Environmental Regulations and the Housing Market: A Review of the Literature

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Abstract

Environmental regulations in the United States are intended to improve the quality of the environment; preserve ecosystems, including wildlife; and protect human health. This article considers the impact of regulations such as the Clean Air Act Amendments; the Clean Water Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Endangered Species Act; the National Environmental Policy Act; and state and local regulations (including "smart growth" controls) on the U.S. housing market. The extent of the impacts could be measured by looking at changes in house prices and the quantity of housing available.

Whether or not environmental regulations are placed directly on the suppliers of housing, it is possible that these regulations will have an impact on the housing market. Environmental laws can impact the supply of land, a key input in the production of housing. Laws can also change the prices of other inputs into the construction of housing (for example, lumber) and can affect the supply of housing in that way. Laws can impact the supply of housing if they increase the amount of time necessary to build housing units or if they increase the possibility of litigation faced by housing developers. On the other hand, if the regulations are effective, they can impact the demand for housing by changing the quality of available housing. All these effects can lead to changes in both the price and the quantity of housing in the market.

The academic literature has focused on the increase in the demand for housing due to improvements in environmental quality. Very few studies attempt to estimate the impact on the supply of land or housing. Some researchers examine the issue by interviewing developers and public officials and asking for estimates of cost impacts (for example, James and Muller, 1977). Others use statistical techniques to control for factors that impact sales prices so that the effect of the regulations can be more clearly seen (for example, Frech and Lafferty, 1984). Generally, these studies find that regulations restricting possible uses of undeveloped land lead to decreases in the prices of that land (for example, Guttery, Poe, and Sirmans, 2000), and land near restricted areas can increase in value due to increased demand (for example, Beaton and Pollock, 1992).

To better understand the impact of environmental regulations on the housing market, research must be extended in several directions. Studies that use statistical techniques to examine the housing market both before and after regulations are put in place are necessary. Although the data requirements of such studies are large, the results will estimate the extent of the increase in prices due solely to the regulations. If policy analysts want to know whether the increase is due to a decrease in housing supply, an increase in housing demand, or a combination of the two, the results from such studies can be used in a "second stage" estimation of separate housing supply and demand equations.

Research also needs to estimate the amount of land removed from the housing market due to environmental restrictions. Landis (2001) has undertaken such a study in California; his work should be extended to other areas. He demonstrated the importance of estimating how much of the land that is removed would be "developable," as well as how the removal impacts the ability of the area under study to grow.

Finally, research should examine the general equilibrium impacts of environmental laws on all markets because the housing market also is affected by the labor market. Riddel (2001) estimated this type of model and showed that open space purchases in Colorado increased the demand for housing by more than they reduced the supply of housing.

If regulations lead to increases in housing prices that make housing unaffordable, the next step would be to consider how to make the regulations less costly or how to subsidize those most affected by the price increases.

Introduction

Environmental regulations in the United States are intended to improve the quality of the environment; preserve ecosystems, including wildlife; and protect human health. These regulations are often written without considering how much they will cost; some regulations are explicitly required to ignore costs. In evaluating current regulations as well as future laws, both the costs and the benefits must be considered. Only in this way can careful decisions be made on which regulations will be enacted and enforced. A decision may be made to ignore the costs, but in doing so, decisionmakers must be mindful of what is being sacrificed as well as what is being gained.

Some environmental regulations impact the housing market by affecting the supply of developable land or by restricting its use. Other environmental regulations focus not on the land market but rather on polluters such as factories, utility plants, and automobiles. Polluters may, however, attempt to pass the costs placed on them to other consumers, including housing developers and landowners. Thus, environmental regulations can impact the cost of supplying housing.

Because environmental regulations can be local in nature, homeowners often will experience the benefits. Thus, researchers often examine changes in the price of housing due to regulations and then use those changes to quantify the benefits received. One can see that increases in the price of housing can be due to decreases in supply and/or increases in demand for housing. The literature has yet to separate those two impacts in a way that the increases due to changes in supply of housing can be measured separately from those due to changes in demand for housing.

This article surveys environmental regulations in the United States with a particular focus on how the housing market is impacted. It first looks at the current regulations, then at the theoretical impact of the regulations on the housing market, and next at empirical studies that attempt to quantify the impact. After a discussion of what the literature examines, the following sections look at the gaps in the literature, and then make some proposals about how future research could be directed for a clearer understanding of the overall impact of regulations on the housing market.

Environmental Regulations in the United States

Federal regulations intended to improve the quality of the environment began in the United States with the Rivers and Harbor Act of 1899. This law forbade the dumping of refuse into any navigable water in the United States. Other laws have followed, especially since the U.S. Environmental Protection Agency (EPA) was created in 1970. State and local governments also have passed laws that regulate the use of air, water, wildlife, and other natural resources.

Environmental regulations in the United States generally focus on a single media, such as air or water. The EPA typically oversees federal regulations, although other agencies, such as the U.S. Army Corps of Engineers (Corps), also can be responsible. The overarching goal of these regulations is to protect the health and well-being of individuals as well as plants and animals.

The quality of air in the United States is the focus of the Clean Air Act (CAA) of 1970, which was most recently amended in 1990 by the Clean Air Act Amendments (CAAA). The goal of the CAA and its amendments is to ensure that the National Ambient Air Quality Standards are met. These standards are set to protect the health of all individuals in the United States. The CAAA control the amount of pollution emitted by both stationary and mobile sources, with an estimated 27,000 stationary sources of air and more than 200 million mobile sources (Tietenberg, 2001). Currently, the regulations typically work through command and control policies, such as requirements on the quantity of emissions from automobiles. Some regulations, however, do allow for more market-based regulations, such as emissions permits in the case of certain pollutants in certain areas (for example, sulfur dioxide trading programs). The regulations are believed to have been effective in reducing air pollution in the United States because air quality has generally improved since 1970 (see exhibits 1-4).

Water pollution is controlled under the Clean Water Act (CWA) of 1972 and the reauthorizations of that act in 1977 and 1987. The three main goals of the CWA are as follows:

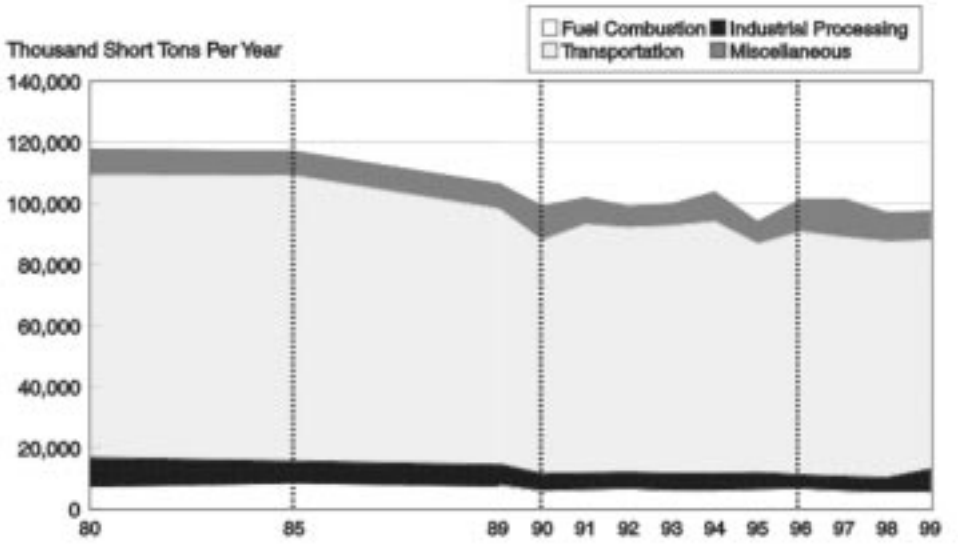
- Elimination of pollution discharges into all navigable waters.
- Ability of all surface waters to be able to support recreational activities.
- Elimination of the discharge of toxic pollutants into water.

These goals are typically met by effluent limitations on identifiable sources and the funding of the construction of publicly owned water treatment plants. It is estimated that more than 60,000 sources of effluent are regulated (Tietenberg, 2001). Water quality has generally improved in the United States since the 1970s, even though the regulation of nonpoint sources has not been stressed.

Drinking water in the United States is legislated by the Safe Drinking Water Act in 1974 and its 1977, 1986, and 1996 amendments, which set standards for the quality of drinking water. The amendments also include funds to help states and localities maintain the quality of their local water purification and testing infrastructure.

Exhibit 1

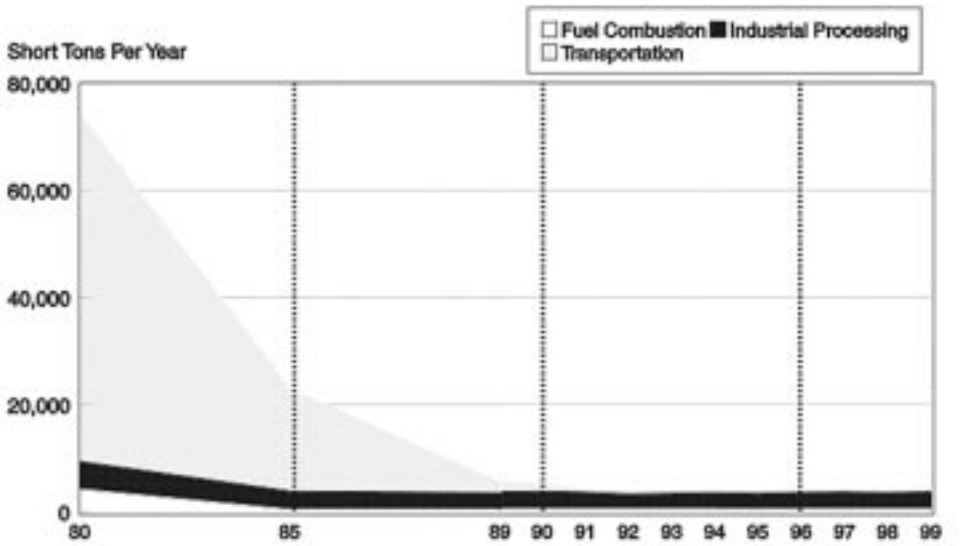
National Total Carbon Monoxide Emissions, 1980–99



Source: U.S. Environmental Protection Agency, 2001a: 14

Exhibit 2

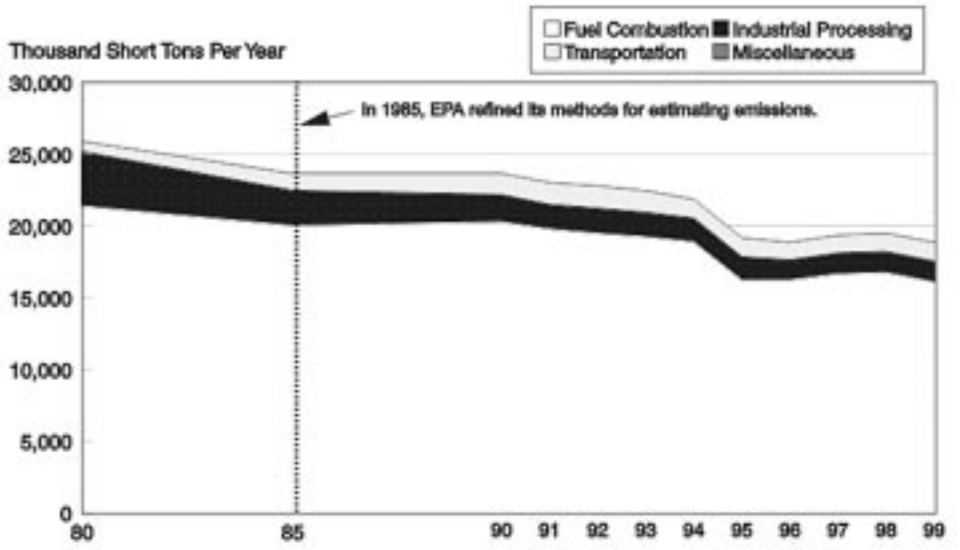
National Total Lead Emissions Trend, 1980–99



Source: U.S. Environmental Protection Agency, 2001a: 20

Exhibit 3

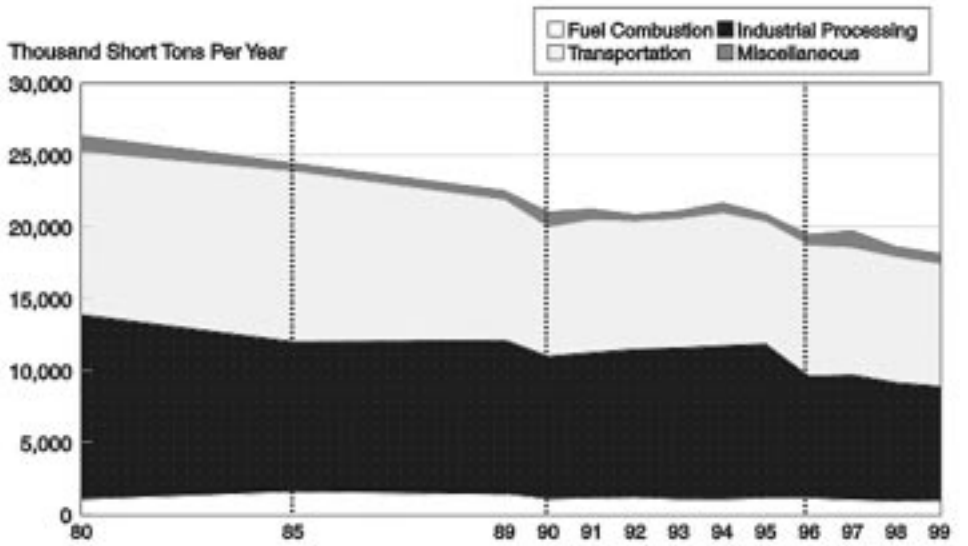
National Total Sodium Dioxide Emissions Trend, 1980–99



Source: U.S. Environmental Protection Agency, 2001b: 63

Exhibit 4

Trend in National Total Anthropogenic VOC Emissions, 1980–99



Source: U.S. Environmental Protection Agency, 2001a: 36

The federal government regulates wetlands in the United States in an effort to preserve them as much as possible. The EPA and the Corps, under the Clean Water Act, enforce these regulations. The CWA requires landowners to receive permission from the Corps before conducting dredging or filling activities on any land defined as a "wetland" or other water of the United States. States and localities can have stricter requirements on landowners in this aspect, and many do. Before issuing a permit, landowners can be required to submit their land to an environmental review to determine the impact on the local area and its habitats if the wetlands were to be altered. Under wetlands regulations, more than human health and well-being are taken into account; the ecosystem, including fish and wildlife, also must be considered (Guttery, Poe, and Sirmans, 2000). The regulations have been successful in slowing the draining of wetlands.

> According to a report issued by the National Wetland Inventory (*Status and Trends of Wetlands in the Conterminous United States 1986 to 1997*, U.S. Fish and Wildlife Service), the rate of wetland loss in the United States has decreased to an estimated annual loss of 58,500 acres (an 80 percent reduction compared to the previous decade). The Natural Resource Conservation Service's Natural Resource Inventory (NRI), reporting on the health of America's private lands, also shows significant reduction in wetland losses. The NRI found an average annual net loss of 32,600 acres of wetlands on nonfederal lands from 1992 to 1997 (a 58 percent reduction compared to the previous decade) (EPA, 2000: 45).

Environmental laws directed toward hazardous waste sites focus on cleaning the sites and getting the responsible parties to pay for the cleaning. The federal regulations governing hazardous waste site cleaning and payment for this are included in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. These laws are meant to reduce the risk to humans from improperly disposed-of toxic substances. Brownfields sites are properties "the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (EPA, "Brownfields," n.d.). Some states have changed the legal liability assumed by purchasers of such property in an effort to increase the development of such sites, especially in urban areas.

Current federal regulations on air and water quality focus primarily on human health. The Endangered Species Act (ESA) of 1973 was enacted to protect the biodiversity of the United States by identifying plants and animals at risk of becoming extinct and then requiring that their ecosystems be protected. The ESA does not allow considering the costs of protecting the ecosystem; if a species is at risk, it must be protected. At least 600 species have been identified as endangered or threatened under the ESA, ranging from the Florida manatee to the black lace cactus (EPA, "Endangered Species," n.d.).

The National Environmental Policy Act (NEPA) of 1969 requires that all federal public policy proposals be assessed for environmental impact, regardless of the agency that is evaluating the program. In 1997, 498 Environmental Impact Statements were completed by the agencies and departments of the U.S. government (Callan and Thomas, 2004). Many states have similar legislation to oversee the environmental impacts of state-level laws. The federal agency that most directly impacts housing is the U.S. Department of Housing and Urban Development (HUD), but other agencies also can affect development (Braconi, 1996). Because state agencies are often called on to administer federal programs, the requirement to assess the impact of a proposed policy on the local environment can filter down to the state level.

The Coastal Zone Management Act of 1972 (CZMA) is not generally thought of as an environmental regulation. Administered by the National Oceanic and Atmospheric

Administration, CZMA is intended to provide a means for states and localities to manage their coastal areas. Some states, such as New Jersey and California, have used the law to restrict or regulate development in their coastal areas in an effort to manage that particular environment (Frech and Lafferty, 1984).

States and localities also enact environmental legislation, some of which has been mentioned above.[1] For example, Washington state allows city and county governments to declare areas "environmentally sensitive," which makes development in the area subject to agency reviews (see Steiner, 2001, for a discussion). New York City requires an "analysis of the environmental impacts of all privately sponsored projects that need discretionary approvals from a government agency" (Salama, Shill, and Stark, n.d.: 49). Such laws can lead to delays and increase the uncertainty about the ability of developers to successfully complete a project. If such delays are anticipated, any expected costs will be capitalized into the price of the land, thus lowering the price of the land.

Although urban growth controls are not inherently environmental regulations, some are designed to enhance the quality of life of an area, and thus include requirements on open space; other controls are intended to decrease the amount of traffic in an area. Therefore, such controls may have environmental goals included in them. Currently, the term *smart growth* is used to encompass urban growth controls and the "prevention of urban sprawl, integration of transportation and land use plans, provision of affordable housing, protection of open space and timely and efficient provision of urban infrastructure" (Knaap, 2001: xi). Some 73 metropolitan areas have used urban growth boundaries to try to limit expansion (see Burby et al., 2001), although it is not clear if this has been done to improve the local environment.

The environmental regulations in the United States are wide-reaching, covering factories, automobiles, municipal water supplies, wetlands, wildlife, and coastal areas. Although few of these laws are specifically directed toward the housing market, we turn now to consider how the laws can directly and indirectly affect that market.

Impact of Environmental Regulations on Housing: Theory

Whether or not environmental regulations are placed directly on the suppliers of housing, these regulations may have an impact on the housing market. If regulations increase costs for firms, the firms' owners will attempt to shift the costs to others. If costs can be shifted to housing suppliers, the incidence of the regulation differs from those that the law is originally directed to. Freeman (1992) discussed what he called the "naïve" view of the cost of environmental regulations when only the costs of pollution controls bought and maintained by the regulated firms are considered. Freeman argued that those costs can be shifted forward. Thus, even if the environmental regulations are not placed directly on the suppliers of housing, the cost of supplying housing can increase due to the regulations.

Environmental laws can impact the supply of land, a key input in the production of housing. These laws also can affect the supply of housing in other ways by changing the prices of other inputs. If the regulations are effective, they can impact the demand for housing by increasing the local environmental quality. All these effects can lead to changes in both the price and the quantity of housing in the market.

Supply of Housing

The first consideration is the market for land. Any regulations that restrict the supply of land will lead to an increase in the price of land. This would include regulations such as the ESA, wetlands regulations, and coastal zone management laws. If the land removed

from the market was desirable land in the eyes of developers, the price of similar land not similarly regulated will increase. An increase in the price of land—a critical factor in housing production—will decrease the supply of housing in the market, leading to an increase in the price of housing, all other factors remaining constant.

In the housing market, supply can be affected by changes other than an increase in the price of land. If the regulations increase the prices of other inputs, supply will again decrease. For example, if the intensified regulation on water treatment plants increases the costs of sewer pipelines, the cost of new developments where such pipelines must be installed will increase.

The supply of new housing can be affected if the increased regulations cause delays in the development process. If the delays are expected, such as situations where reviews must be conducted, developers can incorporate the lags into their timeline, which will increase their holding costs, including interest payments. If the delays are unexpected—for example, when the review process leads to changes in the design of the project—the cost impact will be even greater because developers will not be able to schedule deliveries and workers appropriately.

If the regulations increase the possibility of litigation, the supply of new housing can be affected. Litigation, whether expected or unexpected, can increase the cost of new housing by either forcing the developers to fight the problem in court or encouraging them to be overly inclusive in their reviews in an attempt to avoid potential lawsuits (see discussion by Braconi, 1996). If the litigation is anticipated, the expected costs of such litigation should be capitalized into the price of the land that developers purchase.

Demand for Housing

Demand for housing can also be impacted by environmental regulations. If the regulations are successful in the sense that they improve the quality of the local environment, the demand for housing in that area should increase, thus increasing the price of housing. The notion here is that if there were two identical houses, but one was in a neighborhood with cleaner air, that house would sell for more because individuals would be more interested in obtaining it (see Boyle and Kiel, 2001, for a review of studies on this topic).

One of the reasons that environmental regulations are passed is because environmental goods are public goods (or common property resources) that are exploited in the market if they are not regulated. The government steps in to correct this market failure, thereby improving the quality of life for the impacted society. Laws that had been passed are expected to have improved the local area and made it a more desirable place to live. Houses in that area are now perceived as being of higher quality, and the demand for these houses should increase. In fact, if the demand did not increase, one might wonder why the government would enact such a law.[2]

As exhibit 5 illustrates, a decrease would be expected in the supply of housing due to the increase in the price of inputs, such as land. The shift from S1 to S2 with a corresponding increase in price from P1 to P2 shows this. In addition, an increase in the demand for housing would be expected as the quality of the house's neighborhood improves. The shift from D1 to D2 with a corresponding increase in price from P2 to P3 demonstrates this. Clearly, house prices will increase due to the regulations. What is not as clear, however, is what will happen to the quantity of housing seen in the market. Whether the decrease in supply is greater or less than the increase in demand is largely an empirical question.

Air Regulations

Few of the federal regulations discussed above are directly targeted at housing developers. The regulations could, however, have an indirect effect. The CAAA regulations on mobile source polluters increase the price of new automobiles. If this makes public transportation, and thus houses located closer to public transportation, more desirable, an increase in demand for housing in these locations could occur (Freeman, 1992). The regulations on stationary source polluters should not have an impact on housing unless they restrict large developments in areas where the standards for air quality are currently being exceeded.

Water and Wetlands Regulations

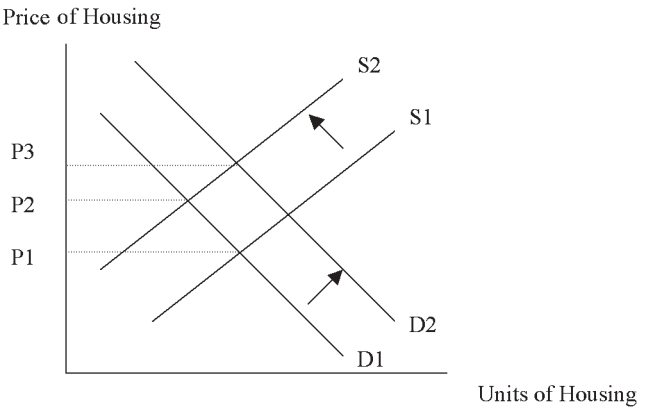
The laws that regulate water quality, especially those that focus on water treatment plants, can generate costs to the suppliers of housing if the increased costs of water treatment are passed on to the housing market. The costs could be passed to the developers of new housing or to the current residents through higher taxes. Wetlands preservation laws focus on developers of housing; by requiring a thorough review before being allowed to develop the property, the costs to the suppliers of housing are increased. The increased uncertainty of whether the permit will be granted may affect the price of properties that contain wetlands, but this should, in theory, decrease the price of that land because increased costs of developing the land would be capitalized into the price of the land.

Endangered Species Act

The ESA could also affect the housing market. If the ESA removes a significant amount of land from possible development, the price of remaining developable land should increase, thus increasing the cost of supplying housing in those areas. When this occurs, the housing market would be expected to adjust by using less land per housing unit over time, which would help mitigate the cost increase. The Endangered Species Act (ESA) could decrease the prices of those lands removed from development because the potential uses of the land would be reduced. Because that land would not be an input to the housing market, changes in its prices are not considered in this article.

Exhibit 5

The Housing Market



Coastal Zone Regulations

Coastal zone regulations should decrease the supply of land available for development for housing, thus increasing the price of the land available for housing projects. Developers would attempt to pass this cost increase to the purchasers of housing. Thus, land similar to that removed from potential development should be impacted and experience a price increase.

Toxic Waste Regulations

Efforts by the EPA to clean up toxic waste sites through the Superfund are likely to increase house prices in the area surrounding the site; as a nearby dangerous property is cleaned, demand for houses in that area should increase. Of course, the length of time that it takes to clean the site will affect how quickly local house prices should increase. The legal liability involved with purchasing or developing such a site, even after it is cleaned, reduces the likelihood that such properties will be redeveloped. Current changes to the regulations are meant to make the program "faster, fairer and more efficient" (Smith and Garcia, 2002: 162). If these changes are successful, the regulations should lead to an increased supply of land, which should decrease the cost of supplying housing.

In the case of brownfields, the federal, state, and local governments generally have attempted to speed up the process through reforms that are intended to "expedite site clean-ups by addressing remedy selection issues and setting risk-based clean-up priorities" (Smith and Garcia, 2002: 164) and to reduce the legal uncertainty. These reforms are aimed at encouraging the redevelopment of these properties, especially in the inner urban core. As with Superfund, redeveloping these properties should affect local house prices and may increase the supply of housing in the area.

Growth Controls

Because smart growth policies vary across locales, predicting their general impact on the housing market is difficult. Urban growth boundaries will limit the supply of developable land and could lead to a decrease in the supply of land. Policies focused on the local quality of life should increase demand for housing in the area. The interaction of these forces will determine the final outcome in the market.

In theory, who will bear the final costs of these regulations should be clear. If the laws put restrictions on the use of some land (for example, ESA), the price of that land will fall; this will cause economic harm to owners of that land. Neighboring land may increase in value due to either the reduction in the amount of land available for development or the perception by purchasers that the area has become more desirable. Owners of these types of properties will experience a gain due to the laws. For regulations that increase the cost of developing land (for example, the Clean Water Act), if the costs are anticipated, they will be capitalized into the price of the land. Therefore, the sellers of that land will receive a lower price for their property. Developers should pay the same in total (land plus costs); thus, the price of housing should not be impacted. If the costs are not anticipated, developers will have higher total costs and will attempt to share those costs with those who purchase homes.

The Impact of Environmental Regulations on Housing: Empirical Results

Any environmental regulation that restricts the supply of land to the housing market will increase the cost of housing by decreasing the supply of housing at any given price. Surprisingly few empirical studies, however, attempt to quantify the magnitude of that shift. Some studies state that the impact is present but make no attempt to measure the increase while controlling for other possible sources of change (for example, Braconi, 1996).

One of the earliest studies to attempt to quantify the impact was by James and Muller (1977), who examined the effect of required environmental impact reviews (EIRs) on local housing costs in Florida and California. As mentioned above, these reviews are required at the federal level under the National Environmental Policy Act (NEPA); some states also passed legislation mandating the consideration of environmental impacts from development. James and Muller looked at San Diego, California, and Broward County, Florida, in part because the programs were quite different in the two states and also because these areas were rapidly growing.

The authors measured two types of costs due to EIRs: (1) the cost of undertaking the review and (2) the cost of "requirements imposed on the developers in order to protect the public interest" (James and Muller, 1977: 284). The first costs were those of preparing the review, public assessment of the review, and the delays due to the review process. After interviewing developers and public officials, the authors estimated that these costs were $192 per housing unit in Florida and $115 per housing unit in California (assumed to be 1975 dollars). The second costs were "the costs of altering the physical characteristics of new residential developments to comply with public requirements arising from the EIR process" (James and Muller, 1977: 289). This included costs due to projects being rejected as well as projects that were required to change in some way. James and Muller used a survey by the Center for Urban Policy Research to estimate that the increases in costs were $194 per unit in Florida and $50 per unit in California (again assumed to be 1975 dollars). The authors did not attempt to quantify the benefits from the EIRs, but did mention that in San Diego, a "majority of the officials contacted in the course of the study thought that EIRs had a significant positive influence on environmental quality in the state," although the public officials in Florida felt that, "EIRs had no effect or only a small effect on their land use decisions" (James and Muller, 1977: 296). James and Muller argued that the benefits were likely to be received by existing local residents, and the costs were likely to be borne by developers and purchasers of new housing units. Of course, as the price of new housing increases, the demand for existing houses increases; thus, the price of existing houses also increases. Whether this relationship is seen as a cost or a benefit to current residents is not clear.

Peiser (1981) studied local land development regulations (including environmental laws) in Dallas and Houston, Texas. These two cities were chosen because they were similar in many ways, yet faced different regulatory requirements. Peiser considered five different types of regulations on developments: utilities, land use controls, subdivisions, roads, and the environment. The relevant environmental regulations included federal Environmental Impact Statements, flood plain permits, coastal areas, and wetlands, with the latter two relevant only in Houston. Peiser examined two developments, one in each city, and found that costs in Dallas were approximately $1,000 per lot (in 1981 dollars) higher than in Houston. Since the author did not break out his cost estimates, how much of that $1,000 is due to environmental regulations is not determinable. Because Houston has more environmental requirements, however, one could assume that those costs are relatively low.

In a 1984 study by Frech and Lafferty, the impact of the California Coastal Commission (CCC) on house prices was estimated. The CCC was created to protect and preserve the environmental resources of the coastal area in California. The authors argued that the CCC would impact house prices through two channels: the reduction of available land for residential development should increase the price, as would the increase in local amenities, such as open space. The authors believed that the former effect would be uniform over their study area because they were looking at only a small coastal area where building extends only 13 miles inland. The latter effect should, in their opinion, be stronger closer to the coastline.

The authors estimated a hedonic regression of the sales price of the house as a function of its characteristics. They included categorical variables based on distance from the coast and an interaction variable that measures the amount of land used for agriculture if the property was in the coastal zone and was sold after the CCC was created; the latter variable takes on a value of zero if the house was not in the coastal zone or was sold prior to the CCC's existence.[3] Using sales data from 1966 to 1975, the authors found that prices did increase for houses close to the coast (by $2,882 to $5,040, in 1975 dollars), while those further inland (0.5 to 13 miles) experienced a smaller price increase ($989 to $1,700, in 1975 dollars). Frech and Lafferty argued that the difference between the two was due to amenity effects. The authors then stated that because "much of the price rise occurred as far as 13 miles inland…most of the price rise is attributable to the reduction of area-wide residential land, rather than improved amenities" (Frech and Lafferty, 1984: 120). Frech and Lafferty went on to point out that the benefits of the increased prices were received by current homeowners and owners of developed land.

In a study of the impact of coastal area building restrictions in Maryland, Parsons and Wu (1991) estimated the decrease in the value of properties that were no longer able to be developed. They first estimated a hedonic regression using data from a developed coastal area. This regression equation was then used to predict the value of "lost amenities" to houses that could not be built in the coastal areas, and, thus, must be built further inland. The authors calculated that houses that would have been built on the waterfront would lose an average of $96,672 in value (in 1983 dollars), while those that would have been built further away would lose an average of $447 in value (in 1983 dollars). This study showed that land that was restricted in its use (rather than restricted in supply) fell in price as predicted. The authors did not attempt to estimate the benefits from the coastal zone restrictions.

Beaton (1991) examined the impact of land use regulations on the prices of vacant land in Pinelands, New Jersey. As he made clear, zoning changes can affect both the supply and the demand sides. Beaton used the repeat sales approach to estimate the price effect of growth management policies while holding other characteristics constant over time. The data he used were sales prices of parcels in the area from 1965 through 1986. Beaton stated that from 1966 through 1972, "economic development was the dominant theme for local planning," and that 1972 through 1981 was a period in which the environmental issues became more important (Beaton, 1991: 13). He found that the values of parcels zoned for residential development increased due to the policies that controlled growth and development. In looking at vacant land, Beaton found that parcels in more restrictive zones fell in value, and the value of those parcels in less restrictive zones fell and later increased after the restrictions were put in place.

Beaton and Pollock (1992) examined the impact of Maryland's environmental protection legislation on housing values using a hedonic regression technique. The legislation, passed in 1986, reduced densities in some areas and controlled "development-related runoff, erosion, and habitat disturbance" in other parts of the Chesapeake Bay area (Beaton and

Pollock, 1992: 3). In 1988, Maryland also enacted wetlands development legislation that further increased the review process for developments in this same area. The laws "grandfathered in" existing development and phased in the implementation of the law. Using a data set of sales that took place between 1981 and 1986, the authors ran hedonic regressions that controlled for various parcel attributes including whether it was located in an area under the new regulations. Beaton and Pollock reported finding that no "significant" drop occurred in values of vacant land, and those areas with access to employment and recreation saw price increases for both vacant and residential land. Thus, land prices did increase in this area after regulation.

In a paper prepared for a HUD conference, Braconi (1996) presented an overview of the impact of environmental regulations on housing. He reviewed the laws established by NEPA, wetlands regulations, coastal zone management, the Clean Air Act, CERCLA, radon regulations, asbestos regulations, historic preservation requirements, unfunded mandates, and lead paint regulations. These regulations impact the cost of building new housing, financing costs experienced by homeowners, and operating expenses, and Braconi discussed each of these in turn. He argued that the increase in house prices between 1963 and 1993 was due, at least in part, to the increase in environmental regulations. He provided only anecdotal evidence, however, of the impact of specific regulations on housing prices.

In a response to Braconi's paper, Evans (1996) pointed out that few environmental regulations existed before 1972; therefore, regulations cannot be blamed for the price increases from 1962 to 1972, and that the increases in house prices also could be due to sociodemographic changes, such as an increase in population.

Guttery, Poe, and Sirmans (2000) studied the impact of wetlands regulations on residential sales prices in Baton Rouge, Louisiana. As discussed above, the costs of complying with these regulations can include delays, preparing the environmental impact report, and meeting the mitigation requirements (Guttery, Poe, and Sirmans, 2000). These costs are placed on the permit applicants (often developers), but economic theory suggests that the applicants will attempt to pass these costs on to the purchasers of the property. The study proposed to test this possibility by examining the sales prices and characteristics of 328 multifamily housing units in the study area between 1983 and 1988. This time period was selected because the regulations on wetlands went into force in 1986; thus the sample included units sold before and after the regulations. The results of the hedonic regression showed that sales prices of wetlands property fell by 10.5 percent, relative to nonwetlands property, after the regulations were put in place. The authors argued that this was due to the restrictions put on the development of the land. One could interpret this result as due to a demand shift in that wetlands properties are now less desirable, causing the prices to fall. The purchasers knew that extra costs would be involved in developing the property, and those costs were capitalized into the reduced sales price.

To estimate the impact of environmental regulations on housing production costs, the amount of land removed from the market must be estimated. If this amount is large relative to the remaining developable land, the regulations could have a significant effect on the housing market. Landis (2001) estimated the impact of various kinds of restrictions on the availability of land in California by combining various data sets in a geographic information systems framework. He reported that in 1996, California had "3.5 million acres of urbanized land, 32 million acres of public or physically undevelopable land, and nearly 25 million acres of potentially developable raw land" (Landis, 2001: 9). Landis estimated that slightly more than 17 million acres were "developable and accessible" (within 6.2 miles of a major roadway), and that slightly less than a million acres were mapped wetland areas. Thus, only 5 percent of the "developable and accessible" land in California is undevelopable due to wetland restrictions. Another 1.8 million acres are a

"highly suitable habitat for eight or more threatened and endangered…species," and thus could be removed from the market under the ESA rulings. Landis interpreted these numbers to mean that environmental constraints (which he defined as "prohibitions on wetlands, flood zones, and prime and unique farmland development") would "slightly reduce the state's ability to accommodate projected household growth through 2010…Only Orange and Los Angeles Counties would encounter land capacity limits" (Landis, 2001: 19).

In an undated research report, Crellin examined the impact of the ESA on property values. Using property transaction in three counties in Washington—from 1986 through 2002 for Clallam County, from 1995 through 2001 for Clark County, and from 1986 through 2001 for Snohomish County, Crellin estimated separate hedonic models for single-family homes, condominiums, commercial properties, and land. In all cases (except for unplatted land in Clallam County), Crellin found that properties located in ESA-designated areas fell in value by between 1.4 and 19.9 percent. In theory, one would expect undeveloped land that has restrictions placed on it to decrease in value, but Crellin provided no explanation as to why existing structures would decrease in value. Regardless, his empirical model did not provide a convincing test of the hypothesis. Crellin's data are countywide, yet he did not control for any town or neighborhood characteristics; perhaps his indicator variable of ESA restrictions picked up those factors. In addition, Crellin controlled for changes over time through the use of a linear time trend; other researchers (for example, Kiel, 1995) have shown that including data before the restrictions were put in place as well as after is important, and that a more general form for the time trend should be used.

Analysis of the Current Empirical Literature

The studies discussed above use either case studies or regression analysis in their attempts to measure the impact of regulations on housing prices. When using case studies, one is often forced to rely on information from surveys of the relevant parties, such as housing developers. These individuals may not report costs accurately because either they did not have an incentive to take the time to correctly calculate the prices or had a political incentive to overstate the costs.

Economists generally prefer to use what are called *revealed preference* models, where the actions of individuals are observed in the market, rather than reported in a survey situation—which is called a *stated preference*. Regression analysis on housing prices is an example of this revealed preference approach. Data are taken from actual transactions made by individuals who are utility or profit maximizing.

The hedonic method (Rosen, 1974) assumes that the housing market is in equilibrium so that the price that is observed is where housing supply is equal to housing demand in the relevant market. The technique requires the researcher to include as explanatory variables all the characteristics of the house that influence its sales price. Thus, a typical hedonic regression is as follows:

$$P_i = \beta_0 + \beta_1 H_i + \beta_2 N_i + \varepsilon_i$$

where P_i is the sales price of the i^{th} house, H_i contains information on the characteristics of the house (such as number of bedrooms), N_i contains information on the neighborhood in which the house is located (such as quality of the local school), and ε_i is the unobservable stochastic random error. The estimated βs, thus, are the marginal impact of a unit change in the characteristics on the price of the house; they are the marginal prices of the included characteristics determined in the housing market.

Hedonic regressions can be used to estimate the prices of environmental characteristics in a house's neighborhood if the quality can be quantified and included in the regression. Although an individual does not directly purchase, for example, air quality, if the individual considers local air quality when purchasing a house, a measure of local air quality should be included in the hedonic regression. Its estimated coefficient then represents its marginal price as determined in the housing market. A large number of studies used this approach when valuing environmental goods; see Boyle and Kiel (2001) for a survey of these studies.

Thus, the studies reviewed above that use the hedonic approach are in good company.[4] The hedonic studies cited in Boyle and Kiel (2001), however, assume that the increase in price is due to a shift in demand; higher environmental quality makes the house more desirable so that the demand increases, making the price increase. Most of the studies reviewed above assume that the increase in price is due to a decrease in supply; higher environmental standards increase input costs and decrease supply, thus increasing the price. Frech and Lafferty (1984) conducted the only study that attempted to model the two shifts separately (although they use a single hedonic regression) by explicitly including characteristics that should impact demand, but not supply, and characteristics that should do the reverse.

The prices estimated in the hedonic regression are the result of the housing market being in equilibrium. If, however, the researcher was interested in knowing the impact of demand and supply separately, a second stage must be considered. As Rosen (1974) discussed, the marginal prices estimated in the hedonic regression could be used to estimate the marginal willingness-to-pay (demand) and supply functions in a second stage. The issue in the second stage becomes one of econometrically identifying the demand and supply functions.

The focus in the economics literature has been on the estimation of the demand function in the second stage, often because knowing the demand function allows the researcher to estimate the social benefits from the regulation in question. As Freeman (1992) made clear, two potential problems exist in this second stage. The first is that the demand function uses the price from the hedonic regression as its dependent variable; that price is an estimated price, not an observed price. If the second stage uses the same data that were used in the hedonic regression, the results for the demand regression will be the same as those for the hedonic regression. The second problem is that the price and quantity of the environmental good are both endogenous in the hedonic regression. Thus "demand shifters," such as income, are correlated with observed choices, and it becomes difficult econometrically to separate the shifters from the demand equation; see Freeman (1992) for a discussion of this issue. The difficulties with estimating the supply function are the same.

Several studies have used Rosen's (1974) approach in an effort to estimate the demand for air quality; see Zabel and Kiel (2000) for a brief review. Researchers attempted to identify the second stage demand equation by making strict assumptions on the demand equation, such as its functional form, by using data from multiple markets or from a market over time. In general, the results were mixed, underlining the difficulty in estimating a second stage demand equation given prices estimated with a hedonic regression.

In Which Direction Should the Literature Go?

Clearly the literature has yet to fully answer the question of the impact of environmental regulations on the housing market. If the question of interest is, "Do current environmental regulations make housing less affordable?" it would be sensible to break the question into two separate parts: (1) do current regulations increase the price of housing through changes in the supply and/or the demand, and (2) does the price increase so much as to render housing unaffordable? If the answers to these questions are "yes," the decision to

be made is whether regulations can be changed in such a way that the price impact can be minimized, if regulations should be removed, or if housing costs should be subsidized for (certain) consumers who are greatly impacted by the regulations.

The first consideration is the question whether regulations increase housing prices through changes in supply and/or demand. To be able to separate the two is important because in the case of supply decreases, a decrease in the quantity of housing in the market is seen; with demand increases, an increase is seen. Thus, the availability of housing is determined by which type of shift occurs in the market, or if both, which shift is greater.

The supply of housing, as discussed above, is impacted by the supply of inputs to housing. An examination of the literature does not indicate how large the changes are in the supply of developable land when environmental regulations are imposed. The research that Landis (2001) performed is important and should be carried out in other localities. The decrease in available land may be so small in most areas that housing prices are not impacted by these rules. This hypothesis can be tested by estimating hedonic regressions on house prices in areas where the regulations have been imposed. The regressions must cover long periods of time, extending from well before the regulations were considered until after they have been enacted.[5] This will enable the researcher to determine the impact of the regulation on the market while carefully controlling for other possible impacts. Cross-sectional studies, or those that do not cover a long enough time span, cannot segregate the regulation's effects. Of course, if an increase in house prices is captured by the hedonic regressions, some of this price increase could be due to increased demand for housing near the restricted area if owners view the restrictions as increasing the quality of the housing.

A similar hedonic regression approach could be used to examine the impacts of changes in other supply costs due to environmental regulations. If changes in the costs of water treatment lead to increased costs to developers, the amount of the cost increase could be estimated in the hedonic regression. Again, having a long time series of data would be important to consider the problem; cross-sectional data would not be useful because other changes could not be controlled.

Another approach would be to estimate the second stage hedonic regressions that would then separate the price changes seen in the housing market into supply effects and demand effects. This technique is not used often because it requires identification of each equation that must be used by looking at multiple housing markets or finding instruments for supply and/or demand shifters. An example of this technique is in Witte, Sumka, and Erekson (1979). The authors developed a unique data set that consisted of a sample of rental properties in North Carolina in 1972. They had information on the rent charged, characteristics of the unit and its neighborhood, and characteristics of both the renter and the landlord. These data enabled the authors to identify the supply and demand equations given the marginal prices estimated in a first stage hedonic rent regression.

To use this technique to study the impact of regulations on house prices, data sets will need to be developed. Although existing data sets have information on the occupant (for example, American Housing Survey), obtaining information on the landlord or the developer of the unit would be difficult. The benefits from estimating the second stage regressions would appear to be worth the effort of putting together such a data set because it would likely provide the clearest answer to the question under consideration.

Another option is to develop more comprehensive models of urban areas. An example of such a model was developed by Riddel (2001). She pointed out that changes in environmental amenities will impact not only the housing market, but also potentially related markets, such as the labor market. If these changes take time to move through the various markets, cross-sectional hedonic regressions will not capture all the price changes.

Other researchers looking at the "quality of life" have modeled housing markets and labor markets simultaneously (for example, Blomquist, Berger, and Hoehn, 1988). The argument for doing this is that positive externalities (including environmental goods) make an area more desirable to workers who are therefore willing to work for a lower wage. As more workers move in to take advantage of the externality, the demand for local housing increases, thereby increasing house prices. Thus, a more "desirable" area will see lower than expected wages and higher than expected house prices.

Riddel (2001) criticized the use of house price hedonic models in estimating the prices of environmental goods because they explicitly ignore the labor market.[6] She, therefore, developed a multimarket model in which prices and quantities in the markets were assumed to vary over time.

Riddel's model included the housing market, the labor market, and the apartment/rental market, and allowed environmental externalities to be endogenous. Because the author was considering the case of open space purchases by the local government in Boulder, Colorado, this environmental good was considered to be a function of the number of households and the level of taxes (used to purchase the good).

Riddel used a dynamic modeling approach to estimate the model using data from 1981 through 1995 and found that the 15,000 acres of open space purchased during her sample period led to an increase in housing prices of 3.75 percent (due to changes in demand as well as in supply). She also reported a 3.3-percent increase in jobs and a slight increase in total housing stock. It appears, although Riddel did not state it this way, that the shift in demand for housing was slightly greater than the shift in supply. Thus "the positive implicit price of open space clearly expresses the value of the program to residents" (Riddel, 2001: 511). Riddel's model did not lead to a separate specification of supply and demand functions, but her results do let us see which of the two shifts dominated by reporting the change in the total quantity of housing due to the program.

Research such as Riddel's (2001) that uses multimarket models should be encouraged. It may avoid some of the econometric complications involved in estimating the second stage regressions in the hedonic framework, and the data requirements might be less restrictive. Both approaches will enable researchers to better understand the impacts of changes in supply and demand due to environmental regulations.

Ongoing concerns exist about the impact of the delays and litigation due to uncertainty created by the regulations. If unanticipated, the delays can lead to increased costs to developers. If fully anticipated, the expected costs would be capitalized into the price of the land affected by the regulations. An interesting line of research would be to examine those areas where the regulatory process has strict timelines that should reduce the delays as well as the uncertainty; the laws should have a smaller impact on these land prices than in areas without such timelines. If, indeed, such timelines do minimize the effect, such an approach should be encouraged nationally. Examining areas where insurance markets might be used to share the costs of uncertainty would also be of interest; for instance, some insurance markets exist for brownfields properties.

When we have determined the extent to which environmental regulations affect the price of housing, we can then ask whether the increase makes housing unaffordable. As Bogdon (2001) pointed out, affordability is easy to define, but difficult to measure. She considered several measures of affordability in the rental market by looking at both the demand and supply side of the market. On the demand side, one could examine the percentage of income spent on housing by households with different levels of income or the income necessary for a household to rent a unit that meets some standard of quality. These measures indicate

the importance of household income to affordability measures. On the supply side, one could look at vacancy rates at different rent levels or at the availability of units renting at or below the fair market rate set by HUD.

Bogdon also looked at measures of affordability for homeowners, particularly first-time buyers. Common measures include the National Association of REALTORS®' affordability index, which is the ratio of the median family income to the income needed to buy the median price house, or the National Association of Home Builders' housing opportunity index, which looks at the distribution of house prices.

Bogdon discussed the need for local authorities to "track affordability measures on a regular basis, compare current and past numbers and use this information to plan policy changes if affordability problems worsen" (Bogdon, 2001: 325). When considering environmental regulations, comparing measures of housing affordability before and after the laws are in place would be important. Given the estimated price increases, will housing affordability problems arise in the area?

Conclusions

Surprisingly little is known about the impact of environmental regulations on the price and quantity of housing in the United States. Most, if not all, economists would say that the increase in the price of inputs, along with any increase in delays and/or uncertainty, would decrease the supply of new housing to the market, thus increasing the price of new housing. And most, if not all, economists also would say that improvements in the environment due to regulation should increase the demand for housing in areas that have experienced the improvement, which would increase price. Many economists have estimated the price increase, with some attributing the increase to changes in supply and others to changes in demand. Why these impacts have not been separated is curious.

It is clear, however, that environmental regulations do increase the price of housing. Whether that increase is good or bad will depend on one's perspective. An increase in the price of housing due to an improvement in the local environment is beneficial to a homeowner in that area; when a Superfund site is cleaned and property values increase, local residents whose investment asset increases in value see this to be good. The price increase, however, makes it more difficult for outsiders to purchase homes in those areas. The issue becomes one of affordability. On the other hand, imagining policymakers refusing to undertake improvements in the environment simply because they would make housing less affordable is difficult; policymakers could improve the environment and then subsidize new owners if that was their concern.

Instead, it seems reasonable to undertake a cost-benefit analysis whereby the costs of the program, including the decrease in the supply of housing, are measured against the benefits of the program, including the increase in the demand for housing. If the benefits are greater than the costs, the program should be considered. In the housing market viewed in isolation, this would mean an increase in the quantity of housing. Of course, we do not want to consider any market in isolation. Rather, social costs and social benefits in all markets that are affected should be examined. This will require the development of more sophisticated models, which will demand more data. The author of this article recommends this as the direction to take.

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Notes

1. A full discussion of current state and local environmental regulations is beyond the scope of this article.

2. It is also possible that the benefits from the regulation are felt nationally, whereas the costs of the regulation are felt only locally. I thank a referee for making this point.

3. The hedonic regression technique will be discussed below. See Freeman (1996) for an excellent discussion of the approach.

4. Or repeat sales analysis, which is a variant of the hedonic technique.

5. To carry out such research, datasets on housing transactions and housing characteristics in the affected area over the relevant time periods would have to be obtained.

6. Riddel (2001) also points out that the assumption required by hedonic models that the housing market be in equilibrium is often inappropriate.

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