An Investigation of the Relationship between Rail Accidents and Property Values in the Era of Unconventional Energy Sources

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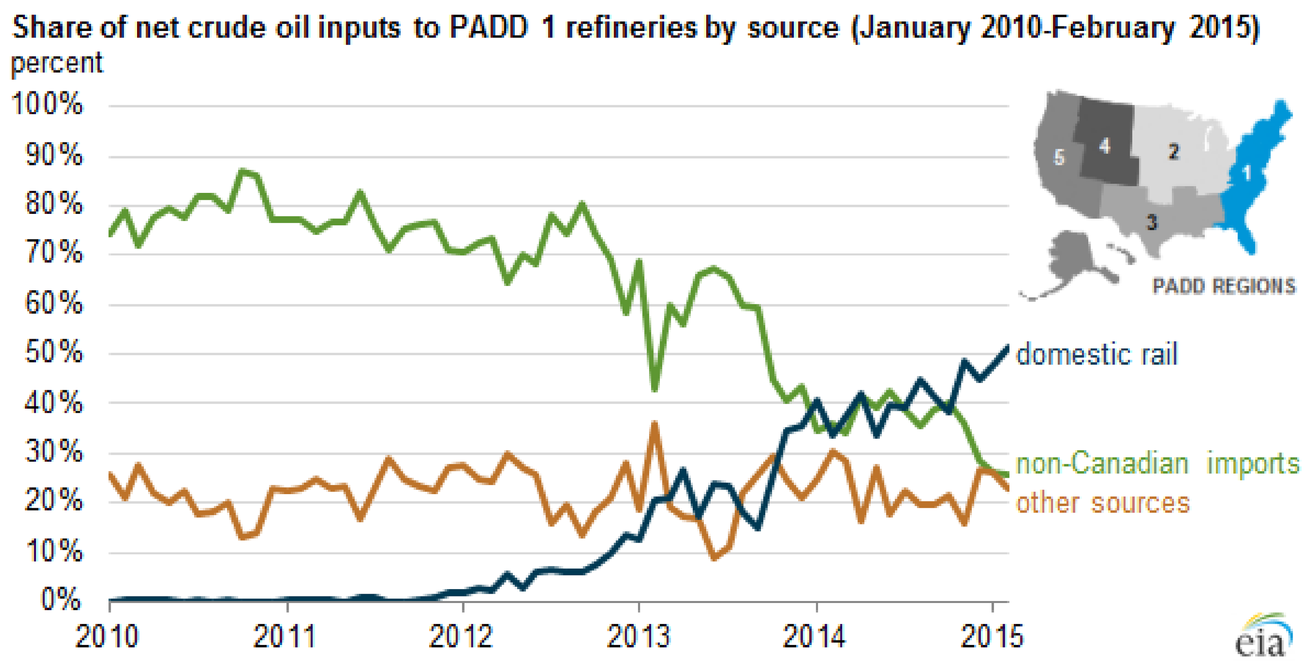
Abstract

This paper provides the first rigorous evaluation of the implicit cost of derailment involving hazardous materials using property values as a metric. We estimate the effect of derailment shock on property values based on 33 derailment occurred in New York State between 2004 and 2013 along with property transaction data within five miles away from railroad in the entire state. Employing difference-in-difference (DiD) strategy, we find that, on average, a derailment depreciates housing values by 5 to 7% for properties within one mile of derailment sites. The effect of a derailment on nearby property values is not permanent: dropped housing price returns to the pre-accident levels after 480 days. Finally, we find that impacts of derailments on property values are limited to local area. This result provides empirical evidence for valuing transportation alternatives in the era of U.S. energy transformation with substantial increases in the rail shipment of fuels.



Lac-Mégantic, Quebec, 2013

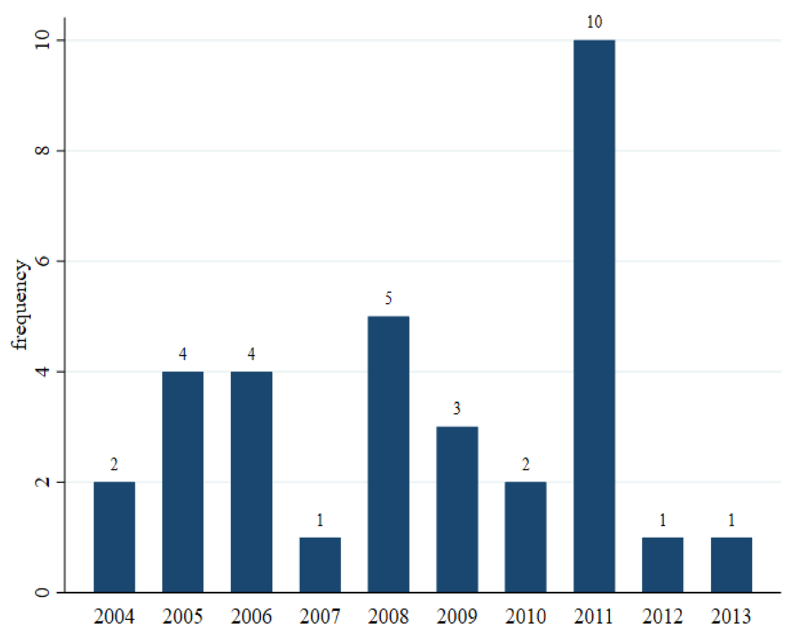
Methodology

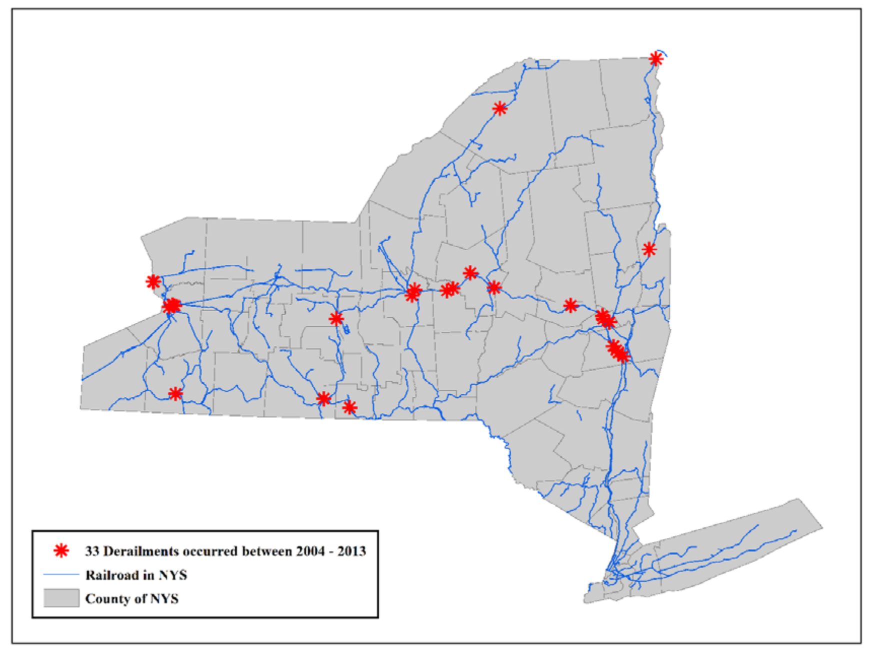
A difference-in-differences (DiD) analysis framework relying on variations inherent in the discussed four DiD transaction groups can help to address the endogenous problem. The DiD model is specified as below:

$$ln(Price)_{ijt} = \alpha + \delta_j + \delta_y + \beta_1 M_{it} + \beta_2 T_{it} + \gamma(M_{it} \cdot T_{it}) + \lambda X_{it} + \kappa D_{it} + \phi_i \times t + \varepsilon_{ijt}$$

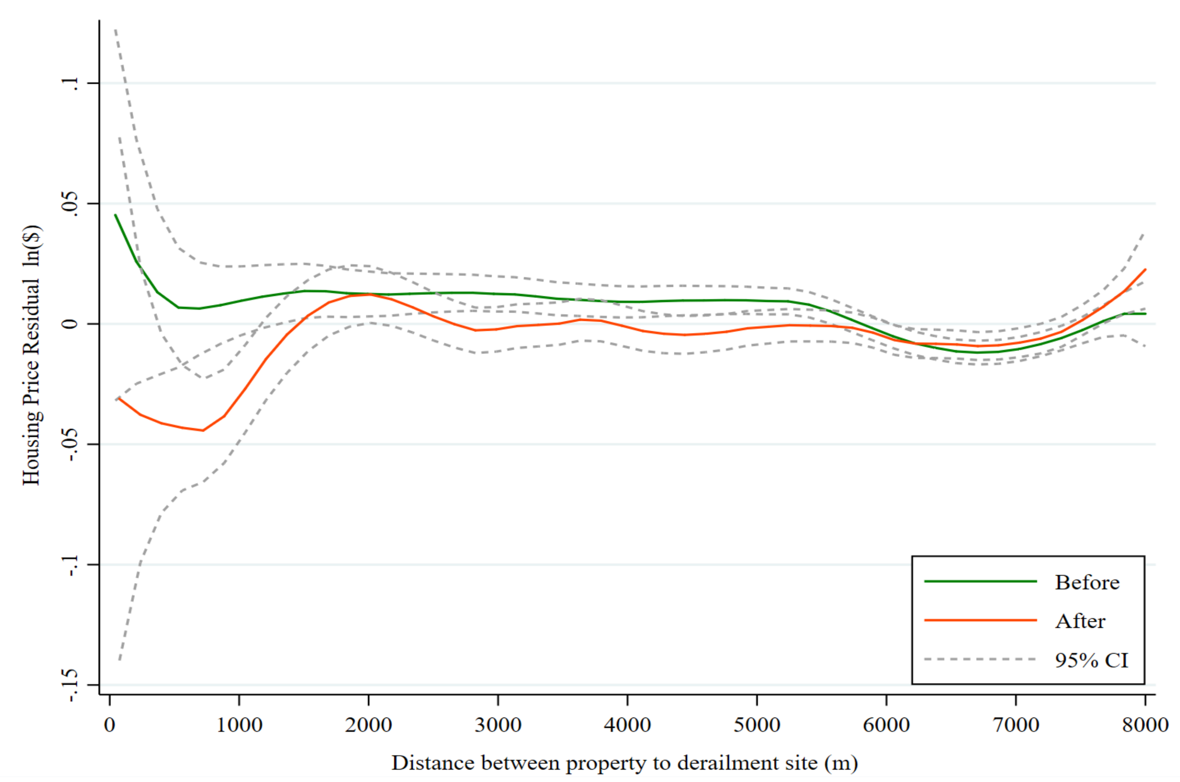
Where i denotes individual transactions, j denotes each derailment, and t denotes the time when transaction occurs. δ_j and δ_y stand for the spatial (e.g., census tract) and temporal fixed effects (i.e., sale month and year) respectively. T is a dummy for whether or not a transaction occurred within 480 days after a derailment. And β_1 and β_2 are coefficients of treatment group and after derailment dummy. X is a vector of property characteristics, including structural characteristics and neighborhood features. Moreover, D is the dummy for any other incidents other than derailment occurred within 1 mile and 480 days before a transaction, D equals to one if there are at least one other incident occurred nearby, zero otherwise. Additionally, M is a dummy that equals to one if a transaction is in the treatment group (within 1 mile of derailment). The coefficient γ for the interaction between M and T is the difference-in-differences estimators for the derailment shock on property values. In order to control for the diverse local temporal trends, we introduce the derailment site specific time trend control ($\phi_i \times t$).

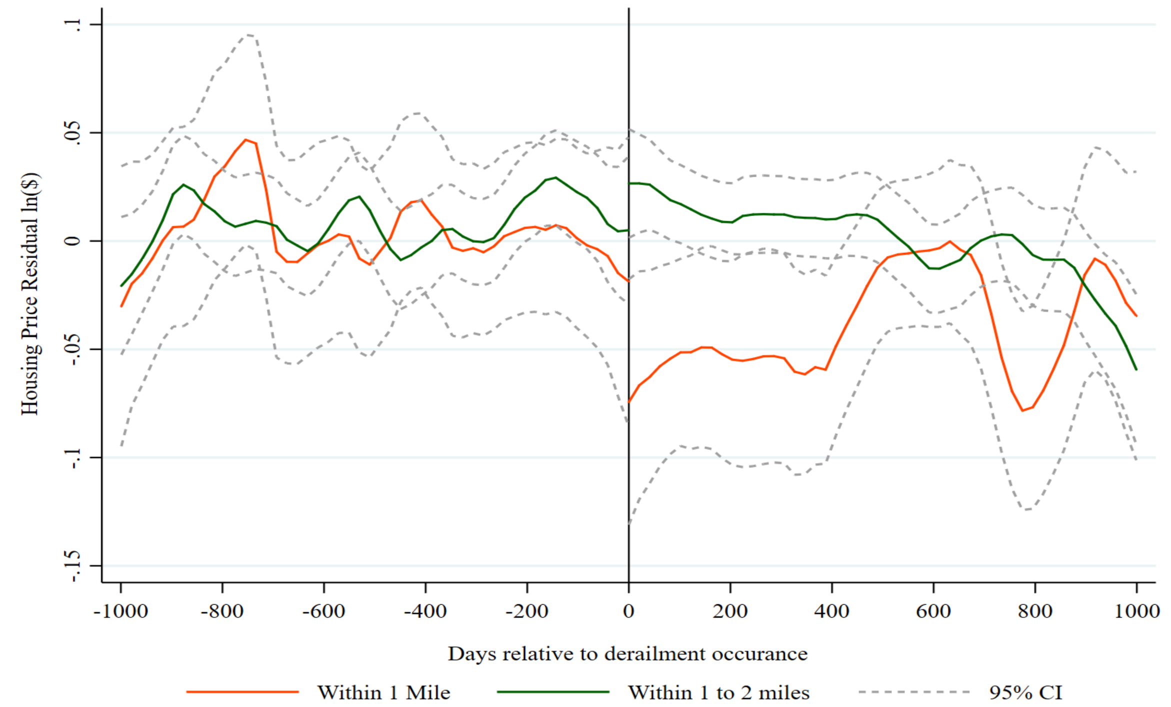
Study Area and Derailments Occurred between 2004 and 2013

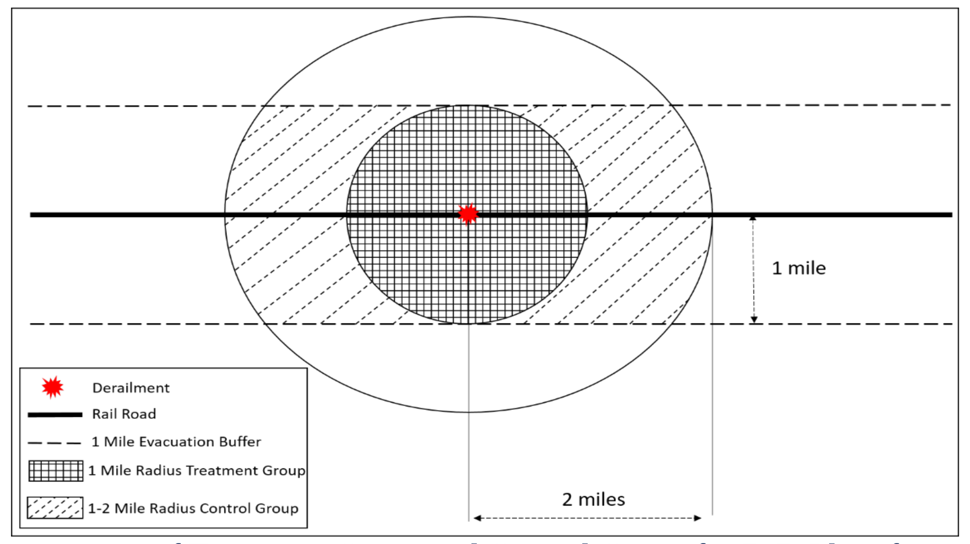




Spatial and Temporal Extents of Derailment Shocks







Demonstration of Treatment Group and Control Group for DiD Identification

Main Results and Conclusions

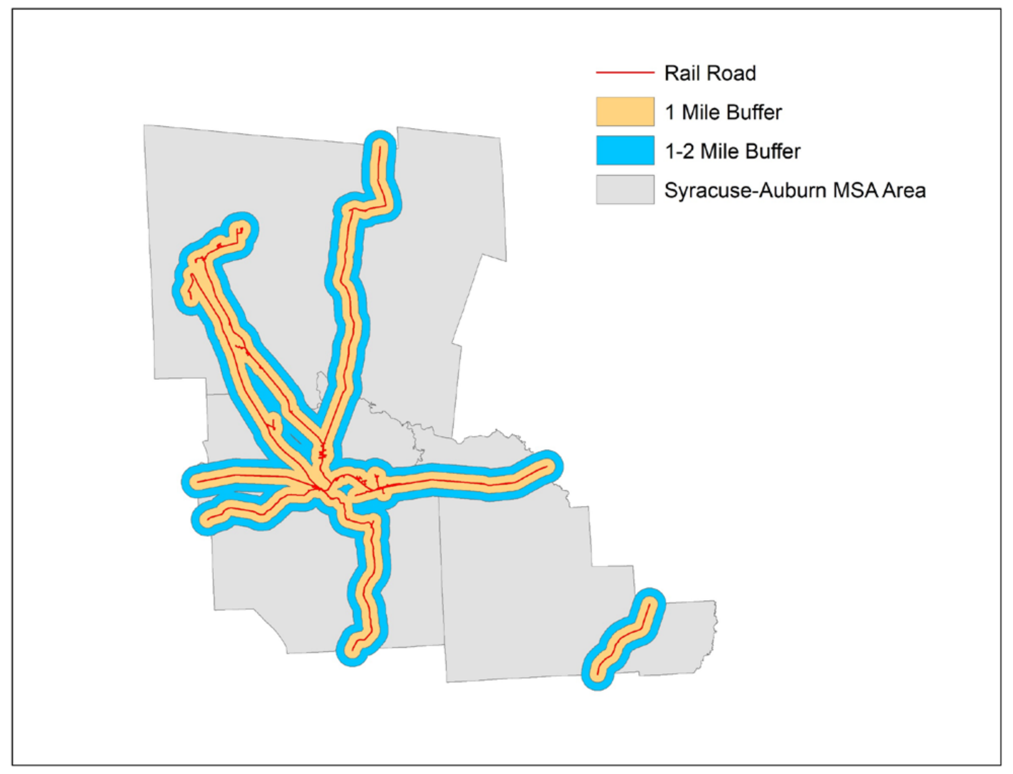
1. Local Effect

	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treatment	-0.070***	-0.060***	-0.075***	-0.052**	-0.048**	-0.056**
	(0.0263)	(0.0177)	(0.0220)	(0.0229)	(0.0231)	(0.0233)
Post	0.001	0.014	0.003	-0.003	0.006	-0.002
	(0.0149)	(0.0194)	(0.0113)	(0.0119)	(0.0189)	(0.0124)
Treatment	-0.030	-0.007	-0.014	-0.010	-0.005	-0.004
	(0.0195)	(0.0396)	(0.0277)	(0.0234)	(0.0244)	(0.0234)
Other Incidents	-0.030	0.017	-0.027	-0.033*	-0.034	-0.034
	(0.0182)	(0.0159)	(0.0215)	(0.0197)	(0.0214)	(0.0207)
Ln(Distance2RailRoad)	0.068***	0.100***	0.072***	0.060***	0.066***	0.062***
	(0.0077)	(0.0206)	(0.0157)	(0.0202)	(0.0203)	(0.0202)
Constant	7.850***	8.915***	7.849***	7.977***	8.067***	8.181***
	(0.2316)	(0.7214)	(0.5906)	(0.6529)	(0.6961)	(0.6560)
R-squared	0.474	0.579	0.729	0.766	0.769	0.769
Spatial FE Levels						
Derailment		Y				
Tract			Y			
Block Group				Y	Y	Y
# of FE groups		33	198	434	434	434
Year/Month FE	Y	Y	Y	Y	Y	Y
Specific Linear Trend						
Derailment					Y	
County						Y
SE clustered		Y	Y	Y	Y	Y
Observations	6,101	6,101	6,101	6,101	6,101	6,101

In general, Model 1 does not include any spatial fixed effects terms. Model 2 through 4 include spatial fixed effects at increasingly finer levels, ranging from derailment to block group. Based on model 4, the last two models further include a specific temporal trend at derailment and county levels, respectively. The coefficient of interaction term of Post (480 days after derailment) and Treatment (within one mile radius of derailment site) variables measures the derailment shock. All DiD models consistently suggest a negative and statistically significant impact of derailment on property values. The size of estimated derailment effect slightly changes at different fixed-effect levels (column 1 to 4), ranging from about 7% to 5%. Adding a temporal specific trend, either at derailment level or county level, does not change the estimation on derailment shock significantly, suggesting that location specific trends have been net out by the DID design. The coefficient for the "other incidents" variable is still negative, but only weakly significant in model 3 and not significant in other models. This result implies that other incidents which are unlikely be observed by property owners and buyers have no impact on the property values.

2. Regional Effect

We identified those five derailments as high impact incidents based on attributes in the ERNS dataset. We perform a DID model based on all transacted properties along railroads to measure regional effect of each high-impact derailment separately. The DID model include spatial (i.e., census tract) and temporal (sale year and month) fixed effects as well as county specific linear trends. Different from the DID models for local effect, we now define all transacted properties within half mile of both sides of railroad as treatment group while those within 1 to 2 miles of both sides of railroads as control group. We are not able to find any significant results in terms of regional derailment effects in these alternative specification.



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