of six years. Nevertheless, the GPI does not attempt to account for the value of such secondary effects of changes in the economy.

The GPI takes a more conservative approach treating each hour of underemployment (the number of unprovided hours for constrained workers) as a cost, just as leisure time is considered a benefit. An hour of leisure time is a desirable objective whereas an hour of underemployment is a burden.

The GPI uses the research of Leete-Guy and Schor (1992) who calculated the number of "unprovided hours" of work in 1969 and 1989 by constrained workers—people who want to work more. The years 1969 and 1989 were chosen because they were business cycle peaks or near-peaks. The year 1997 may also become known as another business cycle peak. There was little increase during that period in the percentage of the workforce that wanted to work but did not work at all (from 0.4 percent to 0.6 percent). But the percentage of workers who ended up in part-time work for at least a part of the year almost quadrupled (from 1 percent to 3.9 percent), while the percentage of those in part-time work for the whole year grew sixfold (from 0.2 percent to 1.3 percent). The proportion in full-time work for only part of the year grew by more than half (from 5.6 percent to 8.7 percent). This evidence represents an involuntary increase in part-time work.

Bluestone and Rose (1997) report that "in 1973, 19 percent of total part-time employment was accounted for by individuals who wanted full-time jobs but could not find them. By 1993, this proportion was up to 29 percent." The incidence of involuntary part-time work is especially high among men; in 1985 half of all part-time men and a quarter of part-time women reported their part-time status was involuntary (Bluestone and Rose 1997).

Based on the survey by Leete-Guy and Schor (1992), the number of hours of underemployment in the entire labor force rose from 4.2 billion hours in 1969 to 14.6 billion hours in 1989. Leete-Guy and Schor have not updated their estimates of unprovided hours for constrained workers, nor have others reported underemployment on this basis.

Mishel et al. (1999) of the Economic Policy Institute, analyzing Bureau of Labor Statistics (BLS), estimate underemployment using the new methods adopted by the Bureau of Labor Statistics (BLS). Since 1994 the BLS has been compiling a new set of alternative measures of unemployment and underemployment that they call "labor force underutilization." Underemployment figures include the number of potential workers who are unemployed, discouraged, and involuntary part-time, or otherwise constrained by socioeconomic conditions. According to this new accounting approach, the official unemployment rate in 1995 was 5.6 percent (7.4 million failing to find work). Adding “discouraged workers,” “marginally unattached,” and the involuntarily part-time workers brings the “underemployment rate” to roughly 10.6 percent, or 13.5 million workers—one in ten of the total labor force. According to their estimates, the underemployment rate declined from 11.4 percent in 1994 to 9.4 percent in 1997. This suggests a decline in the rate of underemployment.

Since we could not reconcile the historical constrained hours estimates of Leete-Guy and Schor with the Mishel et al. estimates of underemployment, we extrapolate the Leete-Guy and Schor figures from 1950 to 1968 and from 1990 to 1997. We assume the number of unprovided hours per constrained worker from 1990 to 1997 continues to increase at the rate of 0.59 percent per year (the rate of increase between 1969 and 1989). Thus we assume a constant growth rate in the number of hours of work that employees and potential employees have not been able to do for lack of opportunity. This approach bypasses changes in unemployment due to business cycles and focuses instead on the effects of long-term trends.

The estimates of unprovided hours per constrained worker is then multiplied by the millions of estimated constrained or underemployed workers and then by an average real wage of $11.20 per hour. As with leisure, this is the average real wage during the accounting period 1950 to 1997. These estimates suggest that the cost of underemployment peaked at $173 billion in 1993 and has since declined to $122.3 billion by 1997 due to the decrease in underemployment.

COLUMN L: COST OF CONSUMER DURABLES

The actual expenditures on consumer durables is a negative adjustment in the GPI to avoid double counting the value of the services of household capital (column F). The value of private expenditures on consumer durables in constant 1982 dollars comes from the *National Income and Products Accounts* (U.S. BEA 1998d, table 1) or the *Economic Report of the President* (CEA 1998). The reason we subtract expenditures on consumer durables is explained under column F. The cost of consumer durables in 1997 is estimated at $668.6 billion.

COLUMN M: COST OF COMMUTING

Most of us bemoan commuting to work as an undesirable yet necessary expenditure of our time and money. As car ownership has tripled, with more single-passenger commuting, congestion has increased and Americans must spend more time getting to and from work. While commuting is for most people an unsatisfying and sometimes frustrating experience, the GDP treats it as a benefit to consumers. The more time and money spent commuting, the more these regrettable activities contribute to the GDP. Moreover, it does not account for the value of time spent commuting; time that could be spent freely with family, at leisure, sleeping, or at work.

Commuting times have steadily increased since the 1950s. According to U.S. Department of Transportation surveys, the average commuting time increased 13.7 percent between 1983 and 1995 (U.S. DOT 1998). In 1983 the average commute to work took 18.2 minutes (one-way). By 1995 it had increased to 20.7 minutes. Ironically, while the average work trip length increased 36.5 percent from 8.5 miles in 1983 to 11.6 miles in 1995, the average time getting to work did not increase as much because of an increase in the average work trip speed from 28.0 mph in 1983 to 33.6 mph in 1995.

The GPI corrects for the shortcoming of the GDP account by subtracting the cost of commuting. There are two distinct types of costs incurred in commuting. The first is the money spent to pay for the vehicle, or for bus or train fare; the second is the time lost that might have been spent on other, more enjoyable or productive activities. The direct (out-of-pocket) costs of commuting were calculated as follows:

C = 0.3 (A - 0.3 A) + 0.3 B

= 0.3 (0.7 A) + 0.3 B

= 0.21 A + 0.3 B where:

C is the direct cost of commuting.

0.3 is the estimated portion of total non-commercial vehicle miles used in commuting in 1983 (see *Statistical Abstract* 1987, 591, table 1033).

A is the cost of user-operated transport (mainly cars) from the *National Income and Product Accounts.*

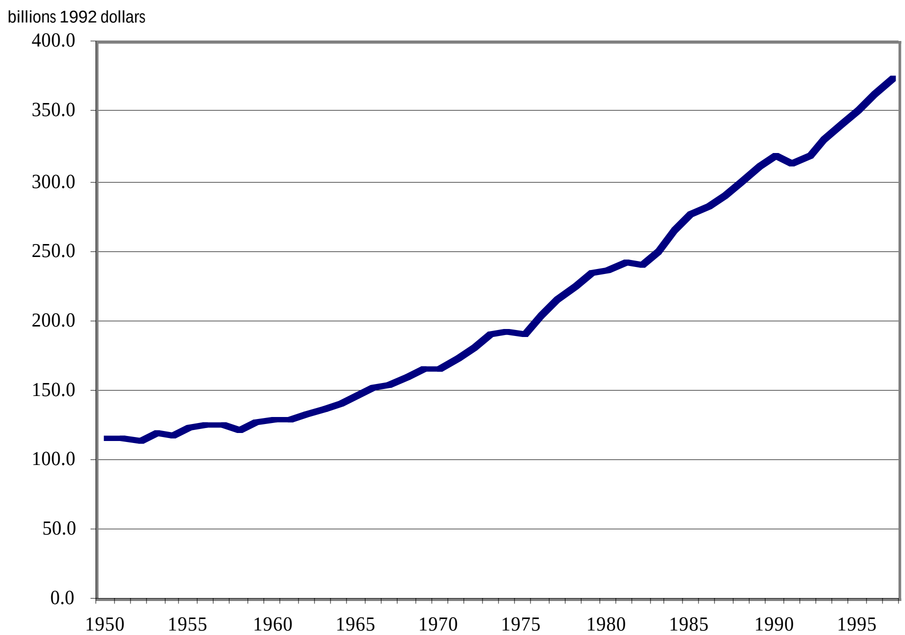
0.3 A is the estimated cost of depreciation of private cars (excluded here to avoid double counting since it is already an element in column F) from the *Statistical Abstract*.

0.3 is the estimated portion of passenger miles on local public transportation used for commuting.

B is the price of purchased local transportation (see *National Income and Product Accounts*).

The indirect costs of commuting (i.e., the value of the time lost) are calculated as the total number of people employed each year times the estimated annual number of hours per worker spent commuting times a constant value for the time. Because some people regard commuting as part nuisance and part leisure, we assigned a value of $8.72 per hour (rather than the $11.20 per hour for lost leisure). The number of hours per year was derived from survey data on time-use by households (Leete-Guy and Schor 1992, 9).[9]

FIGURE 9: ECONOMIC COSTS OF COMMUTING



The estimated cost of commuting in 1997 was $374.5 billion. The above figure shows the rising economic costs of commuting since 1950.

COLUMN N: COST OF HOUSEHOLD POLLUTION ABATEMENT

One of the costs that pollution imposes on the households of the nation is the expenditures made for equipment such as air and water filters. These defensive expenditures do not improve the well-being of households, but merely compensate for the externalities—that is, pollution—imposed upon them as a result of economic activity. Such expenditures merely attempt to restore environmental quality to a baseline level. Since business and government outlays are not included in personal consumption expenditures, we do not subtract their spending for pollution abatement.

For the period 1972 to 1994, we used data published by the Bureau of Economic Analysis (Vogan 1996). For years prior to 1972, we assumed that personal expenditures on pollution abatement and control increased by 20 percent per year

9. Leete-Guy and Schor use several sources, including the Census of Transportation, Vol. 1, 1963 and Current Population Reports, both by the U.S. Department of Commerce. They estimated hours for 1975 and 1985 from Robinson (1986).

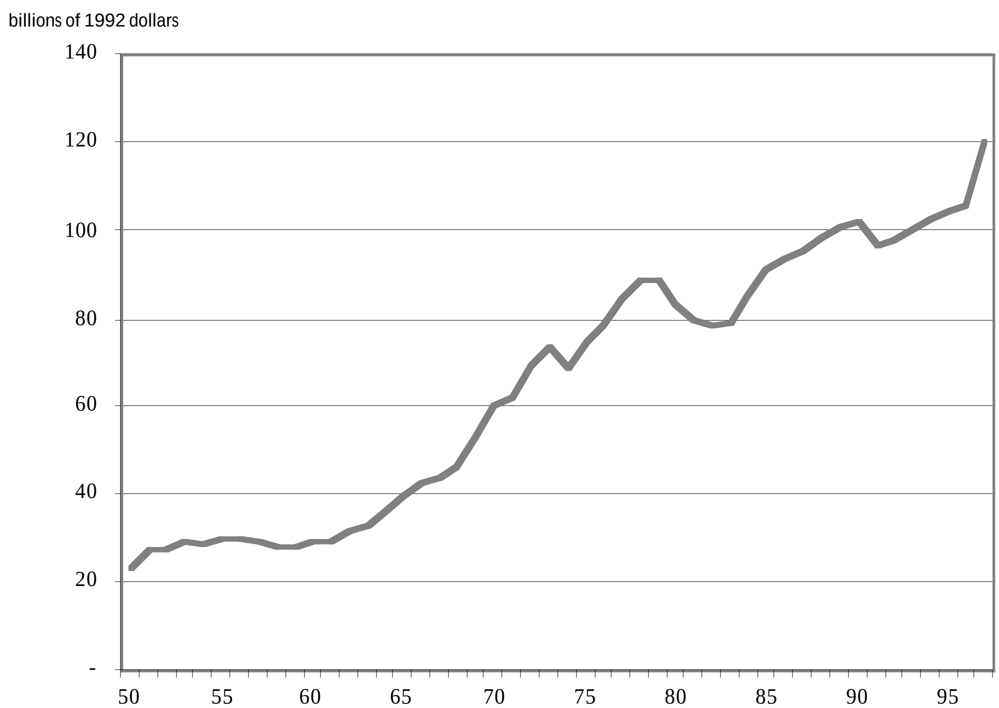
according to the trend after 1972. In 1996 the BEA data series was discontinued, therefore we extrapolated expenditures based on the average rate of increase from 1991 to 1994.

We estimate the cost of household pollution abatement at $11.1 billion in 1997.

COLUMN O: COST OF AUTOMOBILE ACCIDENTS

The damage and economic loss due to automobile accidents represents a real cost of industrialization and increasing traffic densities. Economic loss estimates are derived from *Statistical Abstract* and *Accident Facts* (National Safety Council 1998). Economic loss figures cover only motor vehicle accidents on and off the road and all injuries regardless of length of disability. Economic loss includes wage loss; legal, medical, hospital, and funeral expenses; insurance administration costs; and property damage.

FIGURE 10: ECONOMIC COSTS OF AUTOMOBILE ACCIDENTS



In terms of the economic loss due to motor vehicle accidents, 1997 recorded a significant increase of 13.7 percent over 1996, rising from $119.3 billion in 1996 to $135.7 billion in 1997, in current dollars. The GPI estimates for cost of automobile accidents shows a steady increase in the economic loss (in constant 1992 dollars) from

$23.7 billion in 1950, $29.5 billion in 1960, $60.3 billion in 1970, $83.7 billion in 1980, $102.2 billion in 1990, and $120.5 billion in 1997.

COLUMN P: COST OF WATER POLLUTION

Water is the one of the most precious of all environmental assets, yet the national income accounts provide neither an inventory of the quantity or quality of water resources nor an account for the cost of damage to water quality. The cost of water pollution as estimated in the GPI is not the money spent to clean up polluted water. Sewage treatment and water treatment plants do not improve the quality of water but rather prevent the condition of a river, lake, or groundwater from deteriorating. More pollution simply means more treatment is required to bring the quality of the water to a benchmark level. If treatment expenses were counted as positive, that would indirectly mean that pollution adds to the well-being of America. On the other hand, treatment costs are not subtracted here as defensive expenditures because those are mainly government and corporate expenditures and therefore are not directly related to the GPI baseline, which is based only on personal (household) consumer expenditures (column A).

The costs of water pollution arise from: (1) damage to water quality and (2) damage from siltation which reduces the life span of water impoundments or channels. Although this may involve some double counting (insofar as siltation also damages water quality), on the whole the estimates in this column understate damage because of the lack of data on nonpoint sources of pollution.

Ironically, despite the importance of water to human existence, studies of the economic costs of damage to water quality, whether surface (river) or groundwater, are rare.

Damage to water quality | The cost of damage from water pollution in 1972 was estimated as $12.0 billion, or $39.3 billion in 1992 dollars. This is based on the upper range of estimates in three studies of point source damage to recreation, aesthetics, ecology, property values, and household and industrial water supplies (Freeman 1982, chapter 9). The less conservative figures were used because data were not available for nonpoint sources (urban and farmland runoff). These at least double the total pollutant load in many river basins and increase it several-fold in others. As of the late 1970s, nonpoint sources contributed 57 percent of biological oxygen demand, 98 percent of suspended solids, 83 percent of dissolved solids, 87 percent of phosphorous, and 88 percent of nitrogen discharged into U.S. waterways (Gianessi and Peskin 1981, 804, table 1).

According to the Conservation Foundation (1985), “the years 1974 to 1981 saw little change in water quality with respect to the conventional pollution indicators.” This overall lack of improvement means that regulatory efforts were offset by the growth of population and polluting activities. In contrast to the relative stability of the 1970s and 1980s, water quality is assumed to have declined during the 1950s and 1960s at 3 percent per year, before the concerted national effort to address the issue.

In the absence of more current economic analysis of the cost of water pollution to surface water and groundwater in the United States, we continue to apply Freeman's 1982 estimates of $12.0 billion for 1972, which converts to $39.3 billion in 1992 dollars. We therefore assume that the economic cost from damage to water quality remains constant from 1972 to 1997 at $39.3 billion.

Damage from siltation | Erosion from farmland, streambanks, roadbanks, and construction sites imposes costs in the form of reduced river navigability, siltation of water impoundments, sediment-related flooding, and other off-stream effects. The Conservation Foundation (1985) estimated that this damage was in the range of $3.2 to $13.0 billion in 1980. The geometric mean was thus around $6.5 billion, or $10.8 billion per year in 1992 dollars.

There are no definitive estimates of the changes in siltation over the years the GPI includes. The National Resources Inventory, conducted by the Soil Conservation Service in conjunction with Iowa State University in 1977 and 1982, estimated total erosion at a constant level of 6.5 billion tons of soil loss per year. Our calculations assume that this five-year trend has continued to the present, and that it began in 1972. From 1950 to 1972, we estimate that erosion increased by an average of 1 percent per year. Even if farmland erosion remained constant before 1972, other causes of sedimentation presumably increased due to urban growth, construction, and the development of the interstate highway system.

Combining the damage to water quality and the damage due to siltation, the total cost of water pollution used in the GPI account is estimated at $50.1 billion in 1997.

COLUMN Q: COST OF AIR POLLUTION

The annual economic cost of air pollution to households, infrastructure, the environment, and human health is a typical example of environmental costs that lie outside the boundary of the traditional national accounts. It represents a significant omission from conventional economic indicators like the GDP. Unfortunately, such economic cost estimates are rare.

The GPI uses Myrick Freeman's analysis of the cost of air pollution. His figure of $30 billion in 1972 dollars converted to $90.0 billion 1992 chained dollars (Freeman 1982) is used in the estimates of air pollution costs over the time series, serving as the baseline for column Q. Freeman's analysis divides the costs of air pollution into six categories. The estimated cost in 1970 (in 1992 dollars) for each of these categories was:

1. damage to agricultural vegetation	$12.1 billion
2. materials damage (paint, metals, rubber)	18.1 billion
3. costs of cleaning soiled goods	14.9 billion
4. acid rain damage (aquatic and forest)	4.5 billion
5. urban disamenities (reduced property values and wage differentials)	26.9 billion
6. aesthetics	13.5 billion
TOTAL	$90.0 billion

There is evidence that this $90.0 billion estimate is conservative. It excludes damages to health, except those that show up indirectly in the estimate of wage differentials. It also excludes increased mortality. These two items alone would add perhaps $40 to $60 billion to the 1970 cost estimate.

Other research corroborates that our figure underestimates the full cost of air pollution. Professor Ralph Estes of the American University has devoted several years to an analysis of the external costs that corporations impose on customers, employees, communities, and society—costs that never show up in profit and loss statements (which only list internalized costs). His 1996 study estimates the total costs to be in excess of $2.6 trillion dollars yearly.[10] Estes estimates that health costs associated with air pollution amount to $226 billion (1996, 177). He concludes that "a scorecard that ignores social costs presents a distorted picture of performance that can influence policymakers to be excessively generous with taxpayer-funded corporate benefits and overly lax in enforcing corporate regulations" (Estes 1996). In another study, according to Chilton and Huebner (1997), the American Lung Association estimates that, on average, particulate air pollution reduces life expectancy by two years.

The most recent and definitive studies of air pollution costs are by McCubbin and Delucchi (1996, tables 11-A-1 and 11-A-2). They estimate the annual cost of emissions from gasoline-powered vehicles ranges from $19 billion to $330 billion per year for health damage (which includes a statistical value of life) plus $3 billion to $8 billion for aesthetic and crop damage (in 1995 dollars). They break down air pollution costs by type of emission as follows (in 1995 dollars):

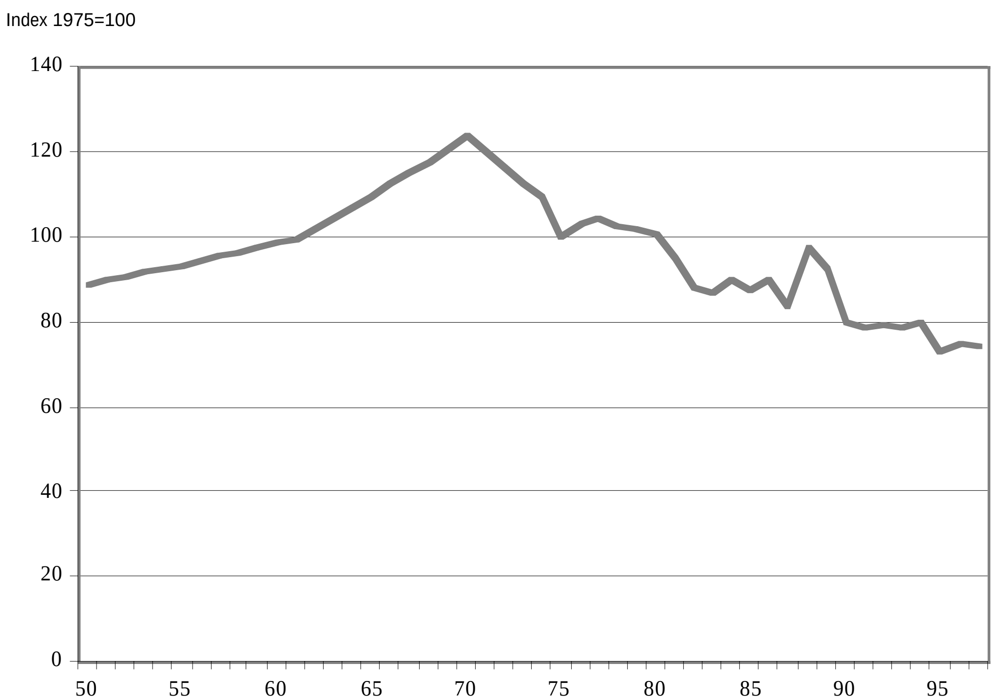
CO (carbon monoxide) $1.1 to $9.3 billion

10. Estes' (1996, 177–178) $2.6 trillion estimate is broken down as follows: price-fixing conspiracies, monopolies, and deceptive advertising ($1.16 trillion); deaths from workplace cancer ($278 billion); health costs from air pollution ($226 billion); discrimination ($165 billion); workplace injuries and accidents ($141 billion); unsafe vehicles ($136 billion); white-collar crime, including income tax fraud, bribery, extortion, kickbacks, and federal regulation violations ($165 billion).

NO_X (nitrogen oxide)	\$1.0 to \$5.3 billion
O_3 (ozone)	\$0.2 to \$1.9 billion
PM-10 (particulates)	\$17 to \$314 billion

Their studies show that most of the health costs associated with air pollution come from particulates, a fact that was not known when Freeman did his study in the 1970s. We have not used the McCubbin and Delucchi figures given the wide range of their cost estimates and their inclusion of the value of life, which we have chosen not to incorporate.

FIGURE 11: AMBIENT AIR POLLUTION INDEX



Using Freeman's damage assessment as a base, we estimate the annual cost of air pollution for years other than 1970 by extrapolating the \$90 billion figure according to the relative change in air pollution levels. To do so, we measure the relative change in air quality using an index of ambient air pollution levels. First, we construct indexes for ambient levels of particulates (PM), sulfur dioxide (SO_X), and nitrogen dioxide (NO_X). In each case, the year 1975 (the year the EPA began collecting the data) is set equal to 100. A single index number of ambient air pollution is created for each year by averaging these three indexes. A value greater than 100 implies an increase in air pollution, while a value less than 100 signifies a decline in air pollution. To calculate the cost of air pollution, we divide the ambient air pollution index of the given year by the index for 1970 and multiply the result by our estimate for the cost of air pollution in 1970 ($90.0 billion).

The air pollution data for the years 1975–1996 are from the EPA's estimates of ambient air pollution (EPA 1998). (The figures for changes in air pollution damage over time are also summarized in the *Statistical Abstract.*) For earlier years, ambient air conditions are assumed to have deteriorated by 1 percent per year in the 1950s and by 2.4 percent per year in the 1960s, and to have improved by 3.0 percent per year from 1971 to 1977 (as a result of the Clean Air Act of 1970). The 1997 figures for NO_x, SO_2, and particulates are projected based on the trend 1990–1996.

The application of an air quality index (using relative changes in air quality since 1975, the benchmark year) to the estimated costs would appear to be a reasonable approach given that it reflects changes in air pollution (i.e., emissions) while assuming a constant economic cost of those emissions. Since 1975, the decline in absolute emissions of sulfur dioxide and particulates (which outweigh the small increase in nitrogen dioxide emissions) suggests a decreasing economic cost of air pollution for these three emissions. The figure above shows the improvement in the ambient air quality (using sulfur dioxide, nitrogen dioxide, and particulate matter levels of emissions converted to an index where 1975 levels equal 100).

The air pollution damages accounted for in the GPI deal primarily with those associated with acid emissions, namely sulfur dioxide (SO_2) and nitrogen dioxide (NOx), as well as particulates. The EPA, however, reports on five air quality parameters that affect long-term air quality: carbon monoxide, lead, nitrogen dioxide, ozone, particulates (PM-10)[11], and sulfur dioxide. Also excluded in our analysis are volatile organics (VOC). Ideally, the damages due to carbon monoxide and ozone should also be considered in an expanded air pollution cost accounting. In the absence of separate cost accounting for each emission, we continue to use Freeman's original estimates, with the caveat that these exclude undoubtedly significant health costs associated with air pollution.[12]

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11. The EPA changed their accounting for particulate matter beginning in 1985. Prior to 1985 only PM-10 particulate emissions were inventoried. Beginning with 1985, substantial refinements in methodology were instituted, and the scope of the inventory was expanded to include PM-10 from agricultural activities, and so-called fugitive dust. Fugitive dust contributes a significant portion of the new total particulate matter emission (e.g., in 1985, 4.09 billion tons of PM-10 were emitted, compared with roughly 36 billion tons of fugitive dust, for a total particulate emission of 40.889 billion tons). The 1975–85 figures reflect only PM-10 particulate emissions.

12. Future estimates may be forthcoming from Resources for the Future (Washington, D.C.) from their air pollution research studies. RFF is studying the ancillary benefits and the net costs of climate policies. This entails the development of a modeling infrastructure for assessment of the ancillary benefits (and costs) of climate policies, and evaluating several leading policies addressing emissions of greenhouse gases for their ancillary benefits, primarily resulting from changes in emissions of criteria air pollutants. The infrastructure for this evaluation is derived from the Tracking and Analysis Framework (TAF), which the U.S. Department of Energy has helped to fund on behalf of the National Acid Precipitation Assessment Program (NAPAP). TAF is an integrated assessment model used to track changes in sulfur dioxide (SO_2) and nitrogen oxides (NOx) emissions from electric utilities, the secondary formation of sulfates and nitrates, the deposition of sulfur and nitrogen, the environmental and public health impacts and economic benefits of such changes, and control costs. In this project; researchers will extend TAF to include

The GPI account estimates the cost of air pollution has been steadily declining due to an improvement in overall air quality resulting in an estimated cost of $54.2 billion in 1997 (in 1992 dollars) compared with an all-time high cost of $90.0 billion in 1972.

COLUMN R: COST OF NOISE POLLUTION

While there are considerable articles about noise pollution as well as standards for noise levels, there are no official inventories of noise pollution conducted in the United States. The damage caused by noise pollution in the U.S. in 1972 was estimated at $4 billion ($12.0 billion in 1992 chained dollars) by the World Health Organization (Congressional Quarterly, Inc. 1972, 980).

Starting with that estimate, we assumed that the quality of the auditory environment declined by 3 percent per year from 1950 to 1972, based on industrialization and increased noise emissions from motor vehicles and airplanes. From 1972 to 1994, noise abatement regulations are assumed to have reduced the rate of deterioration to 1 percent per year, but not to have improved it. With no new noise pollution data since the 1995 GPI estimates, we assume a constant rate of decline in the auditory environment at 1 percent per annum.

For future estimates, it may be possible to assess trends in the auditory environment by looking at the major contributors to noise pollution and thereby estimating trends based on the increases in the physical numbers of these contributors. For example, the aircraft flights, truck transport miles, and automobile miles driven could be used. Generally auditory environmental quality indicators are not collected, though noise level standards are set.

The GPI account estimates the cost of noise pollution in 1997 at $15.3 billion.

COLUMN S: LOSS OF WETLANDS

Wetlands contain some of the most productive habitat in the world. Yet their value is not represented in economic accounts because the benefits—such as regulating and purifying water and providing habitat for fish and waterfowl—are generally "public goods," for which there is no overt price. When a farmer drains and fills a marsh, the GDP rises by the increased output of the farm. However, the loss of services from the wetland goes uncounted. The GPI rectifies this by estimating the value of the services that are given up when wetlands acreage is converted to other purposes.

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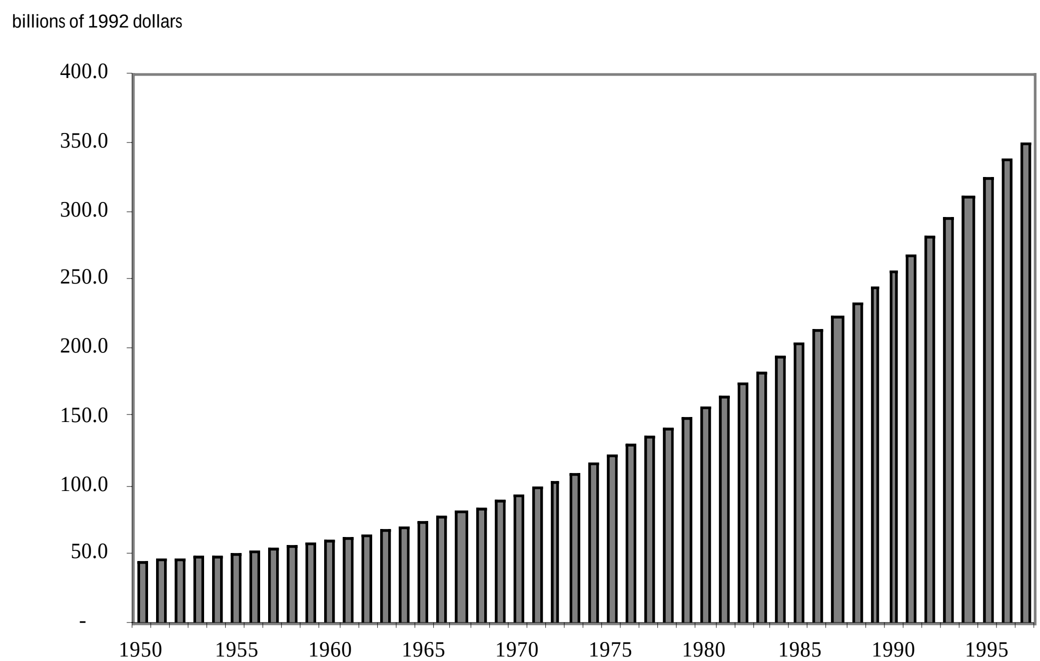
representations of other criteria air pollutants as well as emissions of mercury, carbon dioxide (CO_2), and methane from electric utility sources, industrial sources, area sources and mobile sources.

The U.S. Fish and Wildlife Service estimates that 136 million acres of wetlands were filled in North America from the colonial period to 1950. Acreage declined from an original 395 million (including the contiguous lower 48 states and Alaska) in the 1780s to about 259 million acres in 1950—a loss amounting to 60 acres an hour for 200 years (U.S. FWS 1997b).

Our estimates of acres of wetlands loss are based on the U.S. Fish and Wildlife Service's data published in *Status and Trends of Wetlands in the Conterminous United States* (U.S. FWS 1997b). Their most recent study estimated the loss of wetlands at 462,000 acres per year through 1975; 294,000 acres per year from 1976 to 1984; and 121,000 acres per year in subsequent years (U.S. FWS 1997b). Each of these figures includes 4,000 acres per year lost in Alaska;[13] the remaining acres were lost in the lower 48 states. We extrapolate the loss figures for 1996 and 1997 by using the rate of change from 1985 to 1995.

FIGURE 12: ECONOMIC COST OF LOSS OF WETLANDS



The loss of benefits from wetlands is a cumulative process. For example, if 462,000 acres of wetlands were filled or drained in each of two successive years, at the end of the second year the loss would equal the benefits from 924,000 acres of wetlands. Therefore we apply the loss estimates to the cumulative total acreage lost.

13. The Alaska figures are based on an average annual figure using opening and closing stock estimates from U.S. Fish and Wildlife Services.

Starting from the base estimate of 136 million acres lost by 1950, we add estimates of annual acres lost cumulatively.

Using these totals, we calculate the annual value of ecological services lost by mutiplying the acres lost by an estimate of the value ecological services provided by one acre of wetlands. We begin the calculation with an initial value of $44.6 billion for the annual value of ecological services for all wetlands lost through 1949. Our figure of $44.6 billion for 1950 is based on the following calculations: an average value of $327.87 (1992 dollars) an acre of services from wetlands, multiplied by 136 million acres lost, yields $44.6 billion as a plausible estimate of the cumulative loss through 1949. The value of each of the initial tens of millions of acres was lower than the marginal value of more recently filled acres.

Starting in 1950, we estimate the value of the services from one acre of wetland was $1973 (in 1992 dollars) per year. (That may seem like a sudden jump from $328, but that figure is an average of very low values for the first acres lost in the distant past with values close to $1973 in years through 1949.) This estimate is a relatively conservative figure; other studies of the value of salt water wetlands have calculated estimates 3 to 20 times as high.[14] However, our figure exceeds another estimate by Gupta and Foster (1975) by about one-third the median of their calculations.

In 1951 and following years, we assume that the value of wetland services rises by 5 percent per year, due to increasing scarcity. Thus the cost per lost acre in 1951 was $2072 ($1973 times 1.05), $2175 ($2072 times 1.05) in 1952, and so on. For 1997 our per acre per year estimation is $19,543 (in 1992 dollars). This is lower than other estimates by Costanza et al. (1997) who estimated the average global value of ecological services from global wetlands in 1997 ranging from $25,000 per acre per year for coastal wetlands to $48,000 per acre per year for swamps and floodplains in 1996.

The GPI account estimates the value of ecological services lost due to the accumulated loss of wetlands in 1997 at roughly $349.9 billion. Figure 11 shows this increase in the annual cost to the U.S. economy since 1950.

COLUMN T: LOSS OF FARMLAND

Sustaining the productive capacity of farmland is fundamental to sustaining the basic need of food for American households. The productive capacity of farmland has been reduced in two ways. On one hand, urban expansion permanently removes land from production by paving it over. On the other hand, poor land management destroys the soil: erosion, compaction, and decomposition of organic matter all gradually remove land from production by lowering its productivity.

14. See Lugo and Brinson, "Calculations of the Value of Saltwater Wetlands," in Greeson et al., 1979, 124.

The contention that we can compensate for paving or mismanaging farmland by bringing new land into production is misguided. Most of the land that economists point to in this regard is now idle because it is "dangerously erodible when in crop production" (Healy 1982, 115).

Another contention is that the costs of losing farmland can be safely ignored because the resulting losses will occur in the distant future when people will be far richer than today, and technology far more advanced. This is a *reductio ad absurdum* of conventional economic theory, which suggests that future gains and losses should be "discounted" at the prevailing interest rate to determine the "present value" of an action: in this case, the loss of soil. A century or so from now, Americans are not likely to be impressed at our foresight and wisdom in discounting their needs and well-being to zero.

Production should be regarded as genuine progress only to the extent that it is *sustainable.* Otherwise, it is simply the conversion of capital to current income. The GPI therefore subtracts the cumulative damage to long-term productivity of land that results from urbanization and poor land management (deteriorating soil).

Losses due to urbanization. Urbanization destroys approximately 300,000 acres of cropland per year. This is a conservative estimate, based on the 1981 National Agricultural Lands Study. More recently, according to the USDA (1997a), total American cropland (both cultivated and noncultivated) declined from 382.3 million to 380.5 million acres between 1992 and 1997. This reduction averages out to 360,000 acres per year from 1992 to 1997; how much of this total is urban development was not available in the report.

The value of an average acre of converted cropland, based on its productivity without high applications of fertilizers and other energy-intensive inputs, is estimated to be $329 per acre per year.

The cumulative cost of urbanization up to 1950 is estimated at $2.85 billion. This is based on an average value of $71 per acre for the approximately 40 million acres that have been urbanized or transformed into highways and rights-of-way (USDA 1982). As in the case of wetlands, the marginal utility (or value) of the first acres removed from agriculture is lower than the value of the land most recently urbanized.

Urbanization thus removes annually from the cropland base the biological services worth $2.85 billion in 1950, plus $98.7 million (300,000 acres times $329 per acre) for each subsequent year. These costs are cumulative. For 1997 we estimate the economic costs due to urbanization at $7.5 billion.

Losses due to deteriorating soil condition. Urbanization removes the productive potential of farmland in a highly visible way. But it may not be as serious in the long run as the deterioration of soil due to poor management. The decline of soil quality over the past forty years has been masked by higher inputs of fertilizer, pesticides, and fuel. In addition, soil depletion is not necessarily linear. It may not show up gradually in yield reductions, but rather in a sudden and irreversible decline. Agricultural productivity losses from erosion have been estimated at $1.3 billion per year, or $2.15 billion in 1992 dollars (USDA 1985).

We assume the cumulative damage prior to 1950 was $16.3 billion, with further costs added to that. The rate of erosion is assumed to have grown by 1 percent per year from 1950 to 1972 and to have remained constant from 1973 to 1982. According to the *1997 State of the Land Report* (USDA 1997a), the rate of erosion has declined from 8.0 tons per acre per year in 1982 to 5.2 tons per acre per year in 1995, then levels off. We use these rates to extrapolate the losses from 1983 to 1997. We assume that the annual value of the cumulative damage prior to 1950 was $14.5 billion, with further costs added to that. By 1997 the estimated total cost due to soil erosion was $112.1 billion, in 1992 dollars.

The damage to soil from compaction by heavy machinery in 1980 was estimated at $3.0 billion in 1980 dollars (Sampson 1981), or $4.97 billion in 1992 dollars. We assumed a 3 percent increase per year in the losses due to compaction prior to and following 1980. We were unable to find newer estimates of the cost of soil compaction. The 1997 estimate of the cost of soil compaction is $8.2 billion, in 1992 dollars.

The total economic costs of the loss of farmland to urbanization, soil erosion, and soil compaction in the GPI is estimated at $127.8 billion in 1997 having risen steadily from an estimated $21.1 billion in 1950.

COLUMN U: DEPLETION OF NONRENEWABLE RESOURCES

Why account for depletion of nonrenewable resources? The depletion of nonrenewable resources is a cost shifted to future generations that should be borne in the present. Nonrenewable natural capital cannot be increased, it can only be diminished. As Herman Daly notes (1996) in *Beyond Economic Growth*, for nonrenewable capital the question is not how to invest, but how best to liquidate the inventory and what to do with the net financial wealth realized from that liquidation. Our current accounting system counts this liquidation of natural capital wealth as income "which is clearly wrong, because it is not a permanent or sustainable source of consumption" (Daly 1996). A prudent approach to sustaining the income and well-being of America's households would require investment of a portion of the net rents derived from mining the nonrenewable natural capital into sustainable renewable energy and productivity or energy efficiency gains. A general rule would be liquidate the nonrenewables at a rate equal to the rate of developing substitute renewable resources. Ultimately, in order to sustain a level of well-being and national income, an economy must ensure that the annual stream of benefits (income) derived from all forms of wealth, including renewable and nonrenewable natural capital, can be sustained. Living beyond the sustainable income stream of its capital base (whether renewable or nonrenewable) simply means that while current generations benefit, future generations will be worse off.

There can be no question that the nonrenewable reserves are finite at least within the time constraints of our own life spans. There is also little doubt that the reserve life of nonrenewable natural capital wealth is declining both in North America and globally as we deplete an ultimately finite physical supply of these resources. The only question is how long we can either prolong the reserve life of petroleum resources, limit its decline or forestall an ultimate peak in global demand. Perhaps the best indication regarding energy is the declining amount of energy outputs produced from a given amount of energy inputs. In the United States, the output/input ratio for oil—the amount of new energy actually produced from a given energy expenditure for exploration, extraction, and processing—declined from about 100 in the 1940s to 23 in the 1970s, and to about 8 for new discoveries beyond that (Gever et al. 1986, 70).

Americans are still highly dependent on nonrenewable energy resources for their energy requirements. According to U.S. Department of Energy (1998), of a total consumption of 94.21 quadrillion Btus of energy by the U.S. economy in 1997, 80.36 quadrillion Btus—85.2 percent—came from fossil fuels (21.44 quadrillion Btus from coal, 22.59 from natural gas, and 36.31 from petroleum). Of the fossil fuel total, 58.76 quadrillion Btus, or 73 percent, came from domestic production while the remainder was imported. Nuclear energy contributed 6.69 quadrillion Btus, 7 percent, to total consumption. Only 7.14 quadrillion Btus or 8.2 percent of total energy consumed was in the form of renewable energy.

In terms of production, renewable energy's share of U.S. total energy production has more than doubled since the 1950s from roughly 4 percent of total production to 9.6 percent by 1997. The majority—54 percent—of the renewable energy production comes from conventional hydroelectric power, followed by biofuels at 39 percent, geothermal at 5 percent, solar at 1 percent, and wind at less than 1 percent of total renewable energy production. The GPI focuses on biofuels from biomass as the sustainable substitute energy resource. Of all renewable energy resources, biofuels production has increased the most, rising from less than 1 percent in 1950 to almost 40 percent of total renewable energy production. It is the most important renewable energy resource after conventional hydroelectric power. However, biofuels still constituted only 3.8 percent of the total U.S. energy production in 1997.

Many economists argue that physical depletion of resources is irrelevant because technology will always come to the rescue. Resources will become more abundant rather than scarcer. The evidence for this view lies primarily in the historic decline in prices of nonrenewable resources, particularly oil and other energy sources. (If demand for a commodity stays the same or increases and its price declines, that is generally evidence that the supply has increased, at least in the short term.) As a result, economists tend to claim that there is no reason to be concerned; or at least that any depletion account should be offset by an accumulation account.

Basically, there are two reasons for believing that economic theory is misleading on this issue. First, the depletion of petroleum reserves in any given country is economically significant even if the world supply—and thus world price—remains steady.

Increasingly, that country will have to give up other products to pay for imports as its own supply of oil runs out. Thus, since the U.S. has already depleted much of its oil, and has now turned to imports, the present generation must pay for that previous consumption in one way or another. Similarly, petroleum production in the U.S. today means that our nation will simply have to import more in the future, with all the additional costs and vulnerabilities that entails.

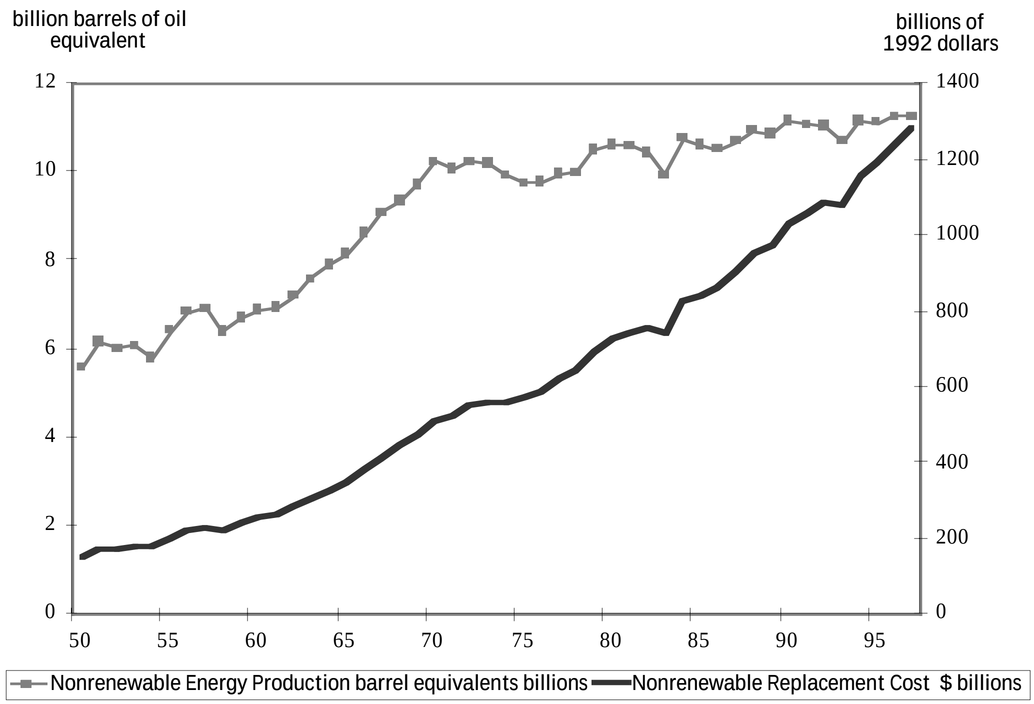
Second, on a global level, the current price of oil and other resources is not necessarily a good indicator of its long-term scarcity. Economic theory says it is; but the underlying argument is circular. The way producers of a resource supposedly know of future scarcity is through the current price. In effect a resource is deemed not scarce today if enough people believe, based on its price, that it will not be scarce in the future. (This is a simplification of an argument made by Richard Norgaard [1990].) An overly optimistic world can effectively deplete its supply of oil just as easily as it can wipe out the passenger pigeon.

If current price is not an unfailing indicator of scarcity, what price should be used to reflect the true cost of nonrenewable resource depletion? The GPI uses estimates of renewable energy replacement costs as an approximation. It estimates the amount of money that would have to be invested to substitute for the energy that is extracted. Specifically, it considers the cost of producing close substitutes such as “gasohol” from sugar cane or other organic material. Of course there are numerous other forms of renewable energy, including wind, solar, and other biomass. There are also new technologies, such as fuel cells, that could provide a technological fix that would forestall the ultimate depletion of nonrenewable resources.

The GPI focuses on energy resources because they account for 75 to 80 percent of the value of raw materials produced in the United States and because a physical measure of energy can be used to aggregate various sources (coal, oil, natural gas, and nuclear power) into a single number, which is not possible for other minerals. Moreover, cheap energy can mitigate the costs of extracting minerals from low-grade ores; but high-grade zinc or copper ores can do little to provide more energy.

We base our estimates of replacement cost of nonrenewable energy resources on the estimated costs of biomass fuel production. While this approach is debatable, we believe it is both intuitive and reasonable, since biomass fuel currently constitutes the second largest share of the renewable energy market and amounts to roughly 4 percent of total energy consumption in 1997. Our estimates would benefit from scenario analyses that consider the economies of scale for solar, wind, and other renewable energy sources.

FIGURE 13: DEPLETION OF NONRENEWABLE ENERGY RESOURCES



Our estimate of $75 per barrel of oil, as the nominal replacement cost in 1988, is based on the assumed marginal cost of producing a barrel-equivalent of energy from biomass if a large proportion of fuel needs were being met from that source. According to a study by the U.S. Department of Agriculture, ethanol would cost around $40 per barrel if biomass conversion were not receiving a subsidy, and if the corn used to make ethanol cost $2.00 per bushel (USDA 1988). If the price of corn were $4.00 per bushel, the cost of producing ethanol would rise to $50 per barrel.

However, if the U.S. tried to double or triple production (from the current level of around 0.5 percent of national gasoline consumption), that "would begin to place strong upward pressure on corn and other grain prices, thereby increasing the production cost of ethanol and reducing its competitiveness with alternative energy sources" (USDA 1988). Increasing the production of ethanol to 50 percent of the energy content of gasoline used in the U.S. might drive the price of corn as high as $15 to $20 per bushel, which would push the cost of producing ethanol up over $100 per barrel.

In addition, erosion (resulting from removal of crop residues from the land) could increase by up to nine times (Council for Agriculture Science and Technology 1984). The energy cost of counteracting those effects could be high enough to eliminate any net energy given from ethanol production. According to Hopkinson and Day (1980), the net energy derived from sugar cane that is transformed into alcohol ranges from 0.8 to 1.7. If the processing plant uses petroleum as its own source of energy the process would produce 8 units of energy for every 10 units consumed. If the process uses bagasse (the sugar cane stalk) for part of its energy needs, it produces 17 units of energy for every 10 units consumed.

Even the latter figure overstates net energy by excluding the cost of transporting the ethanol to its end use. Thus, a more plausible estimate of the replacement cost might be one or two hundred dollars per barrel. Calculations of this magnitude might seem absurd—except that the United States was already paying out the equivalent of over $468 per barrel of oil on military expenditures in the Persian Gulf, before the Gulf War (Lovins and Lovins 1987, 26–27).

Of course focusing our hope on biofuels may itself have limits given the relative scarcity of land and conflicting demands for alternative land use, including food production. This is why we estimate a 3 percent annual growth of the real replacement cost of energy based on increasing demands for land in alternative uses (e.g., food exports) and the rising cost of energy that is used in the manufacture of ethanol. It is reasonable to expect that, as the limits of a resource are approached, the cost of extracting the next unit is more costly than the previous unit.

We have also not considered the issue of reinvesting a portion of the resource rents from nonrenewable energy use into substitute renewable energy resources to provide a sustainable benefit for the well-being of future generations. The fact that, after almost fifty years of nonrenewable energy liquidation, renewable energy makes up less than 10 percent of total energy production in 1997 suggests insufficient investment of nonrenewable resource rents into sustainable energy substitutes for the well-being of future Americans.

The GPI results for 1997 estimate the cost of replacing nonrenewable energy production at $1.3 trillion. This represents the most significant negative adjustment in the GPI account. The consequences of not investing an adequate amount of current income in renewable energy resources are undoubtedly significant. Figure 13 shows the increasing cost associated with replacing nonrenewable energy resource as fossil fuel production rises from 1950 to 1997. The longer we defer investment in renewable energy resources, the greater the economic impact on the well-being of current and future American households.

COLUMN V: LONG-TERM ENVIRONMENTAL DAMAGE

The integrity of natural and biological ecosystems is perhaps the single most important element contributing to the well-being of our nation and its households. Without the services of our surrounding natural environment, which provides clean air, water, arable land, and natural capital resources, the entire basis of production of the economy could not exist. While modern economies and societies have devised ingenious rose-colored glasses that include myopic systems of commerce and technology, these systems seem to ignore the basic laws of physics and that ecosystems exhibit carrying capacities. To ignore sustainable stewardship and the integrity of the "garden" in which we live for short-term financial and economic gains may lead to the collapse of the natural systems upon which human well-being ultimately depends.

Modern industrial civilization has been highly successful in extracting resources from nature. However, the price of that success has been the accumulation of waste products with long-term effects such as carbon dioxide and nuclear wastes. In the case of nuclear power, the costs imposed on future generations through decommissioning atomic reactors would be large, even apart from the difficulties of managing high-level wastes. These costs may eventually amount to several tens of billions of dollars per year.

As large as the costs of radioactive waste management may be, however, they pale beside the potential ones of climate change due to carbon dioxide, chlorofluorocarbons (CFCs), nitrous oxide, and methane emissions ("greenhouse gases").

The impacts of climate change are being increasingly felt around the world, whether or not we can definitively point to the burning of fossil fuels as the reason. The economic impacts are real and amount to billions of dollars in damages in our households, infrastructure, and natural capital. As incidences of severe weather conditions seem to escalate, the costs in insurance payouts and replacing lost or damaged homes, buildings, livestock, and other household resources mount. Ironically, these nature disturbances result in a positive feedback loop whereby increasing frequency and intensity of storms and other severe weather leads to increasing use of natural capital resources as we rebuild shattered homes and infrastructure in the aftermath. Yet neither the cost of our impacts on the earth's climate, nor the increasing costs of cleaning up after the storm, nor the increased depletion of nature's capital is accounted for in the GDP of nations.

Economist William R. Cline has estimated the likely costs of global warming. Based on the Intergovernmental Panel on Climate Change (IPCC), which indicates that a 2.5 degree Centigrade warming is probable by 2025, Cline calculates this would generate around $60 billion (1990 dollars) in annual tangible losses and perhaps another $60 billion annually in intangible losses, particularly species loss (Cline 1992). Cline recognizes that the IPCC may have underestimated the amount of warming by ignoring the short-term "masking" of potential warming by sulfates from urban pollution. Other positive feedback mechanisms may have been underestimated by the IPCC, such as the release of methane from peat deposits and increased trapping of heat by clouds in the upper atmosphere as warming causes a redistribution of clouds from the lower to the upper atmosphere.

Not everyone agrees that the greenhouse effect will be economically damaging. William Nordhaus, for example, has argued that people who live in industrialized countries do not have to be concerned about the buildup of carbon dioxide in the atmosphere, in this respect:

> The climate has little economic impact upon advanced industrial societies.… Cities are increasingly becoming climate proofed by technological changes like air-conditioning and shopping malls.… Greenhouse warming would have little effect on America's national output. About 3 percent of American GNP originates in climate-sensitive sectors such as farming and forestry. Another 10 percent comes from sectors only modestly sensitive—energy, water systems, property and construction. Far the largest sector, 87 percent, comes from sectors, including most services, that are negligibly affected by climate change. (1990)

He concludes that "the impacts of climatic change on developed countries...are likely to be small, amounting to less than 1 percent of national income over the next half-century."

In anticipation of critics like Nordhaus, Cline understates temperature change projections and assigns too much weight to conservative damage estimates. For example, he focuses on the fertilization effects on food crops of increased carbon dioxide, despite the caveat that laboratory results showing this result are biased by the presence of adequate water and fertilizer. He also ignores the fact that weeds will also have access to increased carbon dioxide and that increased temperatures are likely to oxidize the humus in soil that is essential for plant growth.

Cline introduces the important principle that future costs of global warming should be discounted at a very low rate of interest. In that way, the present value of future costs becomes a significant factor in accounts that balance costs and benefits of energy consumption. Thus, his conservative estimates are of the same order of magnitude as ours. Since we are estimating the total cost of long-term environmental damage, including the cost of managing radioactive waste, it is not surprising that our estimate is several times higher than Cline's.

In order to relate current behavior to future damages, the GPI treats the amount of long-term damage to the climate and the environment as directly proportional to the cumulative consumption of fossil fuels and nuclear energy—in effect proportional to nonrenewable energy consumption.[15] Data on energy consumption were taken from *Annual Energy Review 1997* (U.S. DOE 1998). We first calculate the barrel-equivalents of energy consumed from 1900 to 1997. Then we multiply the consumption for each of those years by a $1.45 per barrel "tax," an estimate of long-term environmental damage from cumulative nonrenewable energy consumption.[16] The accumulated cost from 1900 to 1949 is used as the base to which additional annual cost estimates are accumulated. The values could be thought of as the amount of money that would have been accumulated to compensate future generations for the long-term costs of energy consumption if a $1.45 per barrel tax had been levied on each barrel used.

Although the use of a per barrel tax is arbitrary, we feel that it is nevertheless an intuitive approach. We challenge others to estimate more appropriate costs. The billions of dollars in increased insurance payouts to replace and repair of property losses due to severe weather and the insurance industry's increasing interest in assessing risk associated with climate change provides some evidence that the economic costs of climate change are both real and significant. We believe our estimates are quite conservative. Indeed, if you believe there is a finite probability of a disaster or nonlinear catastrophic event on a global scale due to climate change caused, even in part, by human activity, then our estimates of "costs" are both inappropriate and insufficient.

The GPI account estimates that in 1997 the cost of long-term environmental damage amounted to $1.0 trillion, the second largest adjustment in the GPI account.

COLUMN W: COST OF OZONE DEPLETION

In 1993, scientists determined that the rapid decline of frog populations throughout the world was a result of increased levels of ultraviolet radiation reaching the earth's surface. That, in turn, was caused by the reduction of the stratospheric ozone layer, due to the release of millions of metric tons of chlorofluorocarbons (CFCs) and other ozone-depleting chemicals during the past few decades.

From November 1978 to October 1986, the amount of ozone in the stratosphere above the mid-northern hemisphere declined by somewhere between 4.4 percent and 7.4 percent (David Health of NASA's Goddard Space Flight Center, testimony in U.S. House 1987, 32). The resulting increase in ultraviolet radiation will cause a higher

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15 In fact, the release of chlorofluorocarbons (CFCs) into the atmosphere contributes substantially to global warming and is thus unrelated to energy consumption. Nevertheless, since those chemicals are treated in column W, which deals with ozone depletion, we have used the simplifiying assumption that energy consumption is the primary source of long-term environmental damage.

16. Nonrenewable energy excludes solar and wind energy but includes hydropower that we assume also causes long-term environment damage.

incidence of skin cancer, particularly among fair-skinned people. The risk of malignant melanoma is already rising, from a lifetime risk factor of 1 in 600 in 1950 to 1 in 135 in 1987 (Darrel Rigel, testimony in U.S. House 1987, 70–80). Yet human skin cancer represents the least ecologically significant effect of increased UV radiation. Unlike humans, plants and animals (such as frogs) cannot readily protect themselves from these higher levels. The ecological effects could be catastrophic.

Significant progress has been made in reducing the production of CFCs. Since the peak year of 1988, CFC production has continued to decline and is now down to the production levels of 40 years ago. According to Alternative Fluorocarbons Environmental Acceptability Study (AFEAS 1998), the sum of all CFCs voluntarily reported[17] to AFEAS by the chemical industry in 1996 was only 7 percent of the peak production levels of 1988. When reported production is weighted by the global warming potential for each compound, the total CFC production has declined by over 80 percent since 1988.

While annual production of CFCs may have declined dramatically, the cumulative impacts on the depletion of the earth's ozone layer continues in 1998 with the largest Antarctic ozone hole ever observed. According to NASA and the National Oceanic and Atmospheric Administration, the total area of ozone depletion over Antarctica reached an all-time record of 10.5 million square miles, or larger than all of North America (as reported by Joby Warrick in "Hole in Ozone Layer Is Biggest Ever," *Washington Post,* October 8, 1998.) The 1998 ozone hole is one third larger than in 1997 and unusually deep, extending nearly 15 miles into the stratosphere. Near the center of the hole the ozone is gone, destroyed by industrial chemicals, including now-banned CFCs. A revised assessment by the World Meteorological Organization, to be released next year, is expected to predict another 10 to 20 years of severe ozone depletion until recovery, resulting from current reductions in CFC production, begins.

There are no definitive studies showing the combined health and ecological consequences of ozone depletion over the next half century. However, scientists warn that the ozone loss could result in increased exposure to harmful solar radiation that can destroy plants and cause cataracts and skin cancer in humans. Given the potentially catastrophic effects on all forms of life, we made an estimate reflecting our expectation of the order of magnitude of the problems that will be caused by this long-term problem.

The calculation for the cost of ozone depletion involves multiplying the U.S. share of cumulative world production of CFC-11 and CFC-12 by $15 per kilogram in 1972 dollars. We estimate that one-third of worldwide CFC use is in the United States, so

17. The chemical industry voluntarily reports the production and sales of fluorocarbons through a survey compiled by an independent accountant, Grant Thornton LLP for AFEAS.

we multiply total production of CFCs by $5 (one-third of $15) in 1972 dollars, or $15.26 in 1992 dollars. Cumulative worldwide production of CFC-11 and CFC-12 (in metric tons) for 1950 to 1986 come from U.S. House (1987, 435–436). Data for the period 1987–1996 are from *Production Sales and Atmospheric Release of Fluorocarbons through 1997* (AFEAS 1998). The 1997 accumulated production figures for both CFC-11 and CFC-12 are estimated based on the past five-year trend (1991–1996). Annual production rates have fallen dramatically, and thus the annual increase in cumulative production of CFCs has slowed to an average of 1.17 percent per year from 1991 to 1995.

The GPI account estimates the cost of ozone depletion in 1997 at $306.9 billion.

COLUMN X: LOSS OF OLD-GROWTH FORESTS

Whenever forest land is cut for timber or to build a road, a range of ecological values is lost, at least until the forest is regenerated to the same age as the stand that has been cut. Even if successful forest management results in full restocking of the same species of timber, the original forest ecosystem may never be renewed. Forest management that focuses primarily on the timber capital may preclude the species complexity and thus the ecosystem services of the original forest. If the forest is cut or regenerated improperly, or if the size of the total cut is sufficient to drive unique species into extinction, the damage from road building, cutting, and reforestation can be effectively permanent.

In theory, a measurement of the value of forest ecosystems should account for the loss of forest ecosystem integrity and ecological services as well as the cost of unsustainable forest management practices. Conceptually, we focus on two distinct, though interrelated, types of costs associated with road building and timber harvesting. One is resource loss: the reduction in the amount of timber that can be harvested in the future. The other is ecological: the destruction in species of both plants and animals. Our analysis, however, focuses only on the old-growth forests of the Pacific Northwest, thus precluding analysis of the loss of ecological services that may have been realized on vast areas of other U.S. forest lands, most of which are now managed and thus no longer in their original or old-growth state. We therefore believe our estimates of the loss of old-growth forests to be conservative. Future measurements should account for the value of sustainable or unsustainable timber capital that is under managed conditions outside of the Pacific Northwest as well as the economic losses of ecological services due to loss of forest ecosystem integrity and biodiversity.

Replacing complex, old-growth forests with monoculture tree farms creates the impression that the first cost can be easily managed. In fact, the net growing stock of softwoods in the United States has remained approximately constant since the 1950s, and the stock of hardwoods has increased (Powell et al. 1993, 50, table 12). (Softwood volume grew from 432 billion cubic feet in 1952 to 467 billion in 1977, then fell to 450 billion in 1992. The net stock of hardwoods has increased significantly from 1952 to 1992: from 185 billion to 336 billion cubic feet).

Yet the forests or tree farms that have replaced old-growth forests are not biologically equivalent. Tree farms are productive and profitable, at least for one or two rotations of the timber stock; but they do not support the range of wildlife that can be found in old-growth forests. In addition, commercial silviculture makes demands on soil that are not sustainable. In the Pacific Northwest, 80-year-rotation tree harvesting removes around 1000 pounds of nitrogen per acre from the soil, whereas old-growth forests tend to add 2,000 to 4,000 pounds of nitrogen per acre (Norse 1990). Thus, even when the accounts show an increase in total volume of wood, the living resource is likely to have been diminished.

Our estimate of nonmarket or environmental values is based largely on the changing stock of old-growth forest. Much of the debate over the amount of remaining old-growth forest hinges on definition. Old-growth forest in the Pacific Northwest has been defined by the U.S. Forest Service since 1986 as stands with at least 8 trees per acre over 200 years old or 32 inches in diameter, a specific density of conifer snags, and two or more tree species (Old-Growth Definition Task Group 1986; Morrison 1988). Some studies have used less restrictive definitions based entirely on the age of stands.

However, even the most restrictive definitions may understate the ecological losses from edge effects: ten isolated 100-acre stands have far less ecological value than a single 1,000-acre stand. As a result of such factors, any numerical estimate of loss will be imprecise.

The discrepancy in the definition of old-growth forest is epitomized by these two examples: The U.S. Forest Service estimates that of approximately 16.4 million acres in their Pacific Northwest (PNW) plan area, 52 percent are currently in a large-tree or old-growth condition. Their plan projects an increase to 73 percent over the long term.

In a second study, Bolsinger and Waddell (1993) estimate that old-growth forests in California, Oregon, and Washington cover about 10.3 million acres. Estimates were obtained for National Forests, national parks, state parks, state forests, Bureau of Land Management land, U.S. Fish and Wildlife Service land, Native American land, and private ownership. Oregon has almost half of the old-growth, with about 5 million acres in seven different ownerships. More than 80 percent of the old-growth is on federal land, primarily National Forests. Old-growth occupied about half of the forest area when the first comprehensive forest surveys were made in the 1930s and 1940s. The study concludes that fewer than 20 percent of the original forest area is now old-growth.

In order to estimate the cost of losing old-growth forests, we assume that the foregone benefits are directly related to the cumulative erosion of the ecosystems comprised by these forests. Although a few secondary forests in the Northeast, Midwest, or Southeast may have been regrowing long enough to qualify as old-growth, we have assumed that the remaining old-growth of consequence is limited to the Pacific Northwest. Furthermore, since most of the old-growth forest on private lands appears to have been cut by 1950, we focus exclusively on that remaining in National Forests.

From 1950 to 1997, we used rates of reduction of old-growth forests in the Pacific Northwest to estimate the additional cumulative cost of forest decline. This is based on the premise that the value of a diminishing resource for which there is increasing demand (in this case ecological amenities) increases at a growing rate as the supply declines. Each year, we added the loss of value to the cumulative loss up to that point because the erosion of ecological services from cutting an old-growth forest does not occur in the initial year alone, but over a period of decades.

The rate of decline we used was based on a graph showing the decline of habitat for the northern spotted owl on U.S. Forest Service land in Washington and Oregon outside of Wilderness Areas. The graph appears in Bart and Forsman 1992, 95–100. It is based on research that appears in D.R. Anderson et al. 1990. Since the graph continues only to 1986, we estimated the old-growth remaining in 1990 as 2 million acres. According to Morrison (1988) there were only 1.14 million acres of old growth in the six largest forests of the region in 1988. Of that amount, only 0.7 million acres were biologically uncompromised by roads or nearby clearcut edges. Thus, an estimate of 2 million acres remaining in 1990 is probably excessive, but since the definition used by Bart and Forsman was less rigorous than Morrison's, the 2 million-acre estimate is probably more in keeping with the rate of forest reduction in their study.

For 1991 to 1997, the rate of decline of old-growth forests from the 2.0 million assumed stock in 1990 is based on the growth rate of total roads in National Forests at 0.878 percent per year. This is a purely arbitrary projection given that no official U.S. Forest Service statistics exist for old-growth forests. The rate of depletion, while undoubtedly slowing, may indeed be higher than our extrapolations suggest. This extrapolation of course assumes that road construction is uniformly distributed across all National Forests, including old-growth forests. A more accurate picture would require road miles estimates for the Pacific Northwest region, which contains the majority of old-growth forest.

The initial cost of the ecological services lost due to accumulated loss of old-growth forest in 1950 is estimated at $42.6 billion (1992 dollars). In the 1995 GPI, we assumed that the ecological value of the remaining old growth in National Forests in 1950 (beyond their value for timber or pulp) was $1000 per acre in 1982 dollars; here that figure is converted to $1,419 per acre in 1992 dollars. We assume that their value increased by 5 percent per year until only 5 million acres remained in 1967; by 8 percent per year from 1968 to 1979; and by 10 percent per year from 1980 until the present. This reflects the increasing marginal value of old-growth forest as it declines. By 1994, an acre of old-growth forest is valued at $28,000 per acre (in 1992 dollars)—not as timber, but as a source of ecological and recreational values. By 1997, the estimated cost of old-growth forest loss is estimated at $78.2 billion, in 1992 dollars.

In addition to the loss of old-growth forests, the existence of roads in National Forests reduces the population of sensitive species that are affected by noise and traffic, erosion and sedimentation, and the increased presence of humans. These costs are especially pronounced during the construction period, but they persist to a lesser degree through the life of the road.

It might be argued that roads have nonmarket *benefits* because they increase access to forests. The evidence for this is the rise in visitor-days at various federal and state recreation areas, including National Forests. However, there is a certain irony in defining forest roads as a benefit in this respect. The elimination of most forests in the vicinity of urban areas over the past two centuries now forces urban dwellers to drive considerable distances to experience what at one time could have been enjoyed nearby. In some sense, recreational visits to the islands of "nature" in the midst of human artifacts have become another form of defensive expenditure to counteract the negative effects of urbanization. Thus, we have not treated those visits as a benefit.

The calculation of losses due to roads in the National Forests are based on the total stock of roads in any given year. A mile of forest road with a 60-foot right-of-way covers approximately 7 acres of land. If the impacts such as noise, edge effects, and runoff are included, a mile of road affects at least 500 acres of land. This provides a very rough estimate of the environmental costs because the damage caused by roads depends on many factors including age, location, slope, the quality of construction, and the frequency of maintenance. Nevertheless, even the best roads cause some continuing ecological disruption by breaking up the landscape, raising erosion levels, disturbing downstream fisheries, and generally increasing the level of human activity.

Estimates of total miles of forest roads are taken from the 1955, 1960, 1965, 1970, 1975, 1981, and 1992 *Report of the Forest Service.* Although data were available for other years, they vary considerably, which suggests changes in sampling methods. The method used here is to assume smooth growth between the Forest Service data points. For the period 1994 to 1997, statistics for the miles of roads in existence are from the *Report of the Forest Service* 1995, 1996, and 1997 (U.S. Forest Service various years).

In the 1995 GPI, we assume that the cost of damages to forests caused by roads from 1950 to 1959 is $10,000 per mile in 1982 dollars; that figure is here converted to 1992 dollars, or $14,194 per mile. From 1960 to 1979, the cost per mile is assumed to decline on a straight-line basis from $14,194 to $10,645 and to remain at $10,645 after that. We estimate the cost of ecological damage due to roads at $4 billion in 1997.

The GPI estimates for the loss of old-growth forest due to resource loss and ecological service losses is $82.2 billion in 1997.

COLUMN Y: NET CAPITAL INVESTMENT

For an economy to prosper over time, the supply of capital (buildings, machinery, and other infrastructure) must be maintained and increased to meet the demands of increased population. If this does not occur, the society is consuming its capital as income. Thus, one element of economic sustainability is constant or increasing quantities of capital available for each worker. The GPI calculates changes in the stock of capital (or net capital growth) by adding the amount of new capital stock (increases in net stock of private nonresidential fixed reproducible capital) and subtracting the capital requirement, which is the amount necessary to maintain the same level of capital per worker.

The aim of this column is to estimate increases in the stock of capital available per worker. The capital requirement is estimated by multiplying the percent change in the labor force by the stock of capital from the previous year. (This is analogous to creating an index number for the ratio of capital stock to the labor force with 1949 = 100.) A five-year rolling average of changes in labor force and capital is used to smooth out year to year fluctuations.

Estimates of capital stocks are available in the *Survey of Current Business* (BEA 1998c). Figures for 1996 and 1997 were not available at the time of the update, so we estimated those years based on the change from 1989 to 1995—a rate of increase of 1.90 percent per year. The size of the labor force comes from the *Economic Report of the President* (CEA 1998), which uses the estimates of the U.S. Bureau of Labor Statistics.

The GPI considers the(or net capital growth) available to workers or households as a positive adjustment in the GPI account. In 1997 the net capital stock or growth was $44.3 billion representing a slight improvement over 1996 levels of $41.3 billion. However, net capital stock has been declining since its peak in 1985 at $85.8 billion (see figure14).

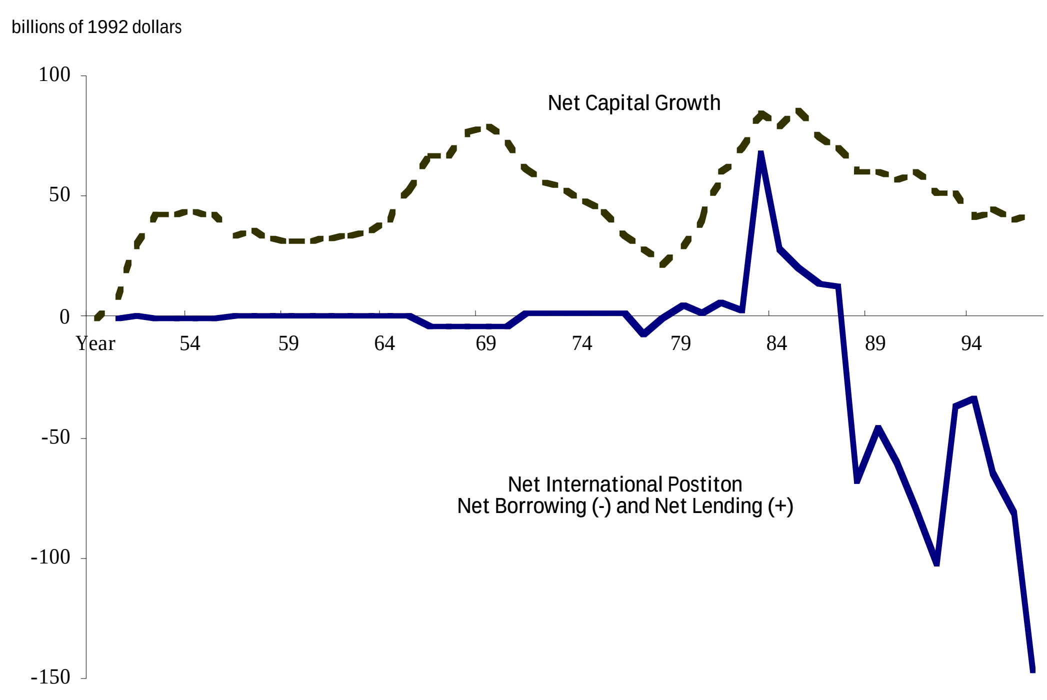
COLUMN Z: NET FOREIGN LENDING OR BORROWING

The economic sustainability of a nation is also affected by the extent to which it relies on foreign funding to finance its current consumption. A nation that borrows from abroad to pay for a spending spree will feel rich for a short time. But the illusion of wealth will vanish when the debt comes due or when the value of the currency drops as foreign investors lose confidence in that nation's ability to repay its loans.

The U.S. net international position measures the amount that Americans invest overseas minus the amount foreigners invest in the United States. The annual change in the net international position indicates whether the U.S. is moving in the direction of net lending (if positive) or net borrowing (if negative). If the change is positive, the U.S. has in effect increased its capital assets. If it is negative, part of U.S. capital formation is in fact based on wealth borrowed from foreign interests that must eventually be repaid with interest. We have thus included annual changes in the net international position as a measure of the long-term viability of our economy.

The interaction of net capital investment (column Y) and net foreign lending or borrowing (column Z) measures the net borrowing to finance current consumption. If net borrowing in column Z exceeds net capital formation in column Y, then borrowing from overseas is for consumption purposes. If borrowed money is used for investment purposes, the negative effects of borrowing are neutralized by the positive effects of investment; but if the borrowed money is used for consumption, that causes the GPI to decline.

FIGURE 14: ELEMENTS OF ECONOMIC SUSTAINABILITY



The premise is that a household cannot live forever on borrowed income, so borrowed income should be subtracted from current spending to derive the sustainable level of expenditure. A household can actually borrow year after year in a growing economy and never cut into current consumption to pay off the loans.

As the United States went deeper into debt in the 1980s and its net international investment position deteriorated, Robert Eisner and other economists criticized the method of calculating this measure. They pointed out that by valuing American assets held abroad at their historic purchase price rather than current market value, the methodology underestimated the net U.S. position. (American assets overseas are older and thus more likely to be undervalued than foreign-owned assets in the U.S. that generally have been acquired more recently.)

For 1983 to 1997, the Bureau of Economic Analysis (BEA) has developed estimates of the net international position with assets at market value, which provides a more useful estimate of net investment than historic cost estimates (BEA 1998c; BEA 1998e; and CEA 1998). We use these new statistics for the period 1983 to 1997. For the period 1950 to 1982, we use the BEA's historic cost estimates (taken from *Statistical Abstract* [1988, 758, table 1330]) for net international position; however, the difference between historic costs and market value are small and would not have altered the net international position substantially. The BEA periodically updates and revises historical net international investment figures, with the latest revisions for the period 1983 to 1997 showing significant changes compared to the figures used in the 1995 GPI account. The BEA publishes these statistics annually, but they also modify estimates for previous years, so it is very difficult to maintain a consistent time series.

The annual figures for the U.S. net international investment position (market value) show a rapid deterioration through the 1980s and 1990s (see figure13). From a net lending position of $349 billion (1992 dollars) in 1983, the U.S. net international position in 1997 had slipped to a net borrowing position of -$1,185 billion, in 1992 constant dollars.

As with the estimates of net capital investment, we adjust the annual net international position values for inflation and then use a five-year rolling average of these values to smooth out year-to-year fluctuations. This tends to dampen the impact of the actual and sometimes extreme annual net international positions. For example, the GPI account for 1997 shows a -$146.1 billion net borrowing position (using a five-year rolling average) compared with the 1997 actual figure of -$1,185 billion.

COLUMN AA: THE GENUINE PROGRESS INDICATOR (GPI)

The Genuine Progress Indicator (GPI) starts with personal consumption adjusted for income inequality (column C), adds four columns (D through G), subtracts seventeen columns (H through X), and adds two columns (Y and Z). The result is a more honest account of the genuine economic progress of the U.S. economy (the state of the households of the nation) by accounting for the value of a number of elements that represent social and ecological costs or benefits. While incomplete, the GPI demonstrates the value of services derived from real wealth and assets that one could argue are more meaningful in defining the well-being of the nation's households than the GDP account. The GPI accounting exercise demonstrates the complexity of accounting for real wealth. If as many economists and statisticians were devoted to this more complete accounting of the state of the economy, we might be empowered with better information to manage more prudently the households and state of the nation.

COLUMN AB: PER CAPITA GPI

Per capita GPI is calculated by dividing the GPI by the population (from CEA 1998).

COLUMN AC: GROSS DOMESTIC PRODUCT (GDP)

The value of the GDP comes from the *Economic Report of the President* (CEA 1998).

COLUMN AD: PER CAPITA GDP

Per capita GDP is the GDP divided by the population.

TABLE 1: THE GPI DATA BY COLUMN

Year	Personal Consumption	Income Distribution	Personal Consumption Adjusted for Income Inequality	Value of Household Work & Parenting	Value of Volunteer Work	Services of Household Capital	Services of Highways & Streets	Cost of Crime	Cost of Family Breakdown
	A	B	C (A / B)	D (+)	E (+)	F (+)	G (+)	H (-)	I (-)
1950	1,034.1	108.0	957.8	604.6	21.9	61.2	29.8	8.1	15.0
1951	1,049.2	103.6	1,012.8	608.8	22.0	64.2	31.4	8.4	15.1
1952	1,082.4	105.0	1,030.5	652.8	22.0	67.7	32.6	8.7	15.4
1953	1,135.0	102.5	1,107.0	694.8	22.1	73.1	29.6	8.9	15.7
1954	1,158.9	106.1	1,092.5	733.7	22.2	76.5	30.2	9.2	15.8
1955	1,242.6	103.8	1,196.6	760.6	22.3	82.4	32.1	9.5	16.0
1956	1,278.2	102.4	1,247.9	771.4	22.3	86.4	35.0	9.8	17.6
1957	1,308.2	100.5	1,302.1	784.9	22.4	88.5	34.5	10.1	19.3
1958	1,318.8	101.3	1,301.5	797.3	22.5	88.9	36.1	10.5	21.3
1959	1,394.6	103.4	1,349.1	826.2	22.6	90.8	36.4	10.8	24.3
1960	1,432.6	104.2	1,374.3	877.5	22.6	93.8	37.5	11.2	26.7
1961	1,461.5	107.2	1,363.5	899.0	22.7	95.0	39.2	11.6	28.1
1962	1,533.8	103.9	1,476.9	917.8	22.8	97.7	41.6	11.9	29.0
1963	1,596.6	103.9	1,537.4	941.9	22.9	102.7	43.8	12.4	30.2
1964	1,692.3	103.6	1,634.0	980.9	23.0	107.8	45.0	12.8	31.7
1965	1,799.1	102.2	1,761.2	1,028.4	23.0	115.2	47.9	13.2	32.9
1966	1,902.0	100.2	1,898.5	1,057.5	26.5	126.5	51.2	13.7	34.1
1967	1,958.6	102.8	1,904.6	1,088.8	30.5	136.2	53.9	14.2	35.3
1968	2,070.2	100.0	2,070.2	1,154.7	35.1	146.7	55.2	14.7	37.2
1969	2,147.5	100.8	2,131.0	1,177.8	40.4	155.4	58.7	15.4	38.9
1970	2,197.8	101.5	2,164.3	1,222.7	46.5	163.9	63.5	16.0	40.4
1971	2,279.5	102.1	2,233.4	1,243.6	53.4	168.3	63.0	16.6	42.1
1972	2,415.9	103.4	2,337.6	1,270.8	61.5	180.5	63.9	17.1	43.9
1973	2,532.6	102.3	2,475.2	1,286.8	70.8	197.0	70.1	17.8	45.4
1974	2,514.7	101.8	2,470.1	1,293.1	81.4	213.6	84.4	18.6	46.5
1975	2,570.0	102.3	2,511.7	1,303.3	81.7	215.6	76.0	19.4	47.6
1976	2,714.3	102.6	2,646.1	1,446.6	82.0	224.3	70.7	20.1	48.6
1977	2,829.8	103.6	2,731.2	1,480.7	82.3	238.4	67.1	20.8	49.1
1978	2,951.6	103.6	2,848.8	1,496.1	82.5	255.1	66.5	21.5	50.6
1979	3,020.2	104.1	2,900.6	1,515.0	82.8	268.7	70.6	22.7	52.1
1980	3,009.7	103.9	2,897.7	1,521.1	83.1	273.4	76.8	23.9	52.8
1981	3,046.4	104.6	2,911.3	1,539.0	83.4	275.6	80.2	24.0	53.7
1982	3,081.5	106.2	2,902.0	1,558.7	83.7	275.7	78.5	24.4	53.2
1983	3,240.6	106.7	3,037.1	1,578.7	83.9	286.3	72.8	24.6	53.5
1984	3,407.6	107.0	3,185.9	1,598.9	84.2	303.7	69.1	25.2	54.1
1985	3,566.5	108.0	3,302.6	1,619.4	84.5	324.3	70.0	25.9	55.0
1986	3,708.7	109.5	3,385.8	1,640.1	84.8	351.7	74.1	26.2	54.7
1987	3,822.3	109.8	3,481.3	1,661.1	85.1	370.2	76.6	26.8	54.4
1988	3,972.7	110.1	3,609.9	1,682.4	85.4	395.9	76.1	27.3	54.6
1989	4,064.6	111.1	3,659.1	1,704.0	85.7	416.4	76.8	28.1	54.5
1990	4,132.2	110.3	3,746.0	1,725.8	84.5	434.7	77.4	28.6	54.8
1991	4,105.8	110.3	3,722.1	1,747.9	83.3	441.8	76.5	28.9	55.7
1992	4,219.8	111.9	3,772.5	1,770.3	82.7	451.1	76.4	29.2	57.0
1993	4,343.6	117.0	3,712.2	1,793.0	82.1	468.6	77.5	29.7	57.3
1994	4,486.0	117.5	3,817.0	1,815.9	84.3	485.1	81.1	30.9	58.3
1995	4,605.6	116.0	3,971.1	1,839.2	86.4	502.6	84.5	29.8	58.9
1996	4,752.4	117.3	4,052.6	1,862.7	87.1	526.9	86.9	29.0	58.0
1997	4,913.5	118.3	4,153.5	1,886.6	87.7	557.1	90.0	28.4	58.8

(all figures are in billions of inflation adjusted (1992) chained dollars, except column B (index number) and columns AB and AD (dollars, not billions of dollars)

TABLE 1: THE GPI DATA BY COLUMN (continued)

Year	Loss of Leisure Time	Cost of Under-employment	Cost of Consumer Durables	Cost of Commuting	Cost Household Pollution Abatement	Cost of Automobile Accidents	Cost of Water Pollution	Cost of Air Pollution	Cost of Noise Pollution	Loss of Wetlands	Loss of Farmland
	J (-)	K (-)	L (-)	M (-)	N (-)	O (-)	P (-)	Q (-)	R (-)	S (-)	T (-)
1950	10.1	13.3	84.8	115.2	0.0	23.7	21.2	64.8	6.1	44.6	21.1
1951	9.5	14.2	77.0	115.2	0.0	27.5	21.7	65.4	6.3	45.6	23.0
1952	9.0	15.2	74.9	114.9	0.0	27.3	22.3	66.1	6.5	46.6	24.9
1953	8.6	16.2	84.6	119.3	0.1	29.6	28.8	66.7	6.7	47.8	26.9
1954	8.1	17.4	84.6	117.5	0.1	29.3	29.5	67.4	6.9	49.0	28.8
1955	7.7	18.6	103.2	124.5	0.1	30.3	30.2	68.1	7.1	50.4	30.8
1956	7.3	19.8	98.6	125.3	0.2	30.3	31.0	68.8	7.4	51.9	32.8
1957	6.8	21.2	98.9	126.1	0.3	29.4	31.7	69.5	7.6	53.6	34.9
1958	6.3	22.7	90.9	122.4	0.4	28.5	32.5	70.2	7.8	55.4	36.9
1959	5.8	24.2	103.2	127.4	0.5	28.3	33.4	70.9	8.1	57.3	39.0
1960	5.3	25.9	105.1	130.8	0.7	29.5	34.2	71.6	8.3	59.4	41.1
1961	4.8	27.6	101.3	129.6	1.1	29.6	35.1	72.3	8.6	61.7	43.2
1962	4.2	29.5	113.1	133.5	1.5	31.5	35.9	74.1	8.8	64.2	45.3
1963	3.6	31.6	124.0	137.1	1.7	33.3	36.9	75.9	9.1	66.9	47.5
1964	3.1	33.7	135.6	140.7	1.9	35.9	37.8	77.8	9.4	69.9	49.6
1965	2.5	36.1	152.8	147.2	2.1	39.8	38.8	79.7	9.7	73.0	51.8
1966	1.9	38.5	165.6	151.8	2.3	42.5	39.8	81.7	10.0	76.4	54.1
1967	1.3	41.2	168.1	155.4	2.6	44.5	40.8	83.7	10.3	80.1	56.3
1968	0.7	44.0	186.7	160.8	2.9	46.6	41.8	85.7	10.6	84.1	58.6
1969	-	47.0	193.2	166.4	3.2	53.2	42.9	87.8	10.9	88.4	60.9
1970	2.3	50.1	187.1	167.2	3.6	60.3	44.0	90.0	11.3	93.0	63.2
1971	4.8	53.3	205.7	173.2	4.0	62.1	45.2	87.3	11.6	97.9	65.6
1972	7.3	56.7	231.9	182.7	4.2	69.8	46.4	84.7	12.0	103.2	67.9
1973	9.9	60.4	255.7	191.4	5.4	73.5	47.6	82.1	12.1	109.0	70.3
1974	26.3	64.2	238.2	192.1	5.4	69.1	48.8	79.7	12.2	115.1	72.7
1975	43.0	68.4	238.2	190.9	7.0	75.1	50.1	72.8	12.3	121.7	75.1
1976	60.4	72.8	268.6	203.1	7.8	78.6	50.1	75.0	12.5	128.8	77.4
1977	78.6	77.4	293.4	215.3	8.5	84.4	50.1	76.0	12.6	135.2	79.8
1978	97.8	82.4	308.8	226.2	8.9	89.1	50.1	74.6	12.7	142.0	82.2
1979	117.2	87.7	307.2	235.3	8.4	88.9	50.1	74.4	12.8	149.3	84.6
1980	122.7	93.3	282.6	236.9	8.3	83.7	50.1	73.4	13.0	157.0	87.0
1981	127.9	99.3	285.8	242.4	9.5	79.9	50.1	69.3	13.1	165.3	89.4
1982	133.1	105.7	285.5	240.3	9.6	78.4	50.1	64.0	13.2	174.1	91.8
1983	138.1	112.5	327.3	249.8	11.2	79.2	50.1	63.3	13.4	183.4	94.2
1984	144.1	119.8	374.9	265.4	12.5	85.0	50.1	65.5	13.5	193.4	96.5
1985	150.1	127.5	411.5	276.8	13.5	91.4	50.1	63.6	13.6	204.1	98.9
1986	156.8	135.6	448.4	282.4	14.7	93.5	50.1	65.3	13.8	213.4	101.3
1987	163.3	144.4	455.0	290.3	12.7	95.2	50.1	61.1	13.9	223.3	103.6
1988	169.5	153.6	483.5	300.6	13.7	98.4	50.1	70.8	14.0	233.8	106.0
1989	176.7	163.5	496.2	311.7	11.8	100.9	50.1	67.2	14.2	244.8	108.4
1990	184.6	165.7	493.3	319.7	9.7	102.2	50.1	58.1	14.3	256.5	110.8
1991	192.0	167.4	461.9	312.4	7.6	96.6	50.1	57.4	14.5	268.9	113.2
1992	201.4	170.6	488.5	320.4	7.9	98.1	50.1	57.6	14.6	281.9	115.6
1993	209.9	173.1	523.8	330.1	8.1	100.7	50.1	57.1	14.8	295.8	118.0
1994	227.6	140.1	561.2	342.4	9.2	103.0	50.1	58.1	14.9	310.4	120.4
1995	238.7	132.3	589.1	350.9	9.8	104.4	50.1	53.1	15.0	325.8	122.8
1996	249.8	129.6	626.1	362.1	10.4	105.9	50.1	54.7	15.2	337.6	125.3
1997	263.6	122.3	668.6	374.5	11.1	120.5	50.1	54.2	15.3	349.9	127.8

(all figures are in billions of inflation adjusted (1992) chained dollars, except column B (index number) and columns AB and AD (dollars, not billions of dollars)

TABLE 1: THE GPI DATA BY COLUMN (continued)

Year	Loss of Farmland	Depletion of Nonrenewable Resources	Long-term Environmental Damage	Cost of Ozone Depletion	Loss of Old-Growth Forests	Net Capital Investment	Net Foreign Lending or Borrowing	Genuine Progress Indicator (GPI)	Per Capita GPI	Real Gross Domestic Product (GDP)	Per Capita GDP
	T (-)	U (-)	V (-)	W (-)	X (-)	Y (+)	Z (+)	AA(+)	AB(sum)	AC	AD
1950	21.1	153.7	244.7	3.3	44.0	8.4	0.0	810.0	5,319.4	1,611.3	10,581.8
1951	23.0	174.2	253.6	4.0	44.1	31.3	0.5	866.0	5,591.3	1,734.0	11,195.9
1952	24.9	175.5	262.5	4.8	44.2	42.8	-	929.5	5,899.9	1,798.7	11,416.5
1953	26.9	182.8	271.6	5.7	44.3	43.5	-	1,005.8	6,279.0	1,881.4	11,745.2
1954	28.8	180.0	280.4	6.8	44.4	44.2	0.1	1,024.0	6,281.4	1,868.2	11,459.5
1955	30.8	205.4	290.1	8.1	44.5	42.7	0.1	1,092.2	6,582.3	2,001.1	12,059.8
1956	32.8	225.4	300.3	9.6	44.6	34.6	1.3	1,118.2	6,620.1	2,040.2	12,079.1
1957	34.9	234.5	310.4	11.3	44.8	35.9	1.3	1,159.1	6,739.8	2,078.5	12,085.4
1958	36.9	224.2	320.5	12.9	44.9	32.7	1.2	1,172.1	6,702.1	2,057.5	11,765.1
1959	39.0	242.4	331.1	14.7	45.1	32.0	1.2	1,191.8	6,701.7	2,210.2	12,428.7
1960	41.1	255.2	342.1	17.0	45.2	31.9	1.2	1,229.4	6,804.8	2,262.9	12,525.0
1961	43.2	266.1	353.2	19.6	45.6	33.3	1.4	1,215.1	6,615.1	2,314.3	12,598.9
1962	45.3	284.1	364.9	22.7	46.0	34.1	1.5	1,292.1	6,926.5	2,454.8	13,159.8
1963	47.5	309.1	377.0	26.4	46.3	36.8	1.5	1,318.0	6,964.8	2,559.4	13,524.5
1964	49.6	331.4	389.7	30.7	46.7	40.9	1.5	1,394.7	7,268.1	2,708.4	14,114.4
1965	51.8	352.4	402.9	35.5	47.2	53.3	1.4	1,513.0	7,786.9	2,881.1	14,827.9
1966	54.1	385.0	416.8	40.9	47.6	67.3	(3.3)	1,621.6	8,250.0	3,069.2	15,614.6
1967	56.3	417.4	431.3	47.1	48.0	67.9	(3.3)	1,601.3	8,058.3	3,147.2	15,838.0
1968	58.6	444.7	446.5	53.9	48.4	77.2	(3.3)	1,767.8	8,807.9	3,293.9	16,411.6
1969	60.9	475.2	462.6	61.8	48.9	80.2	(3.2)	1,783.5	8,799.9	3,393.6	16,743.9
1970	63.2	515.8	479.3	69.2	49.3	72.8	(3.1)	1,788.3	8,721.2	3,397.6	16,569.5
1971	65.6	523.1	496.3	79.5	49.9	62.0	2.5	1,808.2	8,707.3	3,510.0	16,902.5
1972	67.9	549.1	514.2	90.0	50.6	56.6	2.3	1,841.6	8,773.9	3,702.3	17,638.7
1973	70.3	562.6	532.8	101.8	51.2	53.4	2.2	1,926.5	9,091.2	3,916.3	18,481.0
1974	72.7	564.8	551.0	114.2	52.0	49.0	2.1	1,922.8	8,991.2	3,891.2	18,195.6
1975	75.1	572.4	568.7	124.8	52.7	44.3	1.9	1,894.2	8,770.7	3,873.9	17,937.0
1976	77.4	592.2	587.3	136.3	53.6	34.6	2.3	2,033.3	9,325.8	4,082.9	18,725.9
1977	79.8	621.0	606.4	147.0	54.5	28.9	(6.5)	2,012.2	9,136.5	4,273.6	19,404.4
1978	82.2	643.4	626.0	157.4	55.5	22.4	(0.5)	2,041.5	9,171.6	4,503.0	20,230.5
1979	84.6	694.0	645.8	167.2	56.5	29.2	5.0	2,017.4	8,963.8	4,630.6	20,575.4
1980	87.0	726.8	664.8	177.0	57.7	40.7	2.3	1,984.0	8,731.6	4,615.0	20,310.3
1981	89.4	746.7	683.4	186.7	59.0	60.2	6.3	1,970.4	8,586.8	4,720.7	20,572.5
1982	91.8	758.0	701.1	195.9	60.4	71.2	3.4	1,934.2	8,349.1	4,620.3	19,944.0
1983	94.2	743.1	718.8	205.8	62.0	85.6	68.5	2,082.5	8,907.3	4,803.7	20,546.9
1984	96.5	829.7	737.4	216.4	63.7	80.1	28.1	2,002.6	8,492.0	5,140.1	21,796.2
1985	98.9	845.6	756.0	227.1	65.6	85.8	20.3	2,030.9	8,535.8	5,323.5	22,374.8
1986	101.3	862.7	774.6	238.5	67.6	75.0	13.9	2,025.8	8,436.3	5,487.7	22,852.8
1987	103.6	904.3	793.9	250.8	69.8	70.7	12.9	2,045.0	8,440.4	5,649.5	23,317.2
1988	106.0	954.2	814.0	263.0	72.3	60.5	(67.8)	1,962.9	8,028.3	5,865.2	23,988.6
1989	108.4	976.8	834.4	273.4	75.0	61.1	(45.8)	1,969.4	7,979.1	6,062.0	24,560.5
1990	110.8	1,030.7	855.4	280.5	78.0	57.8	(59.8)	1,973.2	7,910.6	6,136.3	24,600.3
1991	113.2	1,056.2	876.5	287.2	78.5	61.2	(78.5)	1,929.1	7,651.4	6,079.4	24,112.7
1992	115.6	1,083.8	897.9	293.3	79.1	51.7	(102.7)	1,855.0	7,274.5	6,244.4	24,487.7
1993	118.0	1,082.7	919.8	298.8	79.7	51.7	(37.2)	1,798.4	6,977.3	6,389.6	24,789.6
1994	120.4	1,160.5	942.1	303.3	80.2	42.0	(33.4)	1,779.2	6,835.3	6,610.7	25,397.2
1995	122.8	1,192.4	964.9	305.1	80.8	45.3	(64.3)	1,840.7	7,005.1	6,761.7	25,733.3
1996	125.3	1,243.0	988.4	306.2	81.5	41.3	(81.7)	1,802.9	6,798.7	6,994.8	26,377.7
1997	127.8	1,281.6	1,012.0	306.9	82.2	44.3	(146.1)	1,745.3	6,521.1	7,269.8	27,163.0

(all figures are in billions of inflation adjusted (1992) chained dollars, except column B (index number) and columns AB and AD (dollars, not billions of dollars)

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