UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF NEW YORK

MICHELE BAKER; CHARLES CARR; ANGELA CORBETT; PAMELA FORREST; MICHAEL HICKEY, individually and as parent and natural guardian of O.H., infant; KATHLEEN MAIN-LINGENER; KRISTIN MILLER, as parent and natural guardian of K.M., infant; JENNIFER PLOUFFE; SILVIA POTTER, individually and as parent and natural guardian of C.P, infant; and DANIEL SCHUTTIG, individually and on behalf of all others similarly situated,

Plaintiffs,

v.

SAINT-GOBAIN PERFORMANCE PLASTICS CORP., HONEYWELL INTERNATIONAL INC. f/k/a ALLIED-SIGNAL INC. and/or ALLIEDSIGNAL LAMINATE SYSTEMS, INC., E.I. DUPONT DE NEMOURS AND COMPANY and 3M CO.,

Defendants.

CIV. No. 1:16-CV-917 (LEK/DJS)

DECLARATION OF JEFFREY E. ZABEL, Ph.D.

I, Jeffrey E. Zabel, Ph.D., declare and state as follows:

1. I prepared the Expert Report attached as Exhibit A to this Declaration.
2. Each of the opinions in the Expert Report is stated to a reasonable degree of economic certainty and was arrived at using reliable and generally accepted professional methods.
3. If called as a witness, I will testify competently to the matters stated in this Expert Report.
4. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: March 25, 2020

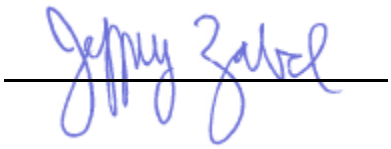
JEFFREY E. ZABEL, Ph.D.

EXPERT REPORT

PROPERTY VALUE DIMINUTION DUE TO PFOA CONTAMINATION IN THE TOWN OF HOOSICK, NEW YORK

Michele Baker et al. vs. Saint-Gobain Performance Plastics Corp. et al.
Civil Action No. 1:16-CV-917

Dr. Jeffrey E. Zabel



Prepared for:

Faraci Lange LLP
Weitz & Luxenberg P.C.
Powers & Santola LLP

March 25, 2020

SUMMARY & QUALIFICATIONS

I have been asked by plaintiff's counsel, in support of a motion for class certification in this case, to provide an opinion regarding the potential impact of perfluorooctanoic acid (PFOA) contamination on property values in the town of Hoosick, NY. In this report, I apply a standard statistical approach to compare changes in property values in Hoosick relative to control areas over time, and establish the existence and magnitude of impacts due to the contamination on a class-wide basis. The results indicate that properties in Hoosick have been depressed by at least 8.75 percent, and as much as 20 percent or more. These estimates have a defined degree of precision, and can be applied to all individual class properties to determine damages.

I am a Professor in the Department of Economics and the co-director of the Masters' Program in Data Analytics at Tufts University. My fields of research focus on urban and real estate economics, environmental economics, labor economics, and the economics of education. I hold a Ph.D. in Economics from the University of California, San Diego. I have published over 35 articles in peer-reviewed economics journals, as well as several book chapters. I am a Fellow of the Weimer School of Advanced Studies in Real Estate and Land Economics and was previously a Research Affiliate of the Center for Real Estate at the Massachusetts Institute of Technology. I am a co-editor of the *Journal of Housing Economics,* serve on the editorial board of *Real Estate Economics*, and I am an Associate Editor for *Regional Science and Urban Economics*. I am also a board member of the Boston Research Data Center, a research branch of the U.S. Census Bureau.

I have conducted a number of studies on the impacts of environmental conditions on property values and real estate markets in research and public policy contexts. These include applications related to air quality (Kiel and Zabel 2000), the perceived health risks of living near nuclear power plants (Tanaka and Zabel 2018), the impact of Superfund sites (Kiel and Zabel, 2001) and the impact of leaking underground storage tank sites (Zabel and Guignet, 2012). A copy of my curriculum vitae is attached as Appendix A. Staff at Industrial Economics, Inc., an economics and environmental consulting firm in Cambridge, MA, provided technical and administrative support in preparation of this report.

PRIOR TESTIMONY

I have provided expert testimony by deposition as follows:

- Deposition in *Duarte et al. vs. United States Metals Refining Company et al.* U.S. District Court, New Jersey. June 4, 2019.

FEE DISCLOSURE

I am compensated at a rate of $400 per hour for time I spend providing these services, including offering testimony in deposition or in court.

BACKGROUND & APPROACH

From the Complaint dated December 10, 2018, the expert report of Dr. Hyeong-Moo Shin, and data provided by plaintiffs' counsel, I understand that defendants' operations at facilities in the Village of Hoosick Falls resulted in PFOA soil and groundwater contamination that ultimately impacted the Village's municipal water system, and a number of private wells throughout the area. Environmental contamination on or in the vicinity of a property can reduce its market value because of concern over health risks, whether they be documented or perceived risks. I understand that research has associated PFOA exposure with certain adverse health effects and these are described in the expert report of Dr. David Savitz in this case. In January of 2016 Governor Cuomo issued an emergency regulation classifying PFOA as a hazardous substance and designating defendants' primary facility a state Superfund site, among other measures to address public health risks.[1]

The standard economic approach to measuring the impact of environmental contamination on property values is the hedonic property value method. The hedonic method involves developing an econometric model of house prices, their structural features (e.g., number of bathrooms, size of the unit) and relevant neighborhood characteristics, including any disamenities such as environmental contamination, to estimate the specific value (positive or negative) of those attributes. This differs from approaches used by real estate appraisers, for example, to estimate the market value of a home. In addition to the impracticality of assessing the impact of widespread contamination on a home-by-home basis, typical appraisal methods are incapable of providing such estimates with conventional statistical measures of accuracy and reliability.

The hedonic method has a long history of applications in peer-reviewed literature and practice (Boyle and Kiel, 2001; Simons and Saginor, 2006; and, Braden et al., 2011 provide relevant summaries). The method is formally recognized within federal regulations for natural resource damage assessment (Department of Interior, 43 CFR Part 11) and guidelines for economic analyses of environmental policy (U.S. Environmental Protection Agency, 2014). It is also routinely applied by assessors and other real estate data and information authorities.

Development of a hedonic model to measure the impact of environmental contamination requires an understanding of the nature and extent of the contamination, and the timing of public knowledge and awareness of this information. The Village of Hoosick Falls website provides a timeline of events related to investigation and discovery of PFOA contamination in this case.[2] As early as December 2014, municipal water supply users received a letter included with their bill that indicated testing for PFOA had, and would continue to occur. This was followed by letters in April, August and early December describing additional testing and treatment options, culminating in a December 18, 2015 letter with a U.S. EPA statement recommending that the public water supply not be used for drinking or cooking purposes. The EPA statement also recommended as a precautionary measure that children and people with skin conditions avoid prolonged contact with the water, such as long showers or baths.[3]

[1] C8 Science Panel findings: www.c8sciencepanel.org/prob_link.html; PFOA action plan announcement: www.governor.ny.gov/news/governor-cuomo-announces-immediate-state-action-plan-address-contamination-hoosick-falls

[2] www.villageofhoosickfalls.com/Water/timeline.html

[3] www.villageofhoosickfalls.com/Media/PDF/EPAStatementHoosickFallsWaterContamination.pdf

On January 12, 2016, the EPA issued a FAQ fact sheet reiterating its municipal system advisory and notifying residents with private wells that tests are available upon request from the state Department of Health (NYSDOH).[4] Later that month, Governor Cuomo announced the immediate action plan referenced above, which was followed by an EPA statement the next day regarding private wells in Hoosick. The statement advised those with well tests greater than 100 parts per trillion to not use their water for drinking or cooking and recommended all who had not been tested to request NYSDOH to do so, and in the interim utilize bottled water.[5] On February 1 a letter was sent to all Village residents reviewing recent events, the disposition of corrective actions, and an acknowledgement that some financial institutions had suspended mortgage lending due to the circumstances.

Owing to the location of defendants' facilities, and the emphasis on contamination within the Village and town more broadly in state and federal communications, advisories, and media reports, my analysis focuses on property value impacts within the boundaries of the town of Hoosick.[6] I also focus on the time period from January 2016 forward, corresponding to widespread recognition of the severity and extent of contamination as reflected in these same sources.

MODEL DEVELOPMENT, ESTIMATION & RESULTS

I follow a set of standard steps for developing a hedonic model and estimating the impact of PFOA contamination on property values in the town of Hoosick:

1) Acquire property sales and housing characteristics data
2) Organize, check, and prepare data for analysis
3) Specify the hedonic model
4) Estimate the model, interpret results and conduct sensitivity analyses

First, I acquired data on all single-family home transactions and associated characteristics (e.g., square footage, bedrooms, bathrooms, age, lot size) for Rensselaer and Washington Counties from 1998 through September of 2019 from CoreLogic. CoreLogic is a property information and analytics company that compiles public records, assessor data, and other sources to create comprehensive databases of housing transactions.

Second, I generated summary statistics and examined the distribution of variables in the dataset to identify anomalies that may have been recorded incorrectly and any outlying observations that may have undue influence on model results. Specifically, I removed sales according to the following criteria:

- Square feet, beds, baths, lot size, or age missing
- Outside the 1st and 99th percentile of price per square foot

[4] www.epa.gov/sites/production/files/2016-01/documents/hoosickfalls_faqs.pdf
[5] www.villageofhoosickfalls.com/Water/Documents/EPAStatementPrivateWellsTownHoosick_012816.pdf
[6] I understand from Dr. Shin's report that the eastern area of the town was excluded from the class "Contamination Zone" because it was contaminated by both the Hoosick Falls McCaffrey Street facility and the Chemfab facility in North Bennington, VT. This distinction is not relevant to my estimation of the impact of PFOA contamination on property values and I include sales data from the entirety of the town in my analysis.

- Home size greater than 5,000 square feet
- Lot size greater than 10 acres

In addition, following standard practice, I eliminated all sales flagged as "REO" (real estate owned), as these reflect sales of foreclosed properties that are not arms-length in nature. Geographic Information System (GIS) analysis was used to locate transactions based on coordinates provided with the sales data, and checked against address information that was also provided. A small number of transactions where location could not be verified based on coordinate or address information were also removed.

Third, I specified a hedonic model, which explains variation in sale prices as a function of property characteristics, location (jurisdiction) attributes, and changes over time. The model compares yearly changes in prices in the town of Hoosick relative to control areas in order to estimate the impact of the contamination on house prices. The dependent variable (sale price) is specified in logarithmic form:

$$\log\left(P_{ijt}\right) = \beta_0 + X_{it}\beta_l + Z_j\beta_2 + H_j\beta_t^h + C_j\beta_t^c + e_{ijt}, \quad i = 1,\ldots, n \text{ and } t = 1,\ldots,T \qquad (1)$$

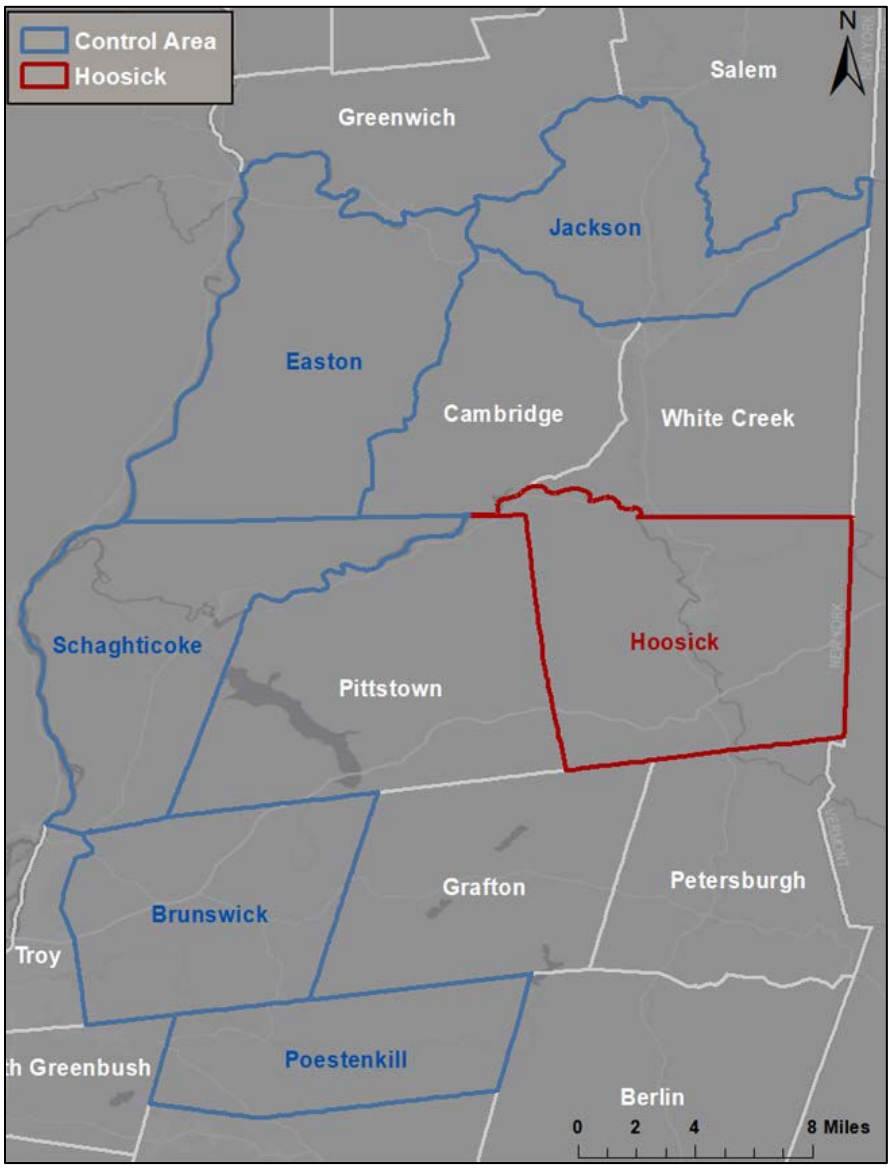
where P_{ijt} is the price of the property i, in jurisdiction j, at time t, X_{it} is a vector of characteristics for property i at time t, Z_j are indicators of jurisdiction j in which the house is located to control for differences in community quality, and H_j and C_j are indicators of the house being in Hoosick or control jurisdictions, respectively, and e_{ijt} is a standard error term. There are n housing transactions in the sample and T time periods (22 years). In the model, I employ a flexible functional form that expresses some property characteristics as indicator variables (e.g., the numbers of bedrooms, number of bathrooms, and age ranges) and allows square footage and lot size to vary nonlinearly with price. Variable definitions are provided in Exhibit 1 below.

Exhibit 1. Hedonic Model Variable Definitions

Variable	Definition
age1_10	Age 1-10
age11_20	Age 11-20
age21_30	Age 21-30
age31_40	Age 31-40
age41_50	Age 41-50
age51_60	Age 51-60
age61_80	Age 61-80
age81_100	Age 81-100
age101p	Age 101+
lotsize_a	Lot Size (Acres)
lotsize_a2	Lot Size Squared
baths2	2 Bathrooms
baths3	3 Bathrooms
baths4p	4+ Bathrooms
beds2	2 Bedroom
beds3	3 Bedroom
beds4	4 Bedrooms
beds5	5 Bedrooms
beds6p	6+ Bedrooms
sqfeet	Square Feet
sqfeet2	Square Feet Squared

Next, I identified a set of control towns (the C_j) to include in the model. Control towns should have similar trends in housing prices to Hoosick prior to awareness and publicity of the PFOA contamination, and generally may be thought of as proximate areas that are in the same or similar real estate markets. I also consulted with an assessor from the area for information about the local market characteristics. Figure 1 below highlights the five towns included as the control area: Jackson, Easton, Schaghticoke, Brunswick, and Poestenkill. Towns bordering Hoosick are excluded, as properties in these areas may also have been impacted to some degree by information and news regarding the contamination, or in the case of Petersburgh and Berlin, PFOA contamination from another source. In the next section of the report I consider the sensitivity of model results to alternative configurations of these control towns.

Figure 1. Town of Hoosick and Control Towns



Fourth, I estimated the model (equation 1). Estimation results are presented in Exhibit 2. The signs, significance and magnitude of coefficients on the structural characteristics conform to expectations, indicating generally that newer, larger homes on larger lots, sell at higher prices, all else equal. For example, on average, a house with two bathrooms sells for approximately 10 percent more than a house with one bathroom, all else equal (the coefficeint estimate for baths2 is 0.103).

Exhibit 2. Hedonic Model Estimation Results

House Characteristics			Year			Hoosick Year		
Variable	Coefficient	SE	Variable	Coefficient	SE	Variable	Coefficient	SE
age1_10	0.648***	(0.028)	1999	-0.019	(0.035)	1999	-0.025	(0.082)
age11_20	0.628***	(0.028)	2000	0.055	(0.036)	2000	-0.020	(0.084)
age21_30	0.573***	(0.029)	2001	0.076**	(0.036)	2001	-0.102	(0.081)
age31_40	0.527***	(0.029)	2002	0.161***	(0.036)	2002	-0.020	(0.087)
age41_50	0.514***	(0.028)	2003	0.198***	(0.036)	2003	0.049	(0.082)
age51_60	0.447***	(0.029)	2004	0.340***	(0.038)	2004	-0.159*	(0.094)
age61_80	0.399***	(0.028)	2005	0.461***	(0.037)	2005	-0.038	(0.085)
age81_100	0.292***	(0.032)	2006	0.516***	(0.037)	2006	-0.051	(0.079)
age101p	0.262***	(0.028)	2007	0.651***	(0.039)	2007	-0.154*	(0.087)
lotsize_a	0.080***	(0.010)	2008	0.643***	(0.038)	2008	-0.023	(0.096)
lotsize_a2	-0.009***	(0.001)	2009	0.604***	(0.040)	2009	-0.188*	(0.096)
baths2	0.103***	(0.013)	2010	0.532***	(0.040)	2010	0.037	(0.099)
baths3	0.269***	(0.022)	2011	0.579***	(0.040)	2011	-0.076	(0.101)
baths4p	0.263***	(0.047)	2012	0.589***	(0.041)	2012	-0.150	(0.100)
beds2	0.141***	(0.048)	2013	0.539***	(0.038)	2013	-0.131	(0.091)
beds3	0.185***	(0.048)	2014	0.531***	(0.039)	2014	-0.158*	(0.089)
beds4	0.174***	(0.049)	2015	0.581***	(0.038)	2015	-0.138	(0.089)
beds5	0.137**	(0.056)	2016	0.585***	(0.035)	2016	-0.276***	(0.096)
beds6p	0.111	(0.071)	2017	0.653***	(0.035)	2017	-0.226**	(0.090)
sqfeet	0.041***	(0.004)	2018	0.660***	(0.035)	2018	-0.173**	(0.083)
sqfeet2	-0.000***	(0.000)	2019	0.668***	(0.039)	2019	-0.268***	(0.091)
Constant	3.154***	(0.067)						

Observations	**6,204**
R-squared	**0.487**
Number of Towns	**6**

***** p<0.01, ** p<0.05, * p<0.1**

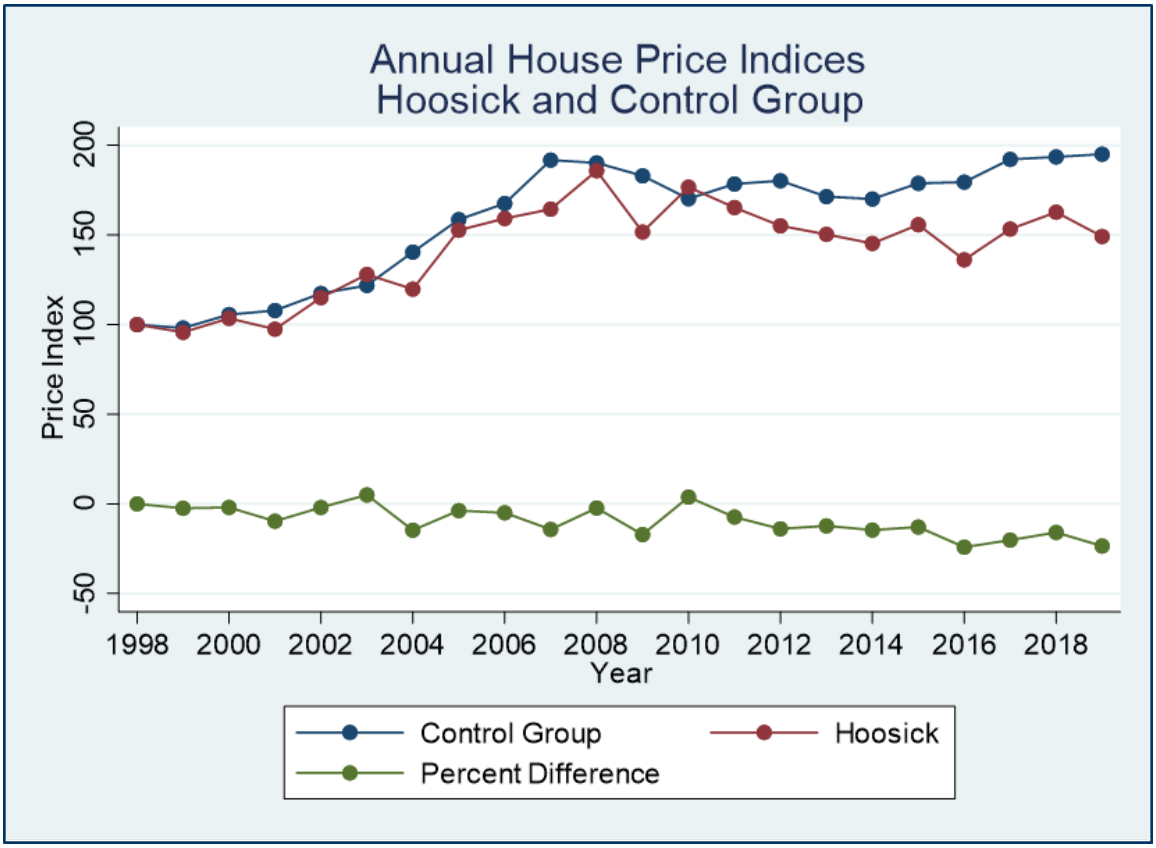
The coefficients on the "Year" variables reflect the annual change in prices (controlling for differences in house characterisitcs and towns) across all towns relative to the initial year of 1998. Coefficients on the "Hoosick Year" variables track annual changes in the town of Hoosick relative to the control group. Importantly, differences between Hoosick and the other towns are generally statistically insignificant over time, until 2016. This indicates that the five identified towns are suitable control areas for the town of Hoosick. Coefficients on the Hoosick Year variables for 2016 through 2019 are significant at the five-percent level or greater, and suggest reductions in average sale prices relative to the other towns on the order of 16 to 24 percent.[7]

Figure 2 displays these results graphically. The estimated changes in prices from the hedonic model are set to 100 in 1998, the initial year, and are displayed as separate price indices for the town of Hoosick and all the other five towns together that make up the control group. Hence, values in years after 1998 indicate price levels in Hoosick and the control group relative to those in 1998. As shown,

[7] Because the dependent variable in the hedonic model is the natural log of price, the coefficient estimate of -0.276 for year 2016 for Hoosick is interpreted as follows: on average, house prices in Hoosick are 24.1% lower than house prices in the control group, all else equal. This involves the following formula: $100*(1-e^{-0.276}) = -24.1\%$. The impacts in other years are calculated in a similar manner.

historically the two indices generally move together, but deviate more noticeably in the period from 2016 forward.

Figure 2. Estimated Price Indices for Town of Hoosick and Control Areas



Statistical results from the hedonic model allow for different interpretations of the impact of the PFOA contamination on property values in the town of Hoosick. Define the years 2016 through 2019 as the 'post' contamination period, and the four years preceding 2016 as the 'pre' contamination period. Define the "post average difference" as the average of the price differences between Hoosick and the control group in the post contamination period and the "pre average difference" as the average of the price differences between Hoosick and the control group in the pre contamination period. Then, one measure of the impact of the PFOA contamination on property values in the town of Hoosick is the difference in the post average difference and the pre average difference. This suggests a reduction in property values of 8.75% and is statistically significant at the 10-percent level.[8]

[8] Hypothesis tests for the statistical significance of the impact of PFOA contamination are based on a null hypothesis that the impact is greater than or equal to zero versus an alternative hypothesis that it is less than zero. The hypothesis test is carried out by comparing the value of the test statistic with a cutoff value that depends on the Type I error allowed for the hypothesis test (Type I error is the probability of rejecting the null hypothesis when it is true). The test is rejected if the value of the test statistic is less than this cutoff value; the evidence is consistent with the alternative hypothesis that the impact is less than zero. Typical values for Type I error are 1%, 5%, and 10%. This is also referred to as the "significance level of the test." The smaller the significance level, the stronger is the evidence needed to reject the null hypothesis. To say that a test is "significant at the 1% level" means that the test is rejected at a 1% significance level. The same holds for 5% and 10% significance level.

This is a conservative estimate (i.e., more likely to understate the impact), however, because the price differences in the pre contamination period are not jointly statistically significant (that is, statistically we cannot reject that they are the same). Examining just the post average difference implies a reduction in property values of 21% and these annual differences are jointly significant at the 5-percent level. Finally, the largest impact is observed in the year 2016, where the difference in prices in Hoosick relative to control areas was approximately 24%. That difference is significant at the 1-percent level.

To investigate the sensitivity of these results to alternative configurations of the control towns, I also estimated models including the adjacent towns of White Creek, Cambridge, Pittstown and Grafton, and an expanded area that included the towns of Greenwich and Salem to the north. These models yielded similar results, with very small absolute differences in impact estimates relative to their magnitude.

CONCLUSIONS

To determine the impact of PFOA contamination, I conducted a standard hedonic analysis that compared changes in sales prices in the town of Hoosick to other areas over time, controlling for differences in property and community characteristics. The hedonic property value method is the standard economic approach to measuring the impact of environmental contamination on property values and has a long history of these applications in peer-reviewed literature and in practice.

The estimates provided here have a defined level of precision (as discussed above), and are robust to alternative modeling assumptions. They can be used to calculate the total impact on property values in Hoosick by applying the percentage diminution to estimates of the market value (absent the effect of contamination) of each property, as reflected, for example, in assessors' records.

REFERENCES

Boyle, M.A. and K.A. Kiel. 2001 "A Survey of House Price Hedonic Studies of the Impact of Environmental Externalities," *Journal of Real Estate Literature* 9(2): 117-144.

Braden, J.B., X. Feng and A. Won. 2011. "Waste Sites and Property Values: A Meta-Analysis," *Environmental and Resource Economics* 50(2): 175-201.

Kiel, K.A. and J.E. Zabel. 2001. "Estimating the Economic Benefits of Cleaning Up Superfund Sites: The Case of Woburn, Massachusetts," *The Journal of Real Estate Economics and Finance* 22(2-3): 163-184.

Simons, R.A. and J.D. Saginor. 2006. "A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values," *Journal of Real Estate Research,* 28(1): 71-104

Tanaka, S. and J.E. Zabel. 2018. "Valuing Nuclear Energy Risks: Evidence from Fukushima Crisis and U.S Housing Prices," *Journal of Environmental Economics and Management* 88: 211-224**.**

Zabel, J.E. and D. Guignet. 2012. "A Hedonic Analysis of the Impact of LUST Sites on House Prices," *Resource and Energy* Economics 34: 549– 564.

Zabel, J.E. and K.A. Kiel. 2000. "Estimating the Demand for Air Quality in Four United States Cities," *Land Economics* 76: 174-193.

U.S. Environmental Protection Agency. 2014. Guidelines for Preparing Economic Analyses. National Center for Environmental Economics, Office of Policy.

APPENDIX A

CV

Jeffrey E. Zabel
CURRICULUM VITAE

Current Affiliation: Professor of Economics
Department of Economics
Tufts University
Medford, MA 02155
Phone: 617-627-2318
FAX: 617-627-3917
email: jeff.zabel@tufts.edu

Fields of Research: Urban/Real Estate Economics, Environmental Economics, Economics of Education,

Teaching Experience: Graduate and Undergraduate Statistics and Econometrics, Undergraduate Environmental Economics and Labor Economics

Education:
Ph.D. in Economics, 1987, University of California, San Diego
B.A. in Mathematics, 1979, Swarthmore College

Employment History:

2010 – present	Professor of Economics, Tufts University, Medford, MA
2014, Spring	Visiting Professor, Economics Department, Harvard University
2013, Fall	Associate of the Department, Economics Department, Harvard University
2010 – 2013, 2015-2016	Director, Graduate Program in Economics, Tufts University
Fall 2008 – Spring 2009	Visiting Scholar, New England Public Policy Center
Fall 2005 – Spring 2006	Visiting Scholar, Center for Real Estate, MIT, Cambridge, MA
1996-2010	Associate Professor of Economics, Tufts University, Medford, MA
1989-1996	Assistant Professor of Economics, Tufts University, Medford, MA
1993-1994	ASA Research Fellow, U.S. Bureau of the Census
1988-1989	Assistant Professor of Economics, Tulane University, New Orleans, LA
1987-1988	Visiting Assistant Professor of Economics, Tulane University, New Orleans, LA

Administrative Positions:

2018 – present	Co-Director, Masters Program in Data Analytics, Tufts University
2015 – present	Co-Director, PhD Program in Human Developmental Economics, Tufts University
Fall 2016 – Spring 2017	Director of Graduate Program, Tufts University
Fall 2010 – Spring 2013	
Fall 2001 – Spring 2005	
Fall 1992 – Spring 1993	

Publications in Refereed Journals:

"Estimating Fixed and Random Effects Models with Selectivity," **Economics Letters** 40 (1992) 269-272.

"A Comparison of Non-Nested Tests for Misspecified Models Using the Method of Approximate Slopes," **Journal of Econometrics** 57 (1993) 205-232.

"The Relationship Between Hours of Work and Labor Force Participation in Four Models of Labor Supply Behavior," **Journal of Labor Economics**, 11 (1993) 387-416.

"House Price Differentials in U.S. Cities: Household and Neighborhood Racial Effects," with Katherine A. Kiel, **Journal of Housing Economics** 5 (1996) 143-165.

"Evaluating the Usefulness of the American Housing Survey for Creating House Price Indices," with Katherine A. Kiel, **Journal of Real Estate Finance and Economics** 14 (1997) 189-202.

"Estimating Wage Elasticities for Life-Cycle Models of Labor Supply Behavior," **Labour Economics** 4 (1997) 223-244.

"An Analysis of Attrition in the PSID and SIPP with an Application to a Model of Labor Market Behavior," **Journal of Human Resources** 33 (Spring 1998) 479-506.

"The Accuracy of Owner Provided House Values: The 1978-1991 American Housing Survey," with Katherine A. Kiel, **Real Estate Economics, the Journal of the American Real Estate and Urban Economics Association**, 27 (1999) 263-298.

"Controlling for Quality in House Price Indices," **Journal of Real Estate Finance and Economics** 19 (1999) 223-241.

"Estimating the Demand for Air Quality in Four United States Cities," with Katherine A. Kiel, **Land Economics**, 76 (2000) 174-193.

"The Economic Benefits from Cleaning Up Superfund Sites: The Case of Woburn Massachusetts," with Katherine A. Kiel, **Journal of Real Estate Finance and Economics** 22 (2001) 163-183**.**

"The Impact of School Characteristics on House Prices: Chicago 1987-1991," with Thomas A. Downes, **Journal of Urban Economics** 22 (2002) 1-25.

"Neighborhood Effects and Housing Demand," with Yannis Ioannides, **Journal of Applied Econometrics**, 18 (2003) 563-58

Publications in Refereed Journals: Continued:

"The Demand for Housing Services," **Journal of Housing Economics,** 13 (2004) 16-35.

"The Effects of Critical Habitat Designation on Housing Supply: An Analysis of California Housing Construction Activity," with Robert Paterson, **Journal of Regional Science**, 46 (2006): 67-95.

"Interactions, Neighborhood Selection, and Housing Demand," with Yannis Ioannides, **Journal of Urban Economics,** 63 (2008): 229-252.

"The Employment Impacts of Active Labour Market Policy: The Case of SSP Plus," with Saul Schwartz, **Canadian Public Policy,** 34(2008): 321-344**.**

"The Impact of Peer Effects on Student Outcomes in New York City Public Schools," **Education Finance and Policy**. 3(2008): 197-249.

"Location, Location, Location: The 3L Approach to House Price Determination," with Katherine A. Kiel, **Journal of Housing Economics,** 17(2008): 175-190**.**

"Amenity-Based Housing Affordability Indexes," with Lynn Fisher and Henry Pollakowski, **Real Estate Economics**, 37(2009): 705-746.

"It's Not Just Span: Size, Spending and Grade Span in K-8 School Organization," with Ross Rubenstein, Amy Ellen Schwartz, and Leanna Stiefel, **Education Finance and Policy,** 4(2009): 60-88.

"The Impact of the Self-Sufficiency Project on the Employment Behaviour of Former Welfare Recipients." with Saul Schwartz and Stephen Donald, **Canadian Journal of Economics,** 43(2010): 882-918.

"Property Tax Limitations and Local Fiscal Conditions: The Impact of Proposition 2½ in Massachusetts," with Bruce Wallin, **Regional Science and Urban Economics**, 41(2011): 382-393

"The Impact of Minimum Lot Size Regulations on House Prices in Eastern Massachusetts, with Maurice Dalton, **Regional Science and Urban Economics,** 41(2011): 471-483.

"The Path Not Taken: How does School Organization Affect 8th Grade Achievement?" with Amy Ellen Schwartz, Leanna Stiefel, and Ross Rubenstein, Wagner School of Public Policy, New York University, **Educational Evaluation and Policy Analysis** 33(2011): 293-317.

Publications in Refereed Journals: Continued:

"The Role of the Housing Market in the Migration Response to Employment Shocks," **Journal of Urban Economics** 72 (2012): 267–284.

"A Hedonic Analysis of the Impact of LUST Sites on House Prices in Fredrick, Baltimore, and Baltimore City Counties," with Dennis Guignet, **Resource and Energy Economics** 34 (2012): 549– 564.

"An Analysis of the Impact of SSP on Wages," with Saul Schwartz and Stephen Donald, **Empirical Economics,** 44 (2013): 231-259.

"What Can We Learn From Hedonic Models When Housing Markets are Dominated by Foreclosures?" (2013) with N. Edward Coulson. **Annual Review of Resource Economics, Volume 5.**

"Unintended Consequences: The Impact of Proposition 2½ Overrides on School Segregation in Massachusetts," **Education Finance and Policy** 9(4) (2014): 481-514.

"The Hedonic Model and the Housing Cycle," **Regional Science and Urban Economics** 54 (2015): 74-86.

"Is Neighborhood Destiny? Exploring the Link between Neighborhood Mobility and Student Outcomes," with Amy Ellen Schwartz, Leanna Stiefel, and Sarah Cordes Wagner School, NYU, **Urban Studies** 53(2) (2016): 400-417.

"A Dynamic Model of the Housing Market: The Role of Vacancies," **Journal of Real Estate Finance and Economics 53(3)** (2016): 368–391

"Valuing Nuclear Energy Risks: Evidence from Fukushima Crisis and U.S Housing Prices," with Shinsuke Tanaka. 2018. **Journal of Environmental Economics and Management 88: 211-224.**

"Local House Price Diffusion," with Jeffrey P. Cohen. Forthcoming in **Real Estate Economics.** Available online at DOI: 10.1111/1540-6229.12241

"Time-Geographically Weighted Regressions and Residential Property Value Assessment," with Jeffrey P. Cohen and Cletus C. Coughlin, forthcoming in the **Journal of Real Estate Finance and Economics.**

"Homeownership and Wealth Accumulation for Low-Income Households," with Allison Wainer. 2017. Forthcoming in the **Journal of Housing Economics.**

Publications in Conference Volumes/Non-Refereed Periodicals/Other:

"Using United States Census Data to Estimate the Demand for Air Quality," with Katherine A. Kiel. **1995 Annual Research Conference Proceedings, Bureau of the Census,** 1995.

"Compensation Estimates for Homeowners for Environmental Disamenities," with Katherine A. Kiel, **1996 Proceedings of the Eighty-Ninth Annual Conference on Taxation, National Tax Association.**

"Brownfields Cleanup? Or, Brownfields Redevelopment?" **Regions, Newsletter of the National Association of Regional Councils**, Winter 2004, 14-15.

"School Efficiency and Student Subgroups: Is a Good School Good for Everyone?" with Dae Yeop Kim, Leanna Stiefel, and Amy Schwartz, **Peabody Journal of Education,** 81(2006) 4: 95-117.

"The Impact of Imperfect Information on the Transactions of Contaminated Properties," National Center for Environmental Economics (EPA) Handbook on Benefits, Costs, and Impacts of Land Use, December 2006.

"Incomplete Grade: Massachusetts Education Reform at 15," with Thomas Downes and Dana Ansel, The Massachusetts Institute for a New Commonwealth, May 2009.

"Valuation in a Bubble: Hedonic Modeling Pre- and Post-Housing Market Collapse," with Kevin Boyle, Lynne Lewis, and Jaren Pope, **Association of Environmental and Resource Economists Newsletter** 32(2): 24-31. November 2012

Books/Edited Volumes:

"The Good, the Bad, and the Ugly: Measuring School Efficiency Using School Production Functions," with Amy Schwartz, in **Measuring School Performance and Efficiency: Implications for Practice and Research, 2005 Yearbook of the American Education Finance Association** Editors: Leanna Stiefel, Amy Ellen Schwartz, Ross Rubenstein and Jeffrey Zabel

Measuring School Performance and Efficiency: Implications for Practice and Research, 2005 Yearbook of the American Education Finance Association Editors: Leanna Stiefel, Amy Ellen Schwartz, Ross Rubenstein and Jeffrey Zabel with Editors Introductory Chapter "Measuring School Efficiency: What Have We Learned?" Eye on Education

"Using Hedonic Models to Measure Racial Discrimination and Prejudice in the U.S. Housing Market," in **Hedonic Methods in Housing Markets – Assessing Environmental Amenities and Segregation**, Springer.

"United States Housing Policy," with Ed Olsen, **Handbook of Regional and Urban Economics, Volume 5.**

"Housing and Labor Market Vacancies and Beveridge Curves: Theoretical Framework and Illustrative Statistics," with Yannis Ioannides, Forthcoming in: Ioannides, Yannis M., Ed. **Recent Developments in the Economics of Housing**. Edward Elgar. 2019.

Research Papers:

"The Impact of School Finance Reform on Residential Income Inequality and Racial and Ethnic Segregation in the U.S.," with Peter Zuckerman. 2018

"Housing and Labor Market Vacancies," 2017, with Yannis Ioannides.

Work in Progress:

"Wealth Accumulation and Mortgage Distress for Low-Income Homeowners," to be presented at Symposium on Housing Tenure and Financial Security, Joint Center for Housing Studies, Harvard University, March 21, 2019.

"Educational Equality in Massachusetts: School Finance Reform and Tax and Expenditure Limitations," with Jaeho Kim and Thomas Downes. TO be presented at the Association for Education Finance and Policy 44th Annual Conference, Kansas City MO, March 23, 2019.

"Housing and Labor Market Spillovers," with Guangbin Hong. To be presented at Urban Economics Workshop, Department of Urban and MIT, May 7, 2019

Grants Received:
"Buildings Risk Assessment," Department of Buildings, New York City. With Justin Hollander, Tufts University (PI), Julius Chang, Columbia University, and Rima Taher, New Jersey Institute of Technology (NJIT), October 2017 – October 2018, $120,000 awarded.

"Prospects for Using Class Size Reform to Boost Student Performance in Massachusetts" Bid number: BD-17-1026-DOE02-DOE01-12717, Massachusetts Department of Elementary and Secondary Education. With Amy Schwartz, Syracuse University. May 2017 – August 2017. $30,000 awarded.

"A Disequilibrium Model of the Housing Market: The Role of Vacancies and Foreclosures." CoreLogic Academic Research Council Grant. Provides free access to county-level data on measures of foreclosures and other market conditions. May 2013.

"A Disequilibrium Hedonic Property Value Model." CoreLogic Academic Research Council Grant. Provides free access to housing transaction level data for 5 counties in the Greater Boston Area for 1995-2012. May 2013.

"Massachusetts Proposition 2½ Overrides as Voluntary Taxes: Do Residents Get What They Want or Do They Only Get What They Need?, Lincoln Institute for Land Policy, January 2013 – December 2013, $30,000 awarded.

"The Demand for Citizenship," with Robert Paterson, Industrial Economics. Submitted in response to RFQ HSHQDC-10-Q-00375 to the U.S. Department of Homeland Security, Office of Procurement Operations, September 2010 – August 2011, $175,000 awarded.

"Estimating the Social Benefits of Cleanup Activities by EPA's Underground Storage Tank Program: Two Approaches," with Anna Alberini, University of Maryland, Cynthia Morrison and Robert Paterson, Industrial Economics Inc. Submitted to the Environmental Protection Agency, January 2008 – August 2010, $170,000 awarded.

"How Should We Organize Primary Schooling? Grade Span, School Size and Student Academic Performance," U.S. Department of Education, (with Amy Schwartz and Leanna Stiefel, New York University, and Ross Rubenstein, Syracuse University), $487,910 grant awarded, August 2004 – May 2006, R305E040096.

"Stormwater Management in Somerville Massachusetts," City of Somerville, MA through a grant from the EPA, $16,984 grant awarded, January 2004 – August 2004.

"An Economic Analysis of Brownfields in Massachusetts," Tufts University Faculty Research Fund Award, $4,800 grant awarded, March 2003.

Grants Received (continued):
"Student Projects to Evaluate Brownfields Sites in Somerville, MA," UCCPS Education for Active Citizenship Grant, Tufts University, $2000 grant awarded, June 2001.

"Measuring and Accounting for Performance in the US K-12 Public Schools," U.S. Department of Education, (with Amy Schwartz and Leanna Stiefel, New York University, and Ross Rubenstein, Syracuse University), $658,096 grant awarded, June 2001 – May 2004, R305T010115.

"Calculating the Economic Benefits from Cleaning Up Superfund Sites: the Case of Woburn Massachusetts - Extensions," Faculty Research Fund Award, Tufts University, $5,000 grant awarded, March 2000.

"Climate Change Course Development Proposal for Economics 30 - Environmental Economics," Tufts Institute for the Environment, $5,080 grant awarded, May 1999.

"An Analysis of Individual Perceptions of Air Quality," Faculty Research Fund Award, Tufts University. 1997-1999. $3,592 grant awarded.

Contracts Awarded:

"Between Home and School: The School Bus and Student Outcomes," Ay Schwartz, Syracuse PI, Spring 2018 – Summer 2018, $5,000.

"A Proposed Feasibility Study for Analyzing the Benefits of Say Yes Buffalo," Say Yes to Education, fall 2017, $12,000 awarded.

"The Impact of the 1993 Massachusetts Education Reform Act," MassINC, with Thomas Downes, $30,000 awarded, summer 2007 – April 2009.

"Research papers to Support Development of NCEE's Handbook on Benefits, Costs, and Impacts of Land Use," EPA Contract 66-W-02-045; Task Order 58, with Industrial Economics, Inc and Resources for the Future. $12,000 awarded, 2006.

"Economic Impact of Critical Habitat Designation Under the Endangered Species Act: Model and Case Study Research Project," National Association of Homebuilders, September 2005, $49,020.70 awarded.

"An Analysis of the Impact of SSP on Employment With a Focus on Wages," response to RPF: The Self-Sufficiency Project, SRDC, Canada. With Saul Schwartz and Stephen Donald. Contract awarded, December 2003: $15,000.

Contracts Awarded Continued:

"An Analysis of SSP PLUS on unemployment spells and employment spells," response to RPF: The Self-Sufficiency Project, SRDC, Canada. With Saul Schwartz and Stephen Donald. Contract awarded, December 2003: $15,000.

Invited Seminars and Conferences (last three years):

- Symposium on Housing Tenure and Financial Security, Joint Center for Housing Studies, Harvard University, March 21-22, 2019 (presenter)
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, October 26, 2018 (organizer)
- Urban Economics Association, Annual Conference, New York NY, October 12–13, 2018 (presenter and discussant)
- Urban Economics and Public Finance Conference, Lincoln Institute for Land Policy, Cambridge, MA, May 4-5, 2017 (participant)
- Endogenous Amenities and Cities, Florida State University, April 26-April 28, Organizer and discussant
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, April 13, 2018 (organizer)
- Urban Economics Association, Annual Conference, Vancouver BC, November 9–11, 2017 (presenter and discussant)
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, October 27, 2017 (organizer)
- Urban Economics and Public Finance Conference, Lincoln Institute for Land Policy, Cambridge, MA, May 5-6, 2017 (discussant)
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, April 14, 2017 (organizer)
- 2017 FSU-UF Critical Issues In Real Estate Symposium, Florida State University, March 30-April 1 2017 (discussant)
- Seminar in Environmental Economics and Policy, Kennedy School of Government, Harvard University, February 25, 2017 (presenter)
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, October 21, 2016 (organizer)
- American Real Estate and Urban Economics Association National Meeting, Washington DC May 31- June 1, 2016 (presenter and discussant)
- Urban Economics and Public Finance Conference, Lincoln Institute for Land Policy, Cambridge, MA, May 4-5, 2016 (participant)
- Greater Boston Urban and Real Estate Economics Seminar, Federal Reserve Bank of Boston, April 8, 2016 (organizer)
- Workshop on Public, Urban and Regional Economics, Federal Reserve Bank of Cleveland, February 26-27, 2016 (presenter)

Awards and Fellowships:

- Teacher of the Year Award, Tufts Undergraduate Economics Program, 2016
- Teacher of the Year Award, Tuft Graduate Economics Program, 2016
- Asian Real Estate Society, RICS Foundation Best Paper Award, July 2006.
- Faculty Research Fellowship, Tufts University, 2005.
- Housing and Urban Development (HUD)/AREUEA Best Paper in Housing and Urban Development, 2001 Annual AREUEA Conference, New Orleans, LA.
- American Statistical Association Research Fellowship, 1993-1994.
- Mellon Research Fellowship, Tufts University, 1993.

Editorial/Board Member Affiliations:

- Board Member of the Boston Research Data Center (BRDC). The BRDC is a research branch of the Census Bureau, 2001 – Present.
- Associate Editor, Regional Science and Urban Economics, 2007 – present.
- Editorial Board, Journal of Housing Economics, 2008 – present.
- Editorial Board, Real Estate Economics, 2009 – present

External Reviewer:

- Clark University, Economics Department, Ph.D. Program, January 2004.
- UCLA, Economics Department, Masters' Program, March 2014.
- George Washington University, Economics Department, December 2018.

Professional Affiliations:

- Fellow, Weimer School of Advanced Studies in Real Estate and Land Economics, 2014 – present
- Research Affiliate, Institute for Education and Social Policy, New York University, 2008 – present.
- Research Affiliate, Center for Real Estate, MIT, Cambridge, MA, June 2006 – June 2008.

Seminar Organizer:
Co-organizer (with Paul Willen) of the Greater Boston Urban and Real Estate Economics Seminar held at the Federal Reserve Bank of Boston
(see https://sites.google.com/site/gburees/)

Member: American Economic Association, American Real Estate and Urban Economics Association, Urban Economics Association.

Consulting Work:
Industrial Economics, Inc, January 2004 – present.

Referee for: Numerous journals, government agencies, and foundations