



Center For Energy and Environmental
Policy Research

Superfund Cleanups and Infant Health*

Janet Currie, Michael Greenstone
and Enrico Moretti

Reprint Series Number 232

*Reprinted from the American Economic
Review, Vol. 101, No. 3, pp. 435-441,
2011.

The MIT Center for Energy and Environmental Policy Research (CEEPR) is a joint center of the Department of Economics, the MIT Energy Initiative, and the Alfred P. Sloan School of Management. The CEEPR encourages and supports policy research on topics of interest to the public and private sectors in the U.S. and internationally.

The views expressed herein are those of the authors and do not necessarily reflect those of the Massachusetts Institute of Technology.

RESPONSES TO ENVIRONMENTAL REGULATION[†]

Superfund Cleanups and Infant Health

By JANET CURRIE, MICHAEL GREENSTONE, AND ENRICO MORETTI*

In 1980, outcry over the health effects of toxic waste in Love Canal, New York, resulted in the Comprehensive Environmental Response, Compensation, and Liability Act, which became known as Superfund. Superfund was intended to provide a mechanism for conducting remedial cleanups at the most dangerous hazardous waste sites. Over the years, it became the largest and most expensive federal program to deal with toxic waste in the United States. Given the substantial cost and slow rate of cleanup, there is considerable debate on whether it is in the public interest to continue the program in its current form (US Environmental Protection Agency 2006).

While the costs of the programs are clear, its benefits are not well understood. Indeed, the policy is controversial in part because there is a paucity of reliable information on the program's benefits. Some previous studies find poorer birth outcomes near a site, while others do not (see Martine Vrijheid 2000). However, evidence of a correlation between proximity to a site and poor birth outcomes does not necessarily represent a causal effect, because populations living

near hazardous waste sites are typically different from the general population, and their health outcomes are likely to differ even in the absence of negative health effects from exposure. For example, Greenstone and Justin Gallagher (2008) found that residents of areas near hazardous waste sites are more likely to be poor and have lower levels of education than others.

Our project is the first to examine the effect of site cleanups on infant health rather than simply focusing on proximity to a site. We focus on single births that occurred within five kilometers of a Superfund site between 1989 and 2003 in five large states—Florida, Michigan, New Jersey, Pennsylvania, and Texas. The basis of our difference-in-differences approach is to compare changes in birth outcomes before and after a site's cleanup among births to mothers who live within 2,000 meters of the site and among those who live between 2,000 and 5,000 meters away. Our approach is made feasible by access to confidential National Vital Statistics System data that includes the exact street address of the mother's residence. Our large sample gives us statistical power to detect small effects.

I. Data and Sample

The primary source of outcomes data for this study are individual Vital Statistics Natality records, which provide data on both birth outcomes and characteristics of the mother. We focus on births to mothers between 15 and 45. The five states we consider include data on 154 sites that were cleaned up between 1989 and 2003. The key data step is that we were able to use geocoded maternal residential address to identify mothers who lived within a given distance of a Superfund site. In addition to focusing on births within 5,000 meters of a site, we further restrict the sample to births conceived between four years before the initiation of a site cleanup and four years after its completion. This provides a sample of roughly

[†]*Discussants:* Joshua Graff Zivin, University of California–San Diego; Olivier Deschenes, University of California–Santa Barbara; Lucas Davis, University of California–Berkeley.

* Currie: Department of Economics, Columbia University, 420 W 118th Street, New York, NY 10027 (e-mail: janet.currie@columbia.edu); Greenstone: Department of Economics, Massachusetts Institute of Technology, 50 Memorial Drive, Building E52, Room 359, Cambridge MA 02142-1347 (e-mail: mgreenst@mit.edu); Moretti: Department of Economics, University of California, 637 Evans Hall #3880, Berkeley, CA 94720-3880 (e-mail: moretti@econ.berkeley.edu). We thank Joshua Graff Zivin for helpful comments and Peter Evangelakis, Samantha Heep, Henry Swift, Emilia Simeonova, Johannes Schmeider, and Reed Walker for excellent research assistance. We gratefully acknowledge support from the NIH under grant HD055613-02 and from the MacArthur Foundation. We are solely responsible for our analysis and conclusions. We thank Katherine Hempstead, Craig Edelman, Joseph Shively, Rachelle Moore, and Glenn Copeland for facilitating access to the data.

621,409 births, with 92,609 births to mothers living within 2,000 meters of one of the 154 sites in the sample.

Data on Superfund sites comes from the Environmental Protection Agency (EPA) and includes the date when the site was added to the National Priority List, the date when cleanup was initiated, and the date when cleanup was completed. In addition, the EPA conducts a hazardous risk assessment for all sites, and this hazardous ranking system (HRS) allows us to identify the most dangerous sites.

II. Econometric Approach

We estimate the following model:

$$\begin{aligned}
 (1) \quad \text{Health Outcome}_{ijt} &= \mu_0 + \mu_1 \text{Close}_{ijt} \\
 &+ \mu_2 \text{During}_{ijt} \\
 &+ \mu_3 \text{After}_{ijt} \\
 &+ \mu_4 \text{Close}_{ijt} \\
 &\times \text{During}_{ijt} \\
 &+ \mu_5 \text{Close}_{ijt} \times \text{After}_{ijt} \\
 &+ \mu_6 \mathbf{X}_{ijt} + \alpha_j \\
 &+ \delta_t + \varepsilon_{ijt},
 \end{aligned}$$

where i indicates a birth, j is the mother's street address, and t denotes the year of birth. There are three key indicator variables in this specification: Close_{ijt} equals one if the mother resided within 2,000 meters of a site where a cleanup was finished during the sample; During_{ijt} equals one if the birth occurred during the site cleanup; After_{ijt} indicates that it occurred after the site cleanup was completed. The vector \mathbf{X}_{ijt} of maternal and child controls includes: indicators for the mother's age (<20, 20–34, 35 plus, age missing); maternal education (less than high school, high school, some college, college, education missing); maternal race and ethnicity (African American, non-Hispanic white, Hispanic, other, race and ethnicity missing); birth order (first, second, third, fourth, fifth or higher order births, and birth order missing); and maternal smoking (smokes, does not smoke, smoking status missing).

We present results that adjust for all time-invariant or fixed neighborhood characteristics in two different ways. In the first, α_j is implemented with a full set of indicators for each site. We also report on specifications that replace the site fixed effects with zip code fixed effects that are based on the zip code of the mother's residence. On the one hand, there are ten times as many zip codes as sites so that zip code fixed effects may control more fully for the characteristics of local areas. On the other hand, the differences in exposure to Superfund site hazards between births within 2,000 meters and those 2,000 to 5,000 meters from a site are likely to be smaller within a zip code. Additionally, we include a vector of indicators for the year, δ_t , which allow us to control for time trends non-parametrically. The estimates are qualitatively similar if year indicators are replaced with state-by-year ones.

The coefficient of primary interest is μ_5 , which is a difference-in-differences estimator of the impact of a site's cleanup on infant health outcomes. It measures the change in outcomes after a site's cleanup, relative to before cleanup, among births to mothers who live within 2,000 meters of the site to those who live between 2,000 and 5,000 meters away. Although we don't emphasize it in the subsequent results, μ_4 is also a difference-in-differences estimator of the impact of living near a site during cleanup.

The key identifying assumption is that any cleanup-related benefits to women 2,000 to 5,000 meters away are smaller than the benefits to those closer to a site. This assumption is reasonable since the primary methods for Superfund sites to affect local residents are through direct contact with the site, migration of toxic dirt or fumes through the air, or invasion of the water supply for houses that rely on well water.

While migration in response to environmental amenities is itself an interesting question (see Currie 2011), the assumptions necessary to identify health effects would be violated if the cleanup causes mothers with systematically different unobserved health endowments to move closer to the site. In order to guard against the possible effects of selective migration, we use the \mathbf{X} vector to adjust for a wide range of observable determinants of infant health and restrict the sample to the period four years before the cleanup's initiation through four years after its completion. We also estimate models focusing

TABLE 1—MEANS OF KEY VARIABLES IN BIRTH DATA

	< 2,000 meters (1)	2,000–5,000 meters (2)	Difference (3)	Diff-in-diff (4)
<i>Panel A. Outcomes</i>				
Congenital anomalies	0.0118	0.0101	0.0018** [0.0008]	−0.0022** [0.0010]
Low birth weight	0.0767	0.0742	0.0016 [0.0035]	−0.0005 [0.0041]
Preterm	0.0869	0.0897	−0.0026 [0.0032]	−0.0030 [0.0035]
Infant death	0.0084	0.0085	−0.0001 [0.0008]	−0.0011 [0.0010]
<i>Panel B. Mother characteristics</i>				
≤19 years old	0.1359	0.1367	0.0004 [0.0067]	0.0021 [0.0071]
≥35 years old	0.1035	0.1135	−0.0114*** [0.0043]	0.0062 [0.0052]
< High school education	0.2512	0.2534	−0.0009 [0.0138]	0.0100 [0.0115]
≥ College education	0.1856	0.2051	−0.0228** [0.0111]	0.0090 [0.0118]
African American	0.2491	0.2919	−0.0383 [0.0420]	0.0062 [0.0322]
Hispanic	0.1973	0.1931	0.0028 [0.0340]	0.0143 [0.0164]
Smoker	0.1556	0.1355	0.0194** [0.0081]	0.0013 [0.0054]
<i>Panel C. Child characteristics</i>				
Birth order	1.9496	1.9791	−0.0280 [0.0305]	0.0039 [0.0260]
Male	0.5115	0.5099	0.0014 [0.0027]	−0.0064 [0.0047]

Notes: For Columns 1–3, only singleton births conceived in the four years before the initiation of a cleanup are included. The number of such births within 2,000 meters of a cleanup site (column 1) is 31,126; within 2,000–5,000 meters of a site (column 2), it is 166,338. Column 3 reports the difference in means after adjustment for year of birth fixed effects. The standard error is clustered at the county-by-year level (in brackets). In column 4, the sample includes all singleton births conceived between four years prior to the initiation of a cleanup and four years after completion; 621,409 births. Column 4 reports the difference-in-differences estimator obtained by fitting a version of equation (1) that includes site and year fixed effects but does not adjust for the **X** vector. The standard error clustered at the county-by-year level is also reported (in brackets). See the text for further details.

- ***Significant at the 1 percent level.
- **Significant at the 5 percent level.
- *Significant at the 10 percent level.

on demographically uniform samples (e.g., white, nonsmoking, 20- 34-year-old mothers with a high school education or more) to probe the robustness of the results to bias due to sorting on observable characteristics.

Finally, models of dichotomous dependent variables were estimated using linear probability models. The variance-covariance matrix allows

for clustering at the county-year level to allow for dependence of observations within these cells.

III. Results

Summary statistics for outcomes and some characteristics of infants are shown in Table 1. Columns 1 and 2 report the means of these

TABLE 2—EFFECTS OF SUPERFUND CLEANUPS ON BIRTH OUTCOMES

	Cong. anom. (1a)	Cong. anom. (1b)	Low BW (2a)	Low BW (2b)	Premature (3a)	Premature (3b)	Infant death (4a)	Infant death (4b)
<i>Panel A. Full sample</i>								
During × close	−0.0009 [0.0011]	−0.0011 [0.0011]	0.0016 [0.0027]	0.0013 [0.0030]	0.0003 [0.0025]	−0.0003 [0.0026]	−0.0009 [0.0011]	−0.0009 [0.0010]
After clean × close	−0.0022** [0.0010]	−0.0029*** [0.0010]	−0.0020 [0.0030]	−0.0033 [0.0028]	−0.0036 [0.0026]	−0.0051* [0.0027]	−0.0011 [0.0010]	−0.0011 [0.0009]
Mean dep. var.:	0.0112	0.0112	0.0795	0.0795	0.0880	0.0880	0.0079	0.0079
R ²	0.0061	0.0126	0.0412	0.0585	0.014	0.0181	0.0028	0.0069
Observations	601,949	599,289	617,698	615,037	617,792	615,131	617,792	615,131
<i>Panel B. Top HRS sites (sites in the top 1/3 of HRS scores)</i>								
During × close	−0.0014 [0.0014]	−0.0021 [0.0015]	0.0002 [0.0044]	−0.0032 [0.0048]	−0.0023 [0.0040]	−0.0064 [0.0044]	−0.0036** [0.0015]	−0.0032** [0.0016]
After clean × close	−0.0014 [0.0017]	−0.0026* [0.0015]	−0.0048 [0.0049]	−0.0080 [0.0049]	−0.0041 [0.0036]	−0.0092** [0.0042]	−0.0045*** [0.0015]	−0.0044*** [0.0015]
Mean dep. var.:	0.0120	0.0120	0.0811	0.0811	0.0899	0.0899	0.0074	0.0074
R ²	0.0060	0.0142	0.0445	0.0712	0.0122	0.0195	0.0024	0.0098
Observations	260,168	258,970	267,623	266,425	267,686	266,488	267,686	266,488
Site FE	Yes	No	Yes	No	Yes	No	Yes	No
Zip FE	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The table reports the coefficients and standard errors (in brackets) associated with $Close_{ijt} \times During_{ijt}$ and $Close_{ijt} \times After_{ijt}$ from the estimation of alternative versions of equation (1). Standard errors are clustered at the county-year level. The sample is limited to singleton births within 5,000 meters of a site conceived between four years prior to the initiation of a cleanup and four years after completion. “Close” is defined as within 2,000 meters of the site. Regressions include controls for race, maternal age, maternal education, maternal smoking, child parity, child gender, year of birth, and zip code. See the text for further details.

- ***Significant at the 1 percent level.
- **Significant at the 5 percent level.
- *Significant at the 10 percent level.

variables in the four years preceding the initiation of the cleanup among births to mothers who live within 2,000 meters and 2,000 to 5,000 meters of one of the Superfund sites. Column 3 reports the difference in these means after adjustment for year-of-birth fixed effects. The associated standard error is clustered at the county-by-year level (reported in brackets).

Panel A shows that infants living close to a site before its cleanup are more likely to have a congenital anomaly. Otherwise, the birth outcomes are statistically indistinguishable. However, the differences in maternal characteristics shown in panel B suggest that such a direct comparison may confound the impact of cleanups with other determinants of infant health. For example, mothers closer to a site are less likely to have a college degree or to be older than 35 years of age. Additionally, they are substantially more likely to smoke. Hence, it is important to control adequately for maternal characteristics, and to explore the possibility that maternal characteristics change systematically following a site cleanup.

Column 4 of Table 1 presents some initial results on Superfund cleanups and the quality of the research design. The entries come from fitting a version of equation (1) that includes site and year fixed effects but does not adjust for the vector \mathbf{X} of maternal and child controls; they are unadjusted difference-in-differences estimates. The most striking finding is that there is a statistically significant decline in congenital anomalies. Table 1 does not show any evidence of differential changes in the determinants of infant health, which provides some support for the validity of the difference-in-differences design. However, Currie (2011) shows evidence that there is some sorting on observables following Superfund cleanups when the specification includes zip code fixed effects, rather than site fixed effects. Hence, the subsequent analysis will adjust for all available covariates, as well as estimating the effects of Superfund cleanups in more uniform samples of mothers.

Panel A of Table 2 shows estimates from the fitting of versions of equation (1) with site fixed

effects in the (a) columns and zip code fixed effects in the (b) columns. There is continued evidence that Superfund cleanups reduce the incidence of congenital anomalies. The coefficients in columns 1a and 1b indicate a reduction of 20–25 percent, relative to the baseline levels shown in Table 1. There is little evidence of an impact on the incidence of low birth weight. In columns 3a and 3b, the point estimates suggest a reduction in the incidence of prematurity in the models with zip code fixed effects. The stronger results for congenital anomalies may indicate that the fetus is most vulnerable in the first trimester of pregnancy, when congenital anomalies are most likely to occur (see Gerald G. Briggs, Roger K. Freeman, and Sumner J. Yaffe 2008), and less vulnerable in the later stages of pregnancy, when the fetus puts on most of its weight and preterm labor may occur.

There is a roughly 14 percent decline in infant mortality rates, but it would not be judged statistically significant by conventional criteria. Deaths are 30 percent less likely than congenital anomalies, and on an order of magnitude rarer than the other negative birth outcomes, suggesting that we have less power to detect effects on deaths. Finally, we note that there is little evidence of a change in any of the birth outcomes during the cleanup.

Panel B of Table 2 repeats the analysis for the subset of births near the Superfund sites believed to be the most dangerous, defined as those with HRS scores in the top third. This sample restriction reduces the estimated impact of the cleanups on the incidence of congenital anomalies, but the effect remains statistically significant in the specification with zip code fixed effects. The estimates of μ_5 in the models for the incidence of low birth weight and prematurity all rise in absolute value and become statistically significant in the case of prematurity for the specification that includes zip code fixed effects.

Perhaps, the most noteworthy results are the statistically significant decline in infant mortality after cleanup at these high HRS score sites. These estimates imply that the infant mortality rate declined by a substantial 4.5 infants per 1,000 births. However, the magnitude of these estimated impacts appears too large; the overall mean is just 7.4 deaths per 1,000 births. It is possible that these results are driven by sorting, as Currie (2011) suggests that sorting following cleanups is stronger at more hazardous sites.

To explore the robustness of our estimates further, we estimated a series of models using more uniform samples. In particular, we excluded smokers, fourth and higher order births, mothers under the age of 20 and older than 34, and mothers with fewer than 12 years of education from our samples. Due to the similarity of the results from the site and zip code fixed effects specifications, we report only on the former here. In Table 3, column 1 repeats the column 1a results from Table 2 as a basis of comparison. Columns 2 through 5 report estimates for white mothers from this uniform sample.

The estimates are generally more than twice as large as the baseline ones in column 1, which suggests that the results for congenital anomalies are not driven by changes in the composition of mothers near a Superfund site after cleanup. A comparison of columns 2 and 3 shows that the estimated effect is robust to defining “close” as 1,500 meters rather than 2,000 meters. A comparison of columns 4 and 5 suggests that boys are more vulnerable to exposure to a Superfund site than girls and that they also have higher baseline rates of congenital anomalies. Column 6 fails to find an impact of cleanups among black infants, although the standard errors are more than three times larger than in the baseline sample since the sample is much smaller. When we conducted this exercise for the other outcome variables we did not find consistent evidence of an impact of Superfund cleanups on the incidence of low birth weight, prematurity, or infant mortality in these subsamples. Hence, only the estimates for congenital anomalies are robust to different specifications.

IV. Discussion and Conclusions

This study is the first to examine the impact of cleanups of hazardous waste sites on infant health. Our estimates suggest that Superfund cleanups reduce the incidence of congenital anomalies by roughly 20–25 percent.¹ The finding of health benefits does not necessarily imply

¹ In a cross-sectional analysis, Paul Elliott et al. (2001) finds that proximity to a hazardous waste site in Great Britain increases the incidence of congenital anomalies. H. Dolk et al. (1998) find a 33 percent increase in the risk on nonchromosomal anomalies for residents living within three kilometers of a hazardous waste site, which is quite similar to our estimate.

TABLE 3—EFFECTS OF SUPERFUND CLEANUPS ON CONGENITAL ANOMALIES: ALTERNATIVE SAMPLES AND SPECIFICATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
During × close	−0.0009 [0.0011]	−0.0027 [0.0017]	0.0002 [0.0022]	−0.0038 [0.0026]	−0.0017 [0.0020]	−0.0027 [0.0031]
After cleanup × close	−0.0022** [0.0010]	−0.0055*** [0.0018]	−0.0044** [0.0022]	−0.0068** [0.0027]	−0.0040** [0.0019]	−0.0021 [0.0034]
Mean dep. var.:	0.0112	0.0109	0.0109	0.0127	0.0089	0.0106
R ²	0.0061	0.0070	0.0070	0.0099	0.0076	0.0143
Observations	601,949	183,693	183,693	94,245	89,448	54,485
Uniform sample	No	Yes	Yes	Yes	Yes	Yes
Other restriction	None	White	White	White, Male	White, Female	Black
Definition close	2,000m	2,000m	1,500m	2,000m	2,000m	2,000m
Site FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See the notes to Table 2. In addition to those details, the “uniform” samples include only nonsmoking mothers with high school education or more, who are between 20 and 34, and only children of parities 1, 2, or 3. See the text for further details.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

that it is in the public interest to continue the Superfund program in its current form. It might be more cost effective, for example, simply to ensure that people do not live near contaminated sites. Further research is clearly needed to determine whether the program is cost effective in improving health outcomes relative to possible alternative use of federal resources. Given the likelihood of a large heterogeneity in the toxicity level of the remaining sites, further research is also needed to determine how the expected benefits of the cleanups may vary across sites, as the program moves its focus from the sites with the highest levels of pollution to the sites with lower levels of pollution.

One appeal of infant health as an outcome is that it avoids the problem of a lack of information on the countless other environmental factors that may affect adult health, including lifetime smoking behavior, lifetime exposure to ambient air pollution, and lifetime exposure to multiple hazardous waste sites. A limitation of our analysis is that it cannot be informative about long-run outcomes, like cancer. Further, there is no standard measure of the willingness to pay to avoid a congenital anomaly, so it is difficult to develop a monetary benefit of these cleanups.²

²The estimates imply that these cleanups averted between 76 and 144 instances of congenital anomalies in the 26,238

A primary limitation of our study is that, like many previous studies of hazardous waste sites, we do not have a direct measure of exposure or the toxins that individuals were exposed to. Hence, our estimates cannot be used to identify the precise pathways or toxins through which proximity harms health. This is an important question for future research.

REFERENCES

- Ashenfelter, Orley, and Michael Greenstone. 2004. “Using Mandated Speed Limits to Measure the Value of a Statistical Life.” *Journal of Political Economy*, 112(1): S226–67.
- Briggs, Gerald G., Roger K. Freeman, and Sumner J. Yaffe. 2008. *Drugs in Pregnancy and Lactation: A Reference Guide to Fetal and Neonatal Risk*. 8th ed. Philadelphia: Lippincott Williams and Wilkins.

infants born to mothers within 2,000 meters of a Superfund site that had been cleaned up. Using Greenstone and Gallagher’s cost-of-cleanup figures, the total cost of cleaning up these sites was approximately \$4 billion (2005 \$). Hence, the cost per anomaly averted greatly exceeds standard estimates of the value of a statistical life (e.g., Orley Ashenfelter and Greenstone 2004). Of course, this paper’s focus on infants cannot measure any health improvements that occur later in life, and we have explored only one dimension of possible health effects.

- Currie, Janet.** 2011. "Inequality at Birth: Some Causes and Consequences." *American Economic Review*, 101(3): 1–22.
- Dolk, H., M. Vrijheid, B. Armstrong, L. Abramsky, F. Bianchi, E. Garne, V. Nelen et al.** 1998. "Risk of Congenital Anomalies near Hazardous-Waste Landfill Sites in Europe: The EURO-HAZCON Study." *Lancet*, 352(9126): 423–27.
- Elliott, Paul, David Briggs, Sara Morris, Cornelis de Hoogh, Christopher Hurt, Tina Kold Jensen, Ian Maitland, Sylvia Richardson, Jon Wakefield, and Lars Jarup.** 2001. "Risk of Adverse Birth Outcomes in Populations Living near Landfill Sites." *British Medical Journal*, 323(7309): 363–68.
- Greenstone, Michael, and Justin Gallagher.** 2008. "Does Hazardous Waste Matter? Evidence from the Housing Market and the Superfund Program." *Quarterly Journal of Economics*, 123(3): 951–1003.
- United States Environmental Protection Agency.** 2006. Superfund's 25th Anniversary: Capturing the Past, Charting the Future. United States Environmental Protection Agency. <http://www.epa.gov/superfund/25anniversary/>. (accessed February 2, 2009).
- Vrijheid, Martine.** 2000. "Health Effects of Residence near Hazardous Waste Landfill Sites: A Review of Epidemiologic Literature." *Environmental Health Perspectives*, 108(S1): 101–12.

This article has been cited by:

1. Janet Currie. 2011. Inequality at Birth: Some Causes and Consequences. *American Economic Review* **101**:3, 1-22. [[Citation](#)] [[View PDF article](#)] [[PDF with links](#)]

MIT CENTER FOR ENERGY AND ENVIRONMENTAL POLICY RESEARCH
REPRINT SERIES

CEEPR Reprints are available free of charge (limited quantities.) Order online at ceep@mit.edu

- 222 The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, A.D. Ellerman and B.K. Buchner, *Review of Environmental Economics and Policy*, Vol. 1, No. 1, pp. 66-87, (2007)
- 223 Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005 Emissions Data, A.D. Ellerman and B.K. Buchner, *Environmental and Resource Economics*, Vol. 41, No. 2, pp. 267-287, (2008)
- 224 The European Carbon Market in Action: Lessons from the First Trading Period, Frank Convery, D. Ellerman and Christian de Perthuis, *Journal for European Environmental & Planning Law*, Vol. 5, No. 2, pp. 215-233, (2008)
- 225 Cost and U.S. Public Policy for New Coal Power Plants with Carbon Capture and Sequestration, Michael R. Hamilton, Howard J. Herzog and John E. Parsons, *Energy Procedia*, Vol. 1, No. 1, pp. 4487-4494, (2009)
- 226 Quasi-Experimental and Experimental Approaches to Environmental Economics, Michael Greenstone and Ted Gayer, *Journal of Environmental Economics and Management*, Vol. 57, No. 1, pp. 21-44, (2008)
- 227 Does Air Quality Matter? Evidence from the Housing Market, Kenneth Y. Chay and Michael Greenstone, *Journal of Political Economy*, Vol. 113, No. 2, pp. 376-424, (2005)
- 228 Black Gold and Fool's Gold: Speculation in the Oil Futures Market, John E. Parsons, *Economia*, Vol. 10, No. 2, pp. 81-116, (2010)
- 229 Towards an Emissions Trading Scheme for Air Pollutants in India, Esther Duflo, Michael Greenstone, Rohini Pande and Nicholas Ryan, Discussion Paper, Prepared for the Ministry of Environment and Forest, Government of India, (2010)
- 230 Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings, Michael Greenstone, Rick Hornbeck, and Enrico Moretti, *The Journal of Political Economy*, Vol. 118, No. 3, pp. 536-598, (2010)
- 231 Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies, Paul L. Joskow, *American Economic Review*, Vol. 101, No. 3, pp. 238-241, (2011)
- 232 Superfund Cleanups and Infant Health, Janet Currie, Michael Greenstone, and Enrico Moretti, *American Economic Review*, Vol. 101, No. 3, pp. 435-441, (2011)

Massachusetts Institute of Technology
Center for Energy and Environmental Policy Research
400 Main Street (E19-411)
Cambridge, Massachusetts 02142