Mandatory Energy Efficiency Disclosure in Housing Markets

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Online Appendix

A Appendix tables and figures

Table A1: Correlations between our energy efficiency proxy and ECAD audit measurements

	Dependent variable: Various components of ECAD audit reports				
	Double-pane windows (1)	Programmable thermostat (2)	Electric heating (3)	Attic R-value (4)	Duct leak percentage (5)
EE proxy	0.114***	0.059***	−0.179***	1.886***	−1.755***
	(0.015)	(0.015)	(0.010)	(0.289)	(0.358)
Mean	0.380	0.614	0.113	21.63	18.80
Std. Dev.	0.485	0.487	0.317	8.932	11.07
Observations	13,215	13,036	13,110	12,464	12,605

*p<0.1; **p<0.05; ***p<0.01 Each column presents linear estimates from regressing a measure from the actual ECAD audit report (in column titles) on our proxy for homes' energy efficiency. The sample used here is all homes from our analysis sample that conducted an ECAD energy efficiency audit. The "EE proxy" term is a value that ranges continuously from zero to one that indicates each home's fixed energy efficiency quantile, defined based on the pre-policy within-vintage electricity use per square foot for the home. "Double-pane windows" is a binary indicator for whether the home has double-pane and/or low-emissivity windows. "Programmable thermostat" is a binary indicator for whether the home has a programmable thermostat. "Electric heating" is a binary indicator for whether the home has electric heating (versus gas). "Attic R-value" is the measured R-value of insulation in the home's attic. "Duct leak percentage" is the measured percent air flow leakage from the home's air ducts. The differing number of observations across columns is due to heterogeneity in the completeness of official ECAD audit reports. For properties that conducted more than one audit, we use the first audit report for each property.

Table A2: Sales Probability: Difference in differences identification tests

	Dependent variable: Indicator for whether the home is sold within the year				
	Full sample			Homes with energy efficiency	
				Below-median	Above-median
	(1)	(2)	(3)	(4)	(5)
I{Inside Austin}	−0.0090***	−0.0040	0.0020	0.0002	0.0023*
	(0.0017)	(0.0047)	(0.0015)	(0.0018)	(0.0014)
I{Inside Austin}	0.0063***	0.0012	−0.0006	0.0008	−0.0015
X I{Post 2009}	(0.0021)	(0.0048)	(0.0019)	(0.0023)	(0.0018)
Years included	1997-2014	2006-2014	1997-2014	1997-2014	1997-2014
Time fixed effects	Year	Year	Vintage-year	Vintage-year	Vintage-year
Sample mean	0.044	0.041	0.044	0.042	0.047
Number of homes	131,050	131,050	131,050	65,620	65,430
Observations	2,357,046	1,180,071	2,357,046	1,179,976	1,177,070

*p<0.1; **p<0.05; ***p<0.01 All columns present difference in differences estimates testing whether the probability that a home is sold varies asymmetrically between Inside Austin and Outside Austin pre- versus post-2009, when the ECAD audit and disclosure policy went into effect. The annual fraction of in-sample homes sold by jurisdiction is shown in Figure A2. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Table A3: ECAD audit disclosure: Difference in differences estimates

	Dependent variable: Indicator for ECAD audit			
	(1)	(2)	(3)	(4)
I{Inside Austin} X I{Post June-2009}	0.455***	0.461***	0.455***	0.452***
	(0.010)	(0.010)	(0.011)	(0.012)
Sales sample	All	All	Repeat	Repeat
Spatial fixed effects	Jurisdiction	Jurisdiction	Property	Property
Time fixed effects	Sample month	Vint-month	Sample month	Vint-month
Number of homes	65,462	65,462	28,639	28,639
Observations	106,045	106,045	69,222	69,222

*p<0.1; **p<0.05; ***p<0.01 Each column presents a difference in differences estimate for the probability that a home that is sold has conducted an ECAD audit. The ECAD audit disclosure program for all sales inside Austin took effect in June 2009. Columns (1) and (2) include all properties that were sold at least once during 1997-2014. Columns (3) and (4) include only properties that were sold more than once during 1997-2014. Figure 2 shows annual average ECAD audit rates by jurisdiction for this full sample. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Table A4: Estimated price capitalization of energy efficiency due to ECAD policy

	Dependent variable: Natural log of sale price	
	(1)	(2)
Energy efficiency	0.003	−0.005
X I{Post June-2009}	(0.017)	(0.017)
Energy efficiency		
X I{Inside Austin}	0.081***	0.035
X I{Post June-2009}	(0.022)	(0.025)
Sales sample	Actual	Placebo
Spatial fixed effects	Property	Property
Time fixed effects	V-M and J-M	V-M and J-M
Mean sale price ($)	249,367	379,938
Number of homes	28,639	5,723
Observations	69,222	13,415

*p<0.1; **p<0.05; ***p<0.01 The placebo sample is homes constructed between 1999 and 2005. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Table A5: Estimated effect of energy audit disclosure on the natural log of homes' sale price—Border sample

	Dependent variable: Natural log of sale price			
	(1)	(2)	(3)	(4)
Panel [A]: Reduced-form estimates				
Energy efficiency	0.009	−0.011	−0.026	−0.012
X I{Post June-2009}	(0.046)	(0.014)	(0.017)	(0.017)
Energy efficiency				
X I{Inside Austin}	0.153***	0.073***	0.104***	0.075***
X I{Post June-2009}	(0.036)	(0.011)	(0.023)	(0.025)
Panel [B]: Average treatment effects				
Energy efficiency	0.356***	0.182***	0.249***	0.176***
X I{ECAD-audited}	(0.088)	(0.028)	(0.057)	(0.060)
Sales sample	All	Repeat	Repeat	Repeat
Spatial fixed effects	Jurisdiction	Property	Property	Property
Time fixed effects	Vint-month	Vint-month	Juris-month	V-M and J-M
Mean sale price ($)	260,286	263,681	263,681	263,681
Number of homes	35,694	15,757	15,757	15,757
Observations	58,022	38,085	38,085	38,085

*p<0.1; **p<0.05; ***p<0.01 Each column presents estimates for the effect of energy audit disclosure on the natural log of homes' sale price. Panel [A] shows reduced-form estimates and Panel [B] shows the average treatment effects for specifications in which the Energy efficiency X I{Inside Austin} X I{Post June-2009} term is used as the instrument. The "Energy efficiency" term is a value ranging continuously from zero to one that indicates each home's fixed energy efficiency quantile. The ECAD audit disclosure program for all sales inside Austin took effect in June 2009. Only the fifty percent of properties closest to the Austin border are included. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Table A6: Estimated price capitalization of energy bills due to ECAD policy

	Dependent variable: Natural log of sale price			
	(1)	(2)	(3)	(4)
Panel [A]: Reduced-form estimates				
Log(annual bill/sqft)	0.019	0.033***	0.019	0.006
X I{Post June-2009}	(0.024)	(0.011)	(0.013)	(0.013)
Log(annual bill/sqft)				
X I{Inside Austin}	−0.148***	−0.095***	−0.074***	−0.064***
X I{Post June-2009}	(0.025)	(0.011)	(0.017)	(0.016)
Panel [B]: Average treatment effects				
Log(annual bill/sqft)	−0.327***	−0.212***	−0.174***	−0.148***
X I{ECAD-audited}	(0.059)	(0.025)	(0.044)	(0.038)
Sales sample	All	Repeat	Repeat	Repeat
Spatial fixed effects	Jurisdiction	Property	Property	Property
Time fixed effects	Vint-month	Vint-month	Juris-month	V-M and J-M
Mean sale price ($)	244,343	249,367	249,367	249,367
Mean annual bill/sqft ($)	0.714	0.706	0.706	0.706
Mean square footage	1908	1925	1925	1925
Number of homes	65,462	28,639	28,639	28,639
Observations	106,045	69,222	69,222	69,222

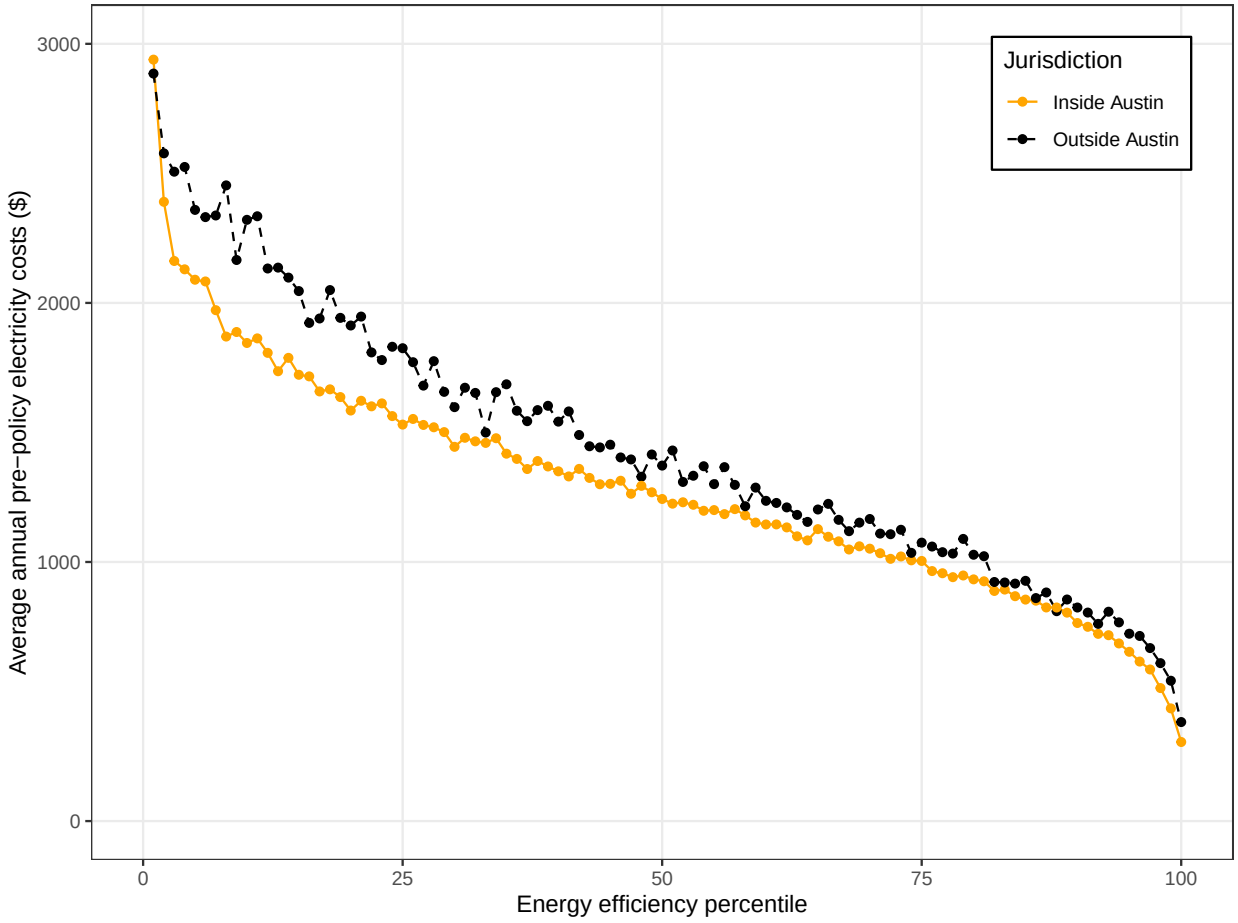
*p<0.1; **p<0.05; ***p<0.01 Each column presents estimates for the capitalization of pre-policy energy bills per square foot into home sale prices. Panel [A] shows reduced-form estimates and Panel [B] shows the average treatment effects for specifications in which the Log(annual bill/sqft) X I{Inside Austin} X I{Post June-2009} term is used as the instrument. The ECAD audit disclosure program for all sales inside Austin took effect in June 2009. Figure 3 shows annual coefficients for energy efficiency capitalization for each jurisdiction. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Table A7: Energy efficiency program rebates: Difference in differences estimates—Border sample

	Dependent variable: Total energy efficiency rebate dollars			
	By seller: within 2-years pre-sale		By buyer: within 2-years post-sale	
	All programs	HPWES	All programs	HPWES
	(1)	(2)	(3)	(4)
I{Inside Austin}	16.6***	18.2***	19.8**	28.6***
X I{Post June-2009}	(5.0)	(5.1)	(9.3)	(8.4)
Post June-2009 mean	47.0	28.7	89.6	64.6
Spatial fixed effects	Jurisdiction	Jurisdiction	Jurisdiction	Jurisdiction
Time fixed effects	Vint-month	Vint-month	Vint-month	Vint-month
Number of homes	35,694	35,694	35,694	35,694
Observations	58,022	58,022	58,022	58,022

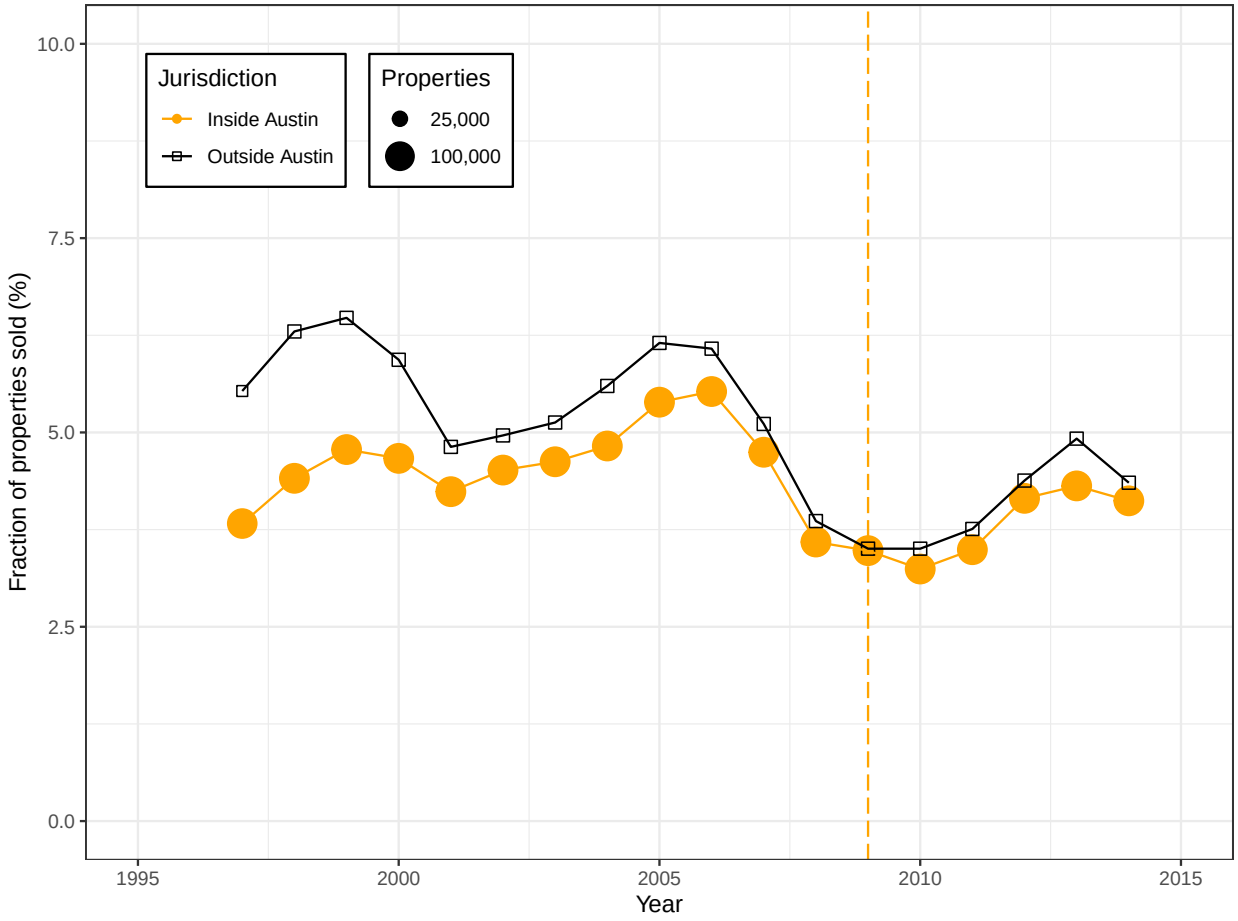
*p<0.1; **p<0.05; ***p<0.01 Each column presents a difference in differences estimate for the total energy efficiency program rebate dollars paid to the property owner for participation in the indicated energy efficiency program(s) during the indicated time period. Columns (1) and (2) evaluate rebates paid for improvements made within the two year prior to the sale. Columns (3) and (4) evaluate rebates paid for improvements made within the two year following the sale. Only the fifty percent of properties closest to the Austin border are included. Standard errors in parentheses are clustered at the level of energy efficiency quartile by jurisdiction by sale year.

Figure A1: Average Annual Energy Bill by Energy Efficiency Percentile



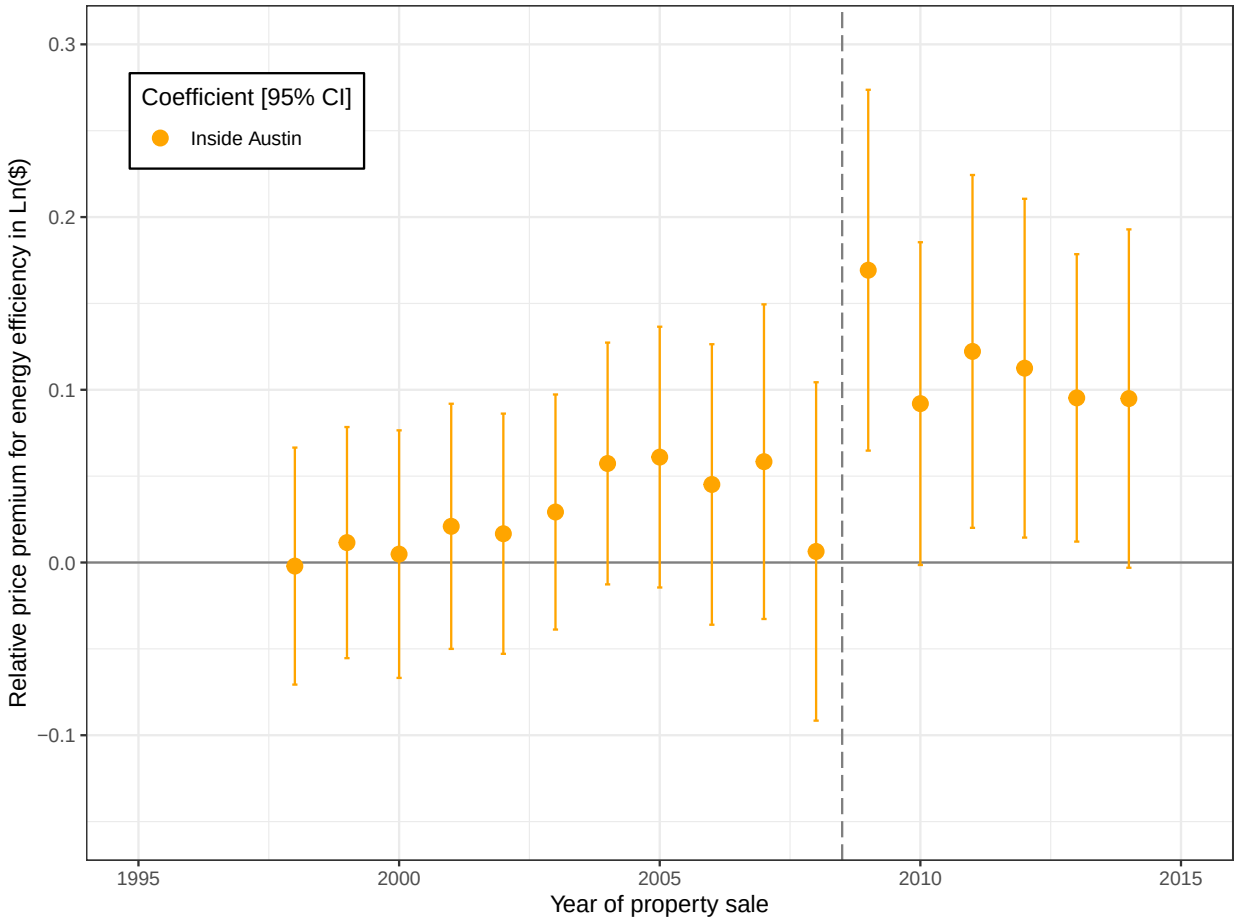
Notes: Figure A1 plots average annual pre-policy electricity costs for each percentile of the energy efficiency proxy in each jurisdiction.

Figure A2: Fraction of in-sample homes sold each year inside Austin and outside city limits



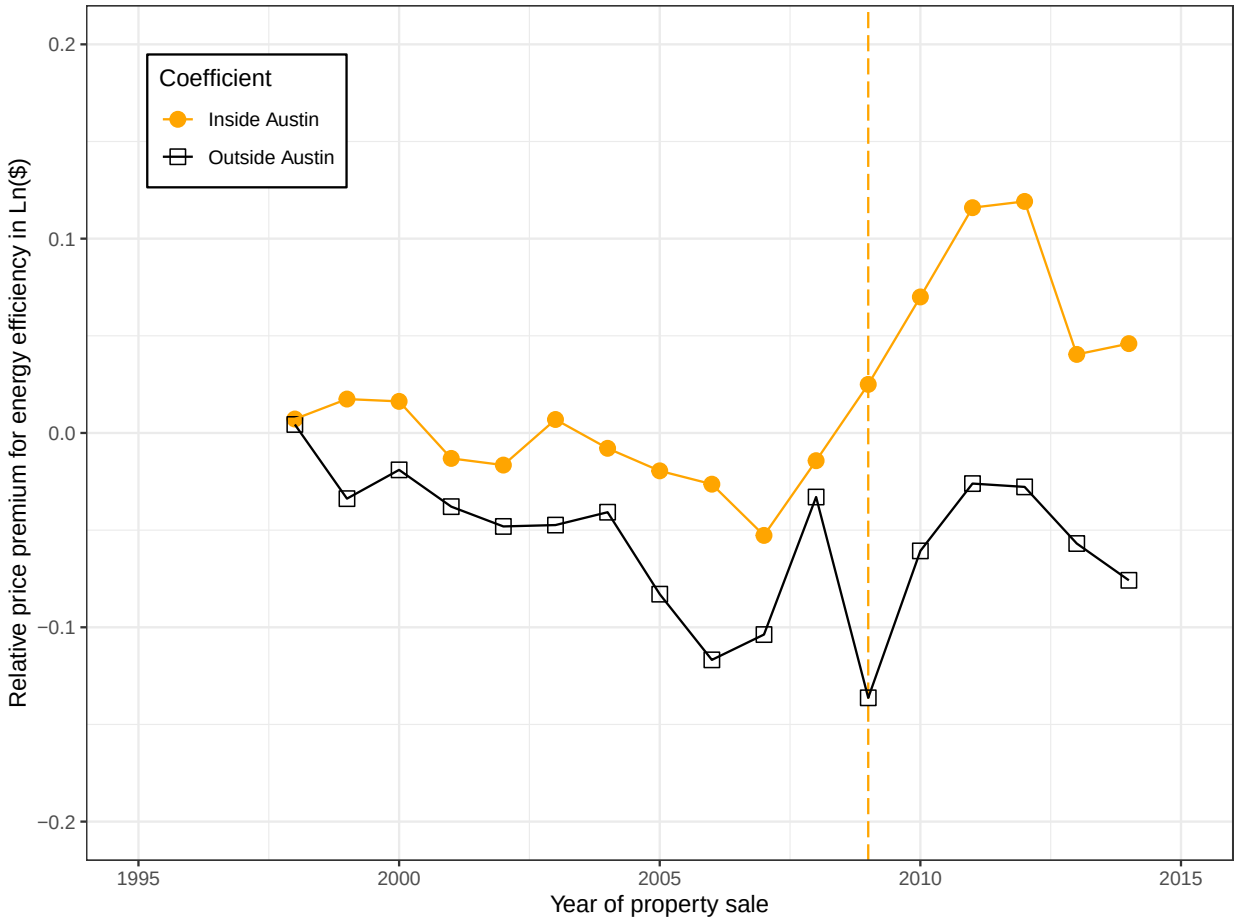
Notes: Figure A2 plots the annual fraction of in-sample homes sold by jurisdiction, inside Austin versus outside of the Austin city limits. The dashed vertical line at 2009 indicates when the ECAD residential energy efficiency audit and disclosure policy went into effect for homes aged 10 years or older sold inside Austin only. The sample includes single family residential properties constructed no later than 1998.

Figure A3: Event Study of the Difference in the House Price-Efficiency Slope Between Austin and Outside Austin



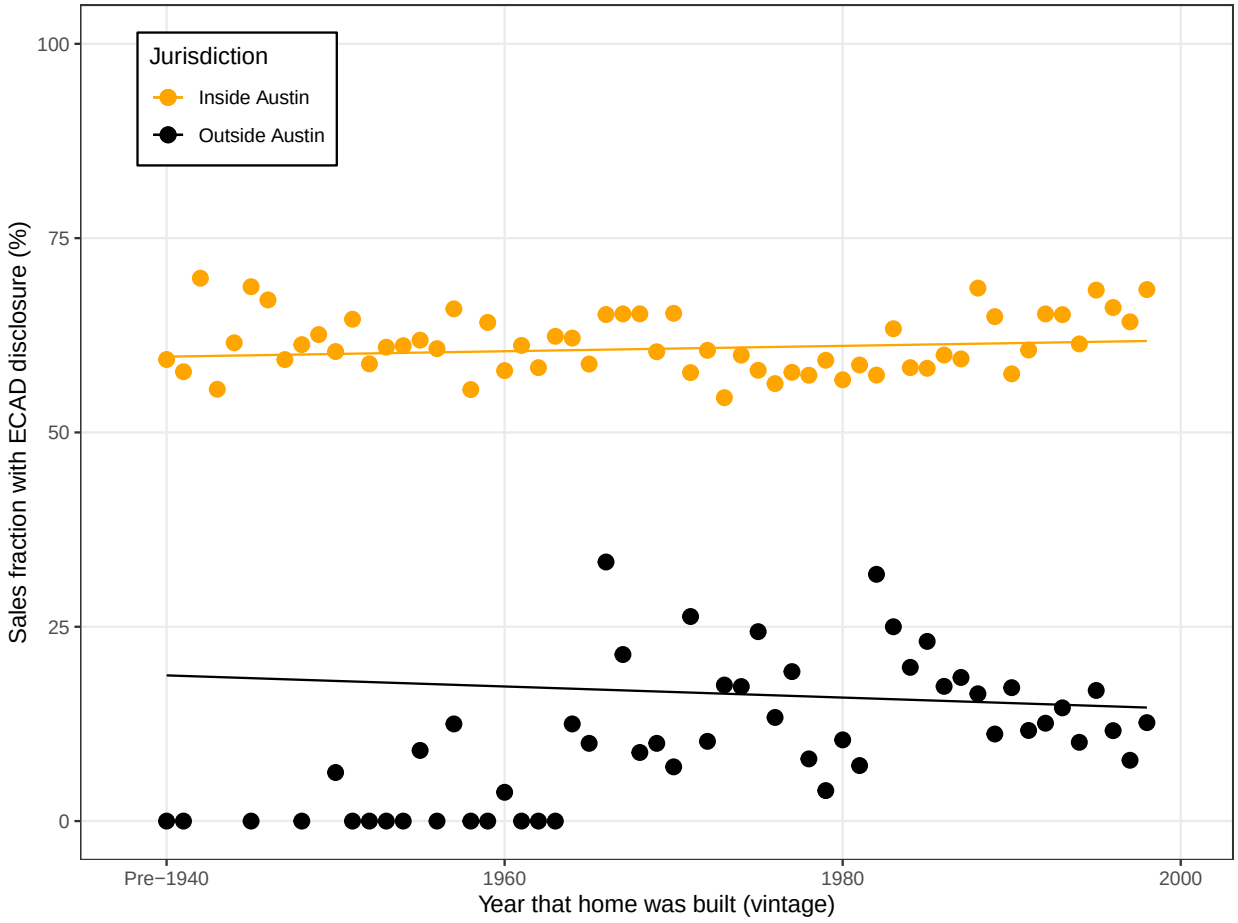
Notes: Figure A3 plots coefficients $\eta_{1998} - \eta_{2014}$ from the following regression, where all variables are defined as in Equation 1 in the main text: $ln(P_{ivjt}) = \sum_{1998}^{2014} \eta_t EEProxy_i \times Austin_j + \sum_{1998}^{2014} \theta_t EEProxy_i + \mu_i + \tau_{vt} + \zeta_{jt} + \varepsilon_{ivjt}$. The omitted base-year is 1997. These coefficients represent year-specific estimates of the difference in the price-efficiency slope between Austin and the comparison group.

Figure A4: Estimated relative energy efficiency price premiums by jurisdiction—Border sample



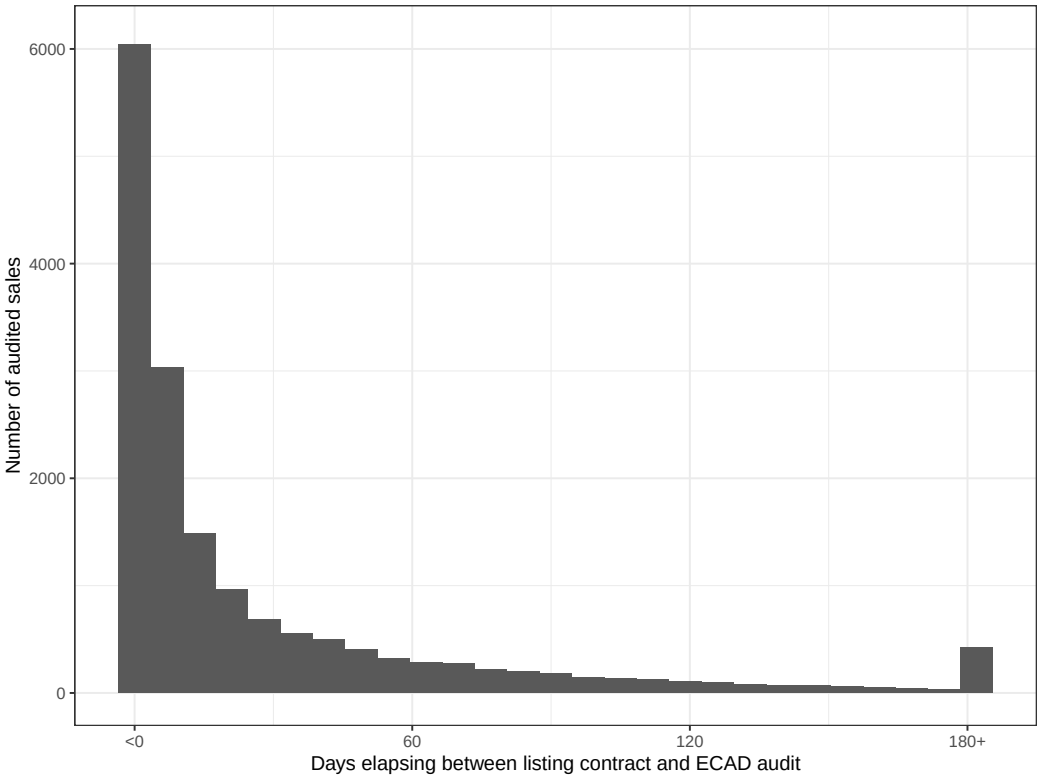
Notes: Figure A4 plots coefficients by jurisdiction – inside Austin versus outside of the Austin city limits – from regressing the natural log of homes' sale prices on the homes' energy efficiency, a term that ranges continuously from zero to one and indicates each home's fixed energy efficiency quantile. The underlying regression includes property fixed effects as well as jurisdiction-by-year fixed effects. The omitted base-year is 1997. The ECAD audit disclosure program for all sales inside Austin took effect in June 2009. Only the fifty percent of properties closest to the Austin border are included.

Figure A5: ECAD audit disclosure propensity by vintage for each jurisdiction

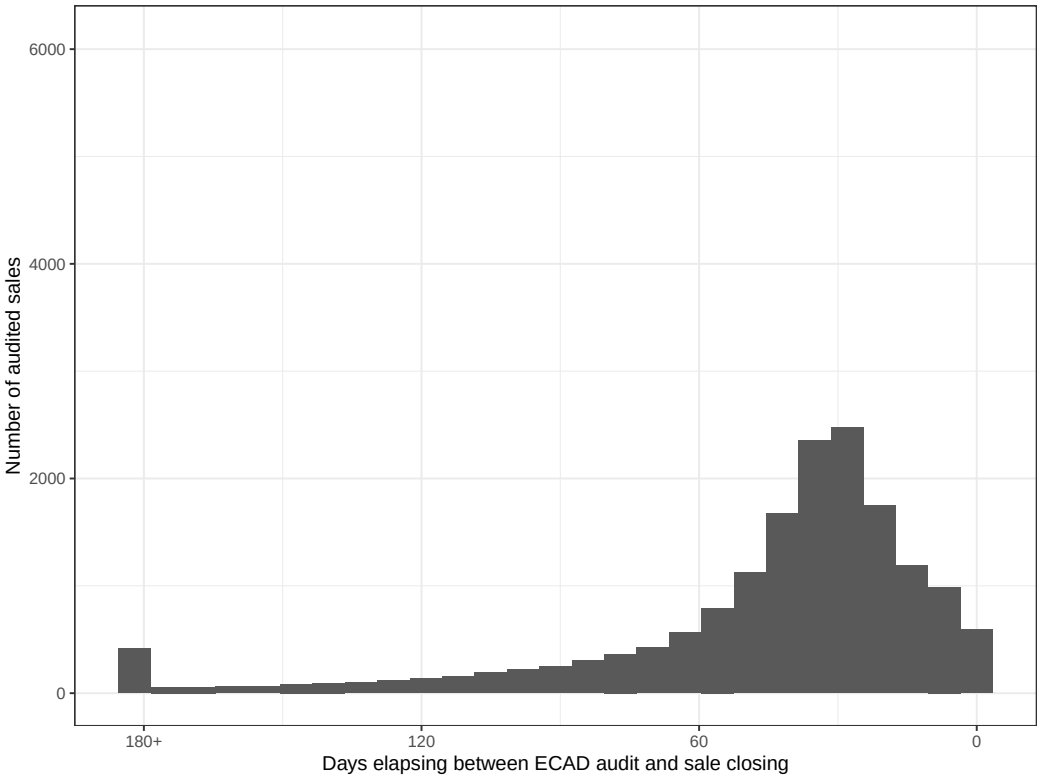


Notes: Figure A5 plots the share of in-sample homes sold inside/outside Austin post-June 2009 that obtained and disclosed an ECAD energy efficiency audit, across vintages. Each point depicts a local average compliance rate for the respective year built. The line shows the linear fit to the underlying microdata.

Figure A6: Timing of ECAD audits with respect to listing and sale contracts



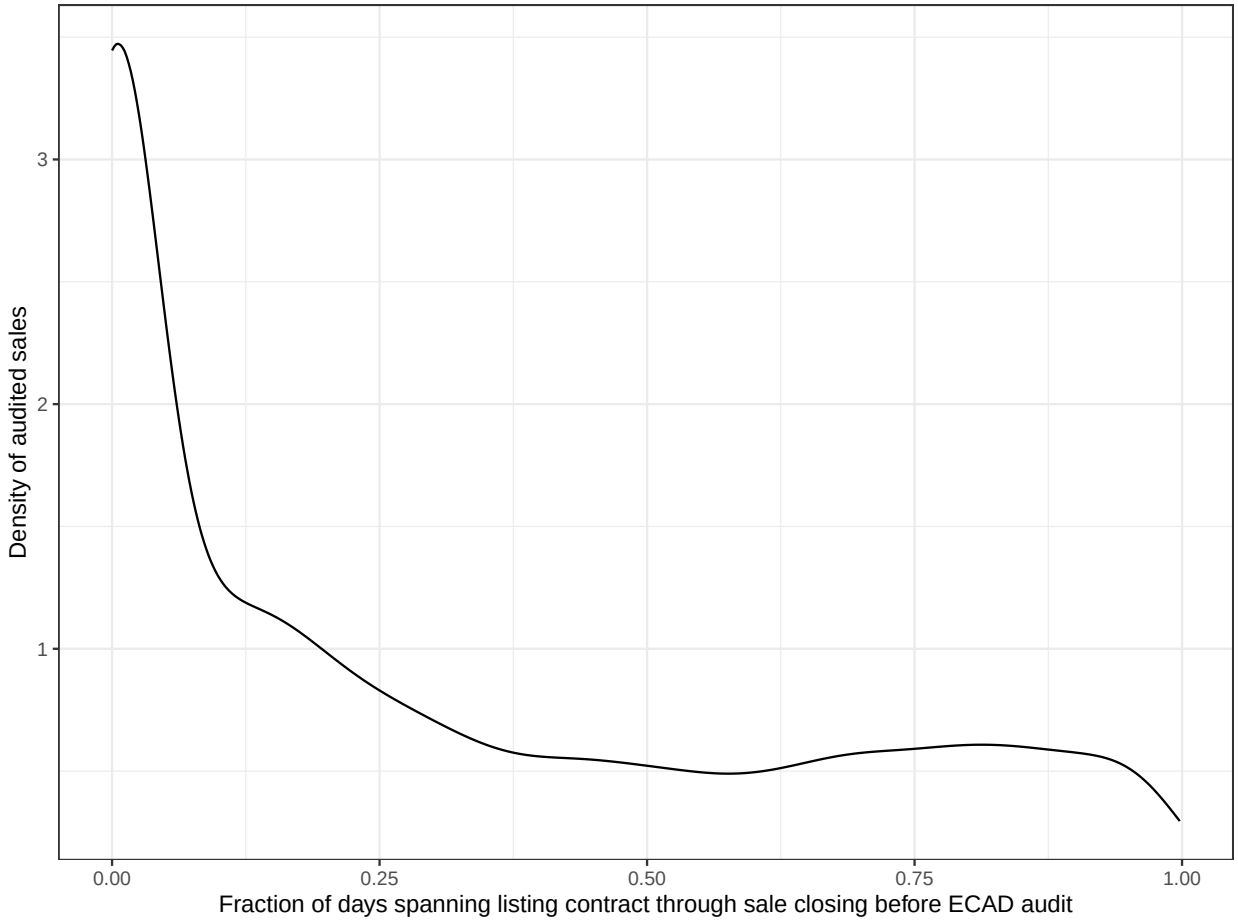
(a) Duration from listing contract to ECAD audit



(b) Duration from ECAD audit to sale closing

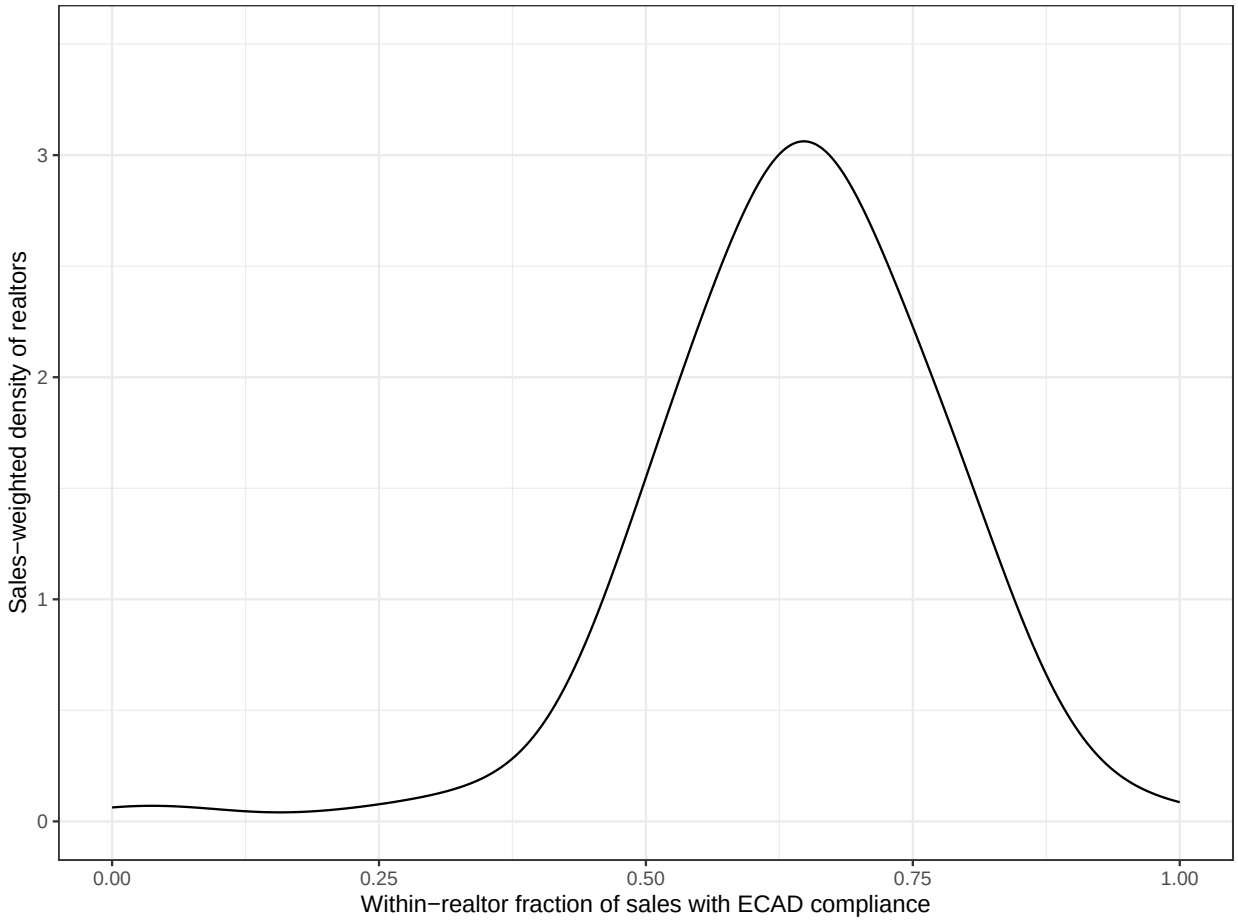
Notes: The date of the listing contract is when the seller formalizes an agreement with the seller's realtor to market the property, which typically occurs before any marketing activities. The date of the sale closing is the official closing date for the property sale transaction.

Figure A7: Timing of ECAD audits with respect to listing and sale contracts



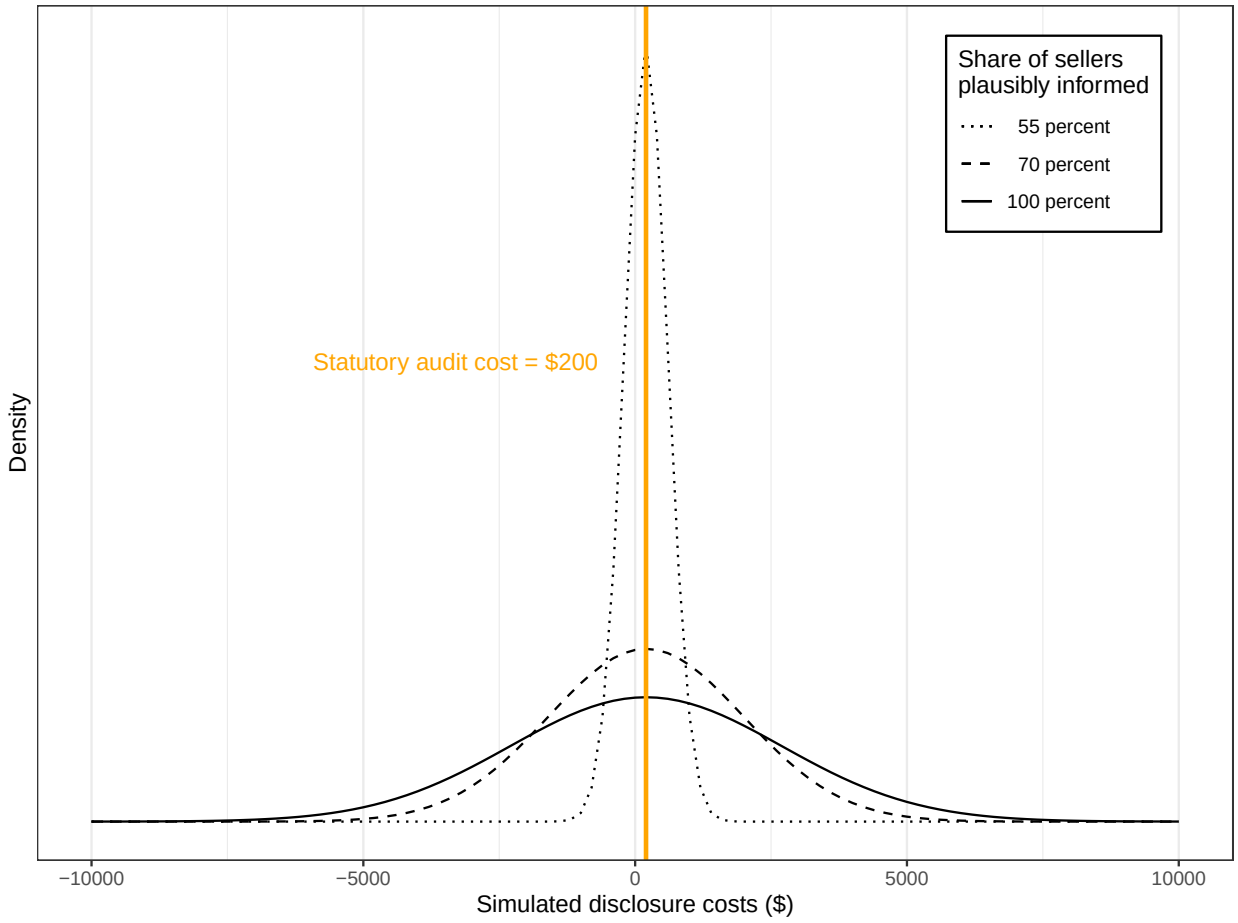
Notes: Appendix Figure A7 shows the density of the fraction of days spanning between the listing contract and the ECAD audit with respect to the total number of days the property was marketed (spanning from the listing contract through the sale closing contract). For example, if a property was audited seven days after the listing contract was signed and was sold 28 days after the listing contract was signed, the value in the figure would be 0.25 for this sale. The date of the listing contract is when the seller formalizes an agreement with the seller's realtor to market the property, which typically occurs before any marketing activities. The date of the sale closing is the official closing date for the property sale transaction.

Figure A8: Density of ECAD compliance rates across realtors



Notes: Appendix Figure A8 shows the sales-weighted density of ECAD compliance for a random subset of realtors who handled home sales within-Austin after the ECAD policy was effective. To create this graph, we first took a one percent sample of post-ECAD sales within Austin City limits and matched each transaction to the seller's realtor using Zillow.com. Then, we determined the full set of properties sold inside Austin post-ECAD by each of these realtors, which we use to compute the compliance density depicted in the figure.

Figure A9: Simulation results: Plausible share of Informed sellers by audit cost heterogeneity—using reduced-form price estimates



Notes: Conducts the same simulation as in Figure A9 but uses reduced-form estimates for the price-energy efficiency effects of the ECAD policy.