Essays in Energy Economics and Entrepreneurial Finance

Table 3: Robustness Tests of Triple Difference Estimation, Part III with Implied Volatility

Dependent variable: Log bitumen bid (b^A)						
Standard errors clustered by:	I. None (robust)	II. State-month	III. Firm-month	IV. Firm-month of year	V. Firm-state	VI. State-year
$\mathbf{I}_{KS_j} \cdot \mathbf{I}_{Policy_t} \cdot \ln V_t^{\text{oil}}$	**-.35*** **	**-.35** **	**-.35*** **	**-.35*** **	**-.35*** **	**-.35** **
	(.063)	(.13)	(.074)	(.071)	(.069)	(.16)
$\mathbf{I}_{\text{policy}_t} \cdot \ln V_t^{\text{oil}}$	1.2***	1.2**	1.2***	1.2***	1.2***	1.2**
	(.22)	(.46)	(.26)	(.25)	(.24)	(.56)
$\mathbf{I}_{\text{policy}_t} \cdot \mathbf{I}_{KS_j}$	.22***	.22*	.22***	.22***	.22***	.22**
	(.054)	(.12)	(.062)	(.059)	(.051)	(.099)
$\mathbf{I}_{KS_j} \cdot \ln V_t^{\text{oil}}$	.67***	.67***	.67***	.67***	.67***	.67***
	(.037)	(.13)	(.049)	(.051)	(.05)	(.18)
$\ln V_t$	-.018	-.018	-.018	-.018	-.018	-.018
	(.022)	(.082)	(.028)	(.028)	(.022)	(.098)
$\mathbf{I}_{\text{state}_j}$	-.65***	-.65	-.65***	-.65***	-.65***	-.65*
	(.19)	(.44)	(.22)	(.21)	(.18)	(.36)
$\mathbf{I}_{\text{policy}_j}$	-2.1***	-2.1***	-2.1***	-2.1***	-2.1***	-2.1***
	(.12)	(.44)	(.17)	(.17)	(.18)	(.62)
$\ln p_t^{\text{oil}}$	.29***	.29***	.29***	.29***	.29***	.29***
	(.02)	(.047)	(.026)	(.025)	(.026)	(.054)
N_j	-.0053***	-.0053**	-.0053***	-.0053***	-.0053***	-.0053**
	(.00096)	(.0024)	(.0011)	(.0011)	(.0012)	(.0022)
$\ln \bar{b}_j$	-.018	-.018	-.018	-.018	-.018	-.018
	(.019)	(.026)	(.02)	(.019)	(.022)	(.024)
$\ln T_j$	-.0055**	-.0055	-.0055**	-.0055**	-.0055*	-.0055
	(.0023)	(.0039)	(.0024)	(.0024)	(.0029)	(.0052)
$\ln b_{ij}^O$	.015	.015	.015	.015	.015	.015
	(.017)	(.023)	(.018)	(.018)	(.02)	(.022)
$\ln M_{ij}$	-.0072***	-.0072***	-.0072***	-.0072***	-.0072***	-.0072***
	(.0021)	(.0022)	(.0023)	(.0024)	(.0026)	(.0022)
County f.e.	Y	Y	Y	Y	Y	Y
Year f.e.	Y	Y	Y	Y	Y	Y
Month of year f.e.	Y	Y	Y	Y	Y	Y
N	6107	6107	6107	6107	6107	6107
R^2	.92	.92	.92	.92	.92	.92

Note: This table reports estimates of the effect of the risk removal policy on an additional unit of implied oil price volatility on bids in Kansas relative to Iowa after vs before the policy. Specifications are variants on Equation 1. Standard errors clustered as described. *** $p < .01$. $1998 \leq \text{Year} \leq 2012$.

Table 4: Robustness Tests of Triple Difference Estimation, Part III with Bid Total per Ton Bitumen as Dependent Variable

Dependent variable: Log bid total per ton bitumen $\left(b^T\right)$						
Standard errors clustered by:	I. None (robust)	II. State-month	III. Firm-month	IV. Firm-month of year	V. Firm-state	VI. State-year
$\mathbf{I}_{KS_j} \cdot \mathbf{I}_{Policy_t} \cdot \ln V_t^{\text{oil}}$	**-.15****	**-.15***	**-.15****	**-.15****	**-.15****	**-.15**
	(.075)	(.073)	(.076)	(.074)	(.072)	(.089)
$\mathbf{I}_{\text{policy}_t} \cdot \ln V_t^{\text{oil}}$	.33***	.33***	.33***	.33***	.33***	.33**
	(.061)	(.082)	(.06)	(.064)	(.089)	(.14)
$\mathbf{I}_{\text{policy}_t} \cdot \mathbf{I}_{KS_j}$	.44*	.44*	.44*	.44*	.44*	.44
	(.26)	(.22)	(.26)	(.25)	(.24)	(.31)
$\mathbf{I}_{KS_j} \cdot \ln V_t^{\text{oil}}$	.17***	.17**	.17***	.17***	.17**	.17**
	(.065)	(.08)	(.067)	(.067)	(.068)	(.067)
$\ln V_t$	.0056	.0056	.0056	.0056	.0056	.0056
	(.01)	(.0099)	(.01)	(.01)	(.01)	(.014)
$\mathbf{I}_{\text{state}_j}$	2.1***	2.1***	2.1***	2.1***	2.1***	2.1***
	(.22)	(.28)	(.22)	(.22)	(.23)	(.26)
$\mathbf{I}_{\text{policy}_j}$	-.93***	-.93***	-.93***	-.93***	-.93***	-.93**
	(.19)	(.23)	(.18)	(.19)	(.25)	(.44)
$\ln p_t^{\text{oil}}$	.14***	.14***	.14***	.14***	.14***	.14*
	(.036)	(.047)	(.035)	(.037)	(.042)	(.076)
N_j	.0099***	.0099	.0099***	.0099***	.0099***	.0099**
	(.0025)	(.0058)	(.0025)	(.0026)	(.0026)	(.0045)
$\ln \bar{b}_j$	.95***	.95***	.95***	.95***	.95***	.95***
	(.0074)	(.017)	(.0076)	(.0087)	(.015)	(.019)
$\ln T_j$	-.97***	-.97***	-.97***	-.97***	-.97***	-.97***
	(.0049)	(.011)	(.0054)	(.0061)	(.0099)	(.013)
$\ln M_{ij}$	.007*	.007*	.007*	.007**	.007**	.007
	(.0038)	(.0034)	(.0038)	(.0035)	(.0034)	(.0045)
County f.e.	Y	Y	Y	Y	Y	N
Year f.e.	Y	Y	Y	Y	Y	Y
Month of year f.e.	Y	Y	Y	Y	Y	N
N	4542	4542	4542	4542	4542	4542
R^2	.97	.97	.97	.97	.97	.97

Note: This table reports estimates of the effect of the risk removal policy on an additional unit of 12-week historical oil price volatility on bids in Kansas relative to Iowa after vs before the policy. Specifications are variants on Equation 1. Standard errors clustered as described. *** $p < .01$. $1998 \leq \text{Year} \leq 2012$.

Table 5: Triple Difference Results using Risk Removal Policy: Alternative Volatility and Oil Measures

	Historical Volatility (26 w)		5th Month Futures (12 w histvol)	
Dependent variable:	I: Log bitumen bid $\left(b^A\right)$	II. Log bid total per ton bitumen $\left(b^T\right)$	III: Log bitumen bid $\left(b^A\right)$	IV. Log bid total per ton bitumen $\left(b^T\right)$
$\mathbf{I}_{KS_j} \cdot \mathbf{I}_{Policy_t} \cdot \ln V_t^{\text{oil}}$	**-.15****	**-.3****	**-.14*****	**-.12***
	(.068)	(.12)	(.036)	(.064)
$\mathbf{I}_{\text{policy}_t} \cdot \ln V_t^{\text{oil}}$	.35***	.1**	.78***	.54**
	(.04)	(.042)	(.039)	(.022)
$\mathbf{I}_{\text{policy}_t} \cdot \mathbf{I}_{KS_j}$	.48**	.9**	.45***	.34
	(.22)	(.39)	(.12)	(.22)
$\mathbf{I}_{KS_j} \cdot \ln V_t^{\text{oil}}$	.1*	.36***	.02	.19***
	(.059)	(.12)	(.029)	(.066)
$\ln V_t$	-.0069	-.011	.0018	.0025
	(.015)	(.017)	(.0094)	(.0095)
$\mathbf{I}_{\text{state}_j}$	-.23	1.5***	.047	2.1***
	(.19)	(.4)	(.097)	(.23)
$\mathbf{I}_{\text{policy}_j}$	-.95***	-.23**	-2.3***	-.065
	(.15)	(.11)	(.13)	(.053)
$\ln p_t^{\text{oil}}$	.24***	.08***	.26***	.051*
	(.029)	(.029)	(.03)	(.026)
N_j	-.0051***	.01***	-.0057***	.0098***
	(.0012)	(.0028)	(.0011)	(.0027)
$\ln \bar{b}_j$	-.0043	.95***	-.026	.95***
	(.023)	(.015)	(.023)	(.015)
$\ln T_j$	-.0066**	-.97***	-.0061**	-.97***
	(.003)	(.01)	(.0029)	(.01)
$\ln b_{ij}^O$	.002		.022	
	(.021)		(.021)	
$\ln M_{ij}$	-.0081***	.0062*	-.0071***	.0062*
	(.0027)	(.0035)	(.0025)	(.0034)
County f.e.	Y	Y	Y	Y
Year f.e.	Y	Y	Y	Y
Month of year f.e.	Y	Y	Y	Y
N	6107	4542	6107	4542
R^2	.92	.97	.92	.97

Note: This table reports regression estimates of the effect of the risk removal policy on an additional unit of oil price volatility on bids in Kansas relative to Iowa after vs before the policy. This is the triple difference specification in Equation 1. Standard errors clustered by firm. *** $p < .01$. $1998 \leq \text{Year} \leq 2012$.

Table 6: Robustness Tests of Triple Difference Estimation with Varying Covariates

Dependent variable: Log bitumen bid $\left(b^A\right)$						
	I. Primary	II.	III.	IV.	V.	VI.
$\mathbf{I}_{KS_j} \cdot \mathbf{I}_{Policy_t} \cdot \ln V_t^{\text{oil}}$	**-.16*** **	**.023*** **	**-.18*** **	**-.21*** **	**-.15*** **	**-.19*** **
	(.036)	(.0047)	(.023)	(.036)	(.025)	(.035)
$\mathbf{I}_{\text{policy}_t} \cdot \ln V_t^{\text{oil}}$	.79***		.58***	.61***	.79***	.61***
	(.04)		(.038)	(.037)	(.039)	(.037)
$\mathbf{I}_{\text{policy}_t} \cdot \mathbf{I}_{KS_j}$	.5***		.56***	.64***	.48***	.6***
	(.12)		(.081)	(.12)	(.086)	(.12)
$\mathbf{I}_{KS_j} \cdot \ln V_t^{\text{oil}}$	.041		.036***	.072**	.035***	.055*
	(.029)		(.004)	(.03)	(.0036)	(.029)
$\ln V_t$	-.0015			-.028***	-.00068	-.029***
	(.0089)			(.0087)	(.0088)	(.0081)
$\mathbf{I}_{\text{state}_j}$	-.021			-.12		-.053
	(.096)			(.097)		(.093)
$\mathbf{I}_{\text{policy}_j}$	-2.4***		-1.7***	-1.8***	-2.4***	-1.8***
	(.13)		(.13)	(.12)	(.13)	(.12)
$\ln p_t^{\text{oil}}$	.27***	.028			.27***	
	(.031)	(.029)			(.031)	
N_j	-.0057***	-.0056***			-.0057***	-.0044***
	(.0011)	(.0012)			(.0011)	(.0012)
$\ln \bar{b}_j$	-.027	-.033			-.026	-.0087
	(.023)	(.023)			(.023)	(.024)
$\ln T_j$	-.006**	-.00057			-.0061**	-.0073**
	(.0029)	(.0032)			(.0028)	(.003)
$\ln b_{ij}^O$	.023	.026			.022	.0054
	(.021)	(.022)			(.022)	(.023)
$\ln M_{ij}$	-.0071***	-.0067**			-.0071***	-.0072***
	(.0026)	(.0029)			(.0025)	(.0026)
County f.e.	Y	Y	Y	Y	Y	Y
Year f.e.	Y	N	N	Y	Y	Y
Month of year f.e.	Y	N	N	Y	Y	Y
N	6107	6107	6107	6107	6107	6107
R^2	.92	.91	.92	.92	.92	.92

Note: This table reports estimates of the effect of the risk removal policy on an additional unit of implied oil price volatility on bids in Kansas relative to Iowa after vs before the policy. Specifications are variants on Equation 1. Standard errors clustered by firm. *** $p < .01$. $1998 \leq \text{Year} \leq 2012$.

Table 7: Triple Difference Results using Risk Removal Policy: Excluding 2008

	Historical Volatility (12 w)		Implied Volatility	
Dependent variable:	I: Log bitumen bid $\left(b^A\right)$	II. Log bid total per ton bitumen $\left(b^T\right)$	III: Log bitumen bid $\left(b^A\right)$	IV. Log bid total per ton bitumen $\left(b^T\right)$
$\mathbf{I}_{KS_j} \cdot \mathbf{I}_{Policy_t} \cdot \ln V_t^{\text{oil}}$	**-.18*** **	**-.13***	**-.43*** **	**-.63*** **
	(.036)	(.075)	(.066)	(.15)
$\mathbf{I}_{\text{policy}_t} \cdot \ln V_t^{\text{oil}}$	.35***	.57***	.18***	.048**
	(.052)	(.16)	(.058)	(.036)
$\mathbf{I}_{\text{policy}_t} \cdot \mathbf{I}_{KS_j}$	.53***	.4	1.4***	2.2***
	(.12)	(.25)	(.24)	(.53)
$\mathbf{I}_{KS_j} \cdot \ln V_t^{\text{oil}}$	.066**	.16**	.23***	.61***
	(.028)	(.067)	(.052)	(.13)
$\ln V_t$	-.02**	.011	-.0055	.028
	(.0077)	(.01)	(.022)	(.033)
$\mathbf{I}_{\text{state}_j}$	-.093	2.2***	-.7***	.55
	(.094)	(.23)	(.19)	(.47)
$\mathbf{I}_{\text{policy}_j}$	-.95***	-1.7***	-.41**	-.063
	(.18)	(.49)	(.2)	(.093)
$\ln p_t^{\text{oil}}$	.2***	.11**	.25***	.12***
	(.021)	(.045)	(.022)	(.045)
N_j	-.0042***	.0095***	-.0042***	.011***
	(.0012)	(.0028)	(.0012)	(.0028)
$\ln \bar{b}_j$	-.045**	.95***	-.038*	.95***
	(.022)	(.015)	(.021)	(.015)
$\ln T_j$	-.0025	-.98***	-.0028	-.97***
	(.0027)	(.0099)	(.0026)	(.011)
$\ln b_{ij}^O$	.039*		.033*	
	(.021)		(.019)	
$\ln M_{ij}$	-.0077***	.0064*	-.0078***	.0058
	(.0026)	(.0038)	(.0027)	(.0038)
County f.e.	Y	Y	Y	Y
Year f.e.	Y	Y	Y	Y
Month of year f.e.	Y	Y	Y	Y
N	5635	4156	5635	4156
R^2	.93	.97	.93	.97

Note: This table reports regression estimates of the effect of the risk removal policy on an additional unit of oil price volatility on bids in Kansas relative to Iowa after vs before the policy. This is the triple difference specification in Equation 1. Standard errors clustered by firm. *** $p < .01$.
$1998 \leq \text{Year} \leq 2012$.

Table 8: Firm Characteristic Descriptive Statistics for Risk Premium Analysis

Firm name	**Year founded**	**# Bids**	**% Wins**	**Public owner (acq date)**	**family-owned***	**First date Bid**	**Last date bid**
Carlson	1900	616	23%	MDU (4/1/2004)	1	Jan-1994	Jan-2010
Manatts	1948	576	40%	-	1	Jan-1994	Apr-2012
Henningsen	1948	486	36%	-	1	Jan-1994	Apr-2012
Mathy	1945	443	48%	-	1	Jan-1994	Apr-2012
Western Engineering	1930	397	16%	-	0	Jan-1994	Apr-2012
Rohlin/Tristate	1963	377	45%	Oldcastle (1/1/2005)	1	Jan-1994	Apr-2012
Norris	1949	328	57%	-	1	Jan-1994	Apr-2012
Castle Rock	1958	311	18%	-	1	Jan-1994	Jul-2005
Cessford	-	304	43%	Oldcastle (8/10/2007)	1	Jan-1994	Apr-2012
Heartland	1991	246	52%	-	0	Feb-1994	Apr-2012
Hodgman	1982	235	10%	-	1	Jan-1994	Mar-2004
Cedar Valley	1971	227	15%	-	0	Jan-1994	Mar-2012
Peterson	1963	174	41%	-	1	Feb-1994	Mar-2012
Knife River	1922	164	16%	MDU (7/1/2005)	0	Apr-2007	Apr-2012
Des Moines Asphalt	1962	153	67%	Oldcastle (6/1/2001)	0	Jan-1994	Feb-2012
Grimes	1982	117	20%	-	1	May-1995	Feb-2012
Blacktop	1970	117	41%	-	0	Mar-1994	Mar-2012
Tschiggfrie	1965	116	26%	-	1	Jan-1994	Apr-2012
Pelling	1952	112	66%	-	1	Mar-1994	Apr-2012
US Asphalt	1985	105	11%	-	0	Jul-1995	Jan-2012
Godberson	1946	89	20%	-	1	Jan-1994	Feb-2012
Flynn	1930	75	24%	-	1	Feb-1994	Jan-2012
Iowa Bridge	1954	75	21%	-	1	Jan-1994	Apr-2012
Taylor	1973	73	12%	-	1	Mar-1994	Apr-2011
Reilly	1947	67	21%	-	1	Feb-1994	Mar-2012
Aspro	1973	65	62%	-	0	Feb-1994	Mar-2012
Duinick	1926	63	19%	-	1	Feb-1994	Apr-2012
Iowa Erosion	1972	61	26%	-	1	Feb-1994	Jan-2012
Kruse	1994	57	28%	-	1	Feb-1995	May-2005
Fort Dodge	1964	54	69%	-	0	Feb-1994	Mar-2012

*before acquired by public firm, if applicable

Table 9: Correlation Matrix of Iowa Firm Characteristics

	$\mathbf{I}_{\text{Public}_i}$	$\mathbf{I}_{\text{Family}_i}$	$\#\text{SIC}_i$	$\mathbf{I}_{\text{Not Div}_i}$	$\mathbf{I}_{\text{Paving Primary}_i}$	$\mathbf{I}_{\text{Small }(Emp)_i}$	$\mathbf{I}_{\text{Small }(Rev)_i}$	Firm Size $(\text{Emp})_i$	Firm Size $(\text{Rev})_i$	$\mathbf{I}_{\text{Related}_i}$	$\mathbf{I}_{\text{Subsid}_i}$	$\mathbf{I}_{\text{JV}_i}$
$\mathbf{I}_{\text{Public}_i}$	1											
$\mathbf{I}_{\text{Family}_i}$	-0.43*	1										
$\#\text{SIC}_i$	0.44*	-0.157*	1									
$\mathbf{I}_{\text{Not Div}_i}$	-0.11*	0.053*	-0.75*	1								
$\mathbf{I}_{\text{Paving Primary}_i}$	-0.21*	0.017	-0.18*	0.081*	1							
$\mathbf{I}_{\text{Small (Emp)}_i}$	0.2*	0.174*	0.36*	-0.19*	0.11*	1						
$\mathbf{I}_{\text{Small (Rev)}_i}$	0.24*	0.159*	0.31*	-0.18*	0.051*	0.89*	1					
Firm Size $(\text{Emp})_i$	0.52*	-0.196*	0.66*	-0.28*	-0.19*	0.36*	0.33*	1				
Firm Size $(\text{Rev})_i$	0.11*	-0.072*	0.18*	-0.048*	-0.0035	0.12*	0.13*	0.68*	1			
$\mathbf{I}_{\text{Related}_i}$	-0.024*	0.029*	0.13*	-0.16*	0.083*	0.15*	0.21*	0.022*	-0.023*	1		
$\mathbf{I}_{\text{Subsid}_i}$	-0.049*	-0.091*	-0.0068	0.11*	0.27*	0.17*	0.086*	0.052*	0.0039	0.094*	1	
$\mathbf{I}_{\text{JV}_i}$	0.11*	0.095*	0.35*	-0.22*	0.091*	0.29*	0.32*	0.26*	0.092*	0.053*	-0.048*	1

Note: This table reports Phi and Pearson correlation coefficients for the firm characteristics used in the markup heterogeneity analysis. $*p < .05$. $1994 \leq \text{Year} \leq 2012$.

Table 10: Markup Analysis - Impact of Firm Diversification

Dep Var: $\hat{m}_{B,j,i}$			
Diversification Variable:	# SIC codes	**1** | Not Diverse (1 SIC code)	**1** | Paving Primary Activity
Div Var$_i \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$	**-.77****	**2.1****	**2.7****
	(.33)	(.97)	(1.3)
Div Var$_i \cdot Wait_j$	2.2**	-6.4**	-7.4*
	(1)	(3)	(4)
Div Var$_i \cdot \ln V_t^{\text{oil}}$	4.5*	-2.2	-24***
	(2.4)	(6)	(7.6)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-.012	-2.8***	-3.5***
	(.71)	(.81)	(1.2)
Div Var$_i$	-15**	14	64***
	(7.4)	(18)	(23)
$Wait_j$	.88	9.1***	11***
	(2.2)	(2.5)	(3.8)
$\ln V_t^{\text{oil}}$	3	14***	29***
	(4.8)	(5)	(7.3)
N_j	-.66**	-.68**	-.75**
	(.33)	(.31)	(.29)
$\ln T_j$	-6.4***	-6.4***	-6***
	(.58)	(.56)	(.5)
$\ln M_{ij}$	-1.2	-1.6	-.95
	(1.1)	(1.1)	(1.2)
$\ln \bar{b}_j$	2.9***	2.7***	2.8***
	(.82)	(.83)	(.8)
Firm Size (Emp)$_i$	.004	.0032	-.0017
	(.0051)	(.0043)	(.0038)
Firm Size (Rev)$_i$	-.0022	-.0021	.0031
	(.0053)	(.0047)	(.0043)
Year f.e.	Y	Y	Y
Month-of-year f.e	Y	Y	Y
N	7970	7970	7970
R^2	.49	.49	.49

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq$ Year ≤ 2012.

Table 11: Markup Analysis - Impact of Firm Size

Dep Var: $\hat{m}_{B,j,i}$				
Size Variable:	**1** | Small (Emp)	**1** | Small (Rev)	Firm Size (Emp)	Firm Size (Rev)
Size Var$_i \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$	**1.7***	**.43**	**-.0019***	**-.0081****
	(.99)	(.98)	(.00099)	(.0035)
Size Var$_i \cdot Wait_j$	-5.6*	-2	.0053*	.025**
	(3)	(3)	(.0032)	(.01)
Size Var$_i \cdot \ln V_t^{\text{oil}}$	-7.9	.13	.013*	.028**
	(6.3)	(6.1)	(.0079)	(.014)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-2.8***	-2***	-1.1**	-1.3***
	(.74)	(.71)	(.54)	(.5)
Size Var$_i$	26	2.5	-.037	-.085**
	(18)	(17)	(.023)	(.041)
$Wait_j$	9.3***	7.2***	4.1**	4.6***
	(2.3)	(2.2)	(1.6)	(1.5)
$\ln V_t^{\text{oil}}$	18***	13***	8.6**	11***
	(4.2)	(3.9)	(3.5)	(2.9)
N_j	-.61*	-.6*	-.56*	-.63**
	(.32)	(.32)	(.32)	(.31)
$\ln T_j$	-6.5***	-6.5***	-6.6***	-6.5***
	(.6)	(.58)	(.57)	(.56)
$\ln M_{ij}$	-1.1	-1.2	-1.3	-1.1
	(1.1)	(1.1)	(1.1)	(1.1)
$\ln \bar{b}_j$	3***	3***	3***	3***
	(.76)	(.76)	(.81)	(.81)
Year f.e.	Y	Y	Y	Y
Month-of-year f.e	Y	Y	Y	Y
N	8035	7970	8035	7970
R^2	.48	.48	.48	.48

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 12: Markup Analysis - Impact of Relationship to other Iowa Contractors

Dep Var: $\hat{m}_{B,j,i}$			
Relation Variable:	**1** | Related	**1** | Subsidiary	**1** | JV
Rel Var$_i \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$	**1.8***	**2.7****	**.32**
	(1)	(1.1)	(.98)
Rel Var$_i \cdot Wait_j$	-5.5*	-8.1**	-1.5
	(3.1)	(3.3)	(3)
Rel Var$_i \cdot \ln V_t^{\text{oil}}$	-.93	-19**	1
	(7.7)	(7.5)	(6)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-2.3***	-3.7***	-1.9***
	(.54)	(.95)	(.71)
Rel Var$_i$	5.4	60***	-2.5
	(21)	(22)	(17)
$Wait_j$	7.4***	12***	6.7***
	(1.7)	(2.9)	(2.2)
$\ln V_t^{\text{oil}}$	13***	27***	12***
	(3.7)	(6.8)	(3.9)
N_j	-.59*	-.6*	-.6*
	(.31)	(.31)	(.33)
$\ln T_j$	-6.4***	-6.5***	-6.5***
	(.6)	(.53)	(.62)
$\ln M_{ij}$	-.95	-1.2	-1.2
	(1.1)	(1.2)	(1.2)
$\ln \bar{b}_j$	2.8***	3***	3***
	(.85)	(.83)	(.81)
Firm Size (Emp)$_i$	.000028	.00026	.00059
	(.0037)	(.004)	(.0039)
Firm Size (Rev)$_i$	.0012	.00086	.00065
	(.0041)	(.0044)	(.0043)
Year f.e.	Y	Y	Y
Month-of-year f.e	Y	Y	Y
N	7970	7970	7970
R^2	.49	.48	.48

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 13: Markup Analysis - Impact of Firm Size

Dep Var: $\hat{m}_{B,j,i}$ Family Variable:	**1** | Family·**1** | Not Diverse	**1** | Family·**1** | Related	**1** | Family·**1** | Subsidiary	**1** | Family·**1** | Small (Emp)
Fam Var$_i \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$	**2.5*** **	**2.2** **	**2.7*** **	**2.5*** **
	(.93)	(.95)	(.92)	(.9)
Fam Var$_i \cdot Wait_j$	-7.9***	-6.6**	-8.3***	-8***
	(2.8)	(3)	(2.8)	(2.7)
Fam Var$_i \cdot \ln V_t^{\text{oil}}$	.62	-.7	-9.7	-13**
	(5.4)	(6.7)	(6.2)	(5.5)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-2.6***	-2.2***	-3***	-2.9***
	(.71)	(.55)	(.77)	(.75)
Fam Var$_i$	6.4	6.3	34*	40**
	(16)	(18)	(18)	(16)
$Wait_j$	8.8***	7.2***	9.9***	9.6***
	(2.2)	(1.7)	(2.4)	(2.3)
$\ln V_t^{\text{oil}}$	12***	13***	18***	19***
	(4.4)	(3.7)	(5.3)	(4.5)
N_j	-.73**	-.59*	-.56*	-.58*
	(.32)	(.31)	(.32)	(.3)
$\ln T_j$	-6.5***	-6.5***	-6.6***	-6.6***
	(.54)	(.58)	(.57)	(.6)
$\ln M_{ij}$	-1.3	-1	-1.3	-1.2
	(1.1)	(1.2)	(1.2)	(1.1)
$\ln \bar{b}_j$	3***	3***	2.9***	3***
	(.8)	(.8)	(.82)	(.79)
Firm Size (Emp)$_i$	.0023	.00019	.00041	
	(.0041)	(.0041)	(.004)	
Firm Size (Rev)$_i$	-.0013	.0011	.0009	
	(.0046)	(.0046)	(.0044)	
Year f.e.	Y	Y	Y	Y
Month-of-year f.e	Y	Y	Y	Y
N	7927	7927	7927	7989
R^2	.49	.49	.49	.48

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 14: Markup Analysis Robustness - Impact of Public Ownership with Alternative Standard Error Clustering

Dep Var: $\hat{m}_{B,j,i}$ Standard errors clustered by:	I. None (robust)	II. State-month	III. Firm-month	IV. Firm-month of year	V. Firm-state	VI. State-year
$\mathbf{I}_{\text{Public}_i} = 1 \cdot Wait_j \cdot \ln V_t^{\text{oil}}$	**-5****	**-5***	**-5***	**-5****	**-5*****	**-5***
	(2.4)	(2.5)	(3)	(2.5)	(1.9)	(2.6)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot Wait_j$	14*	14*	14	14*	14**	14*
	(7.7)	(7.4)	(9.5)	(8)	(6.1)	(7.6)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot \ln V_t^{\text{oil}}$	44***	44**	44**	44***	44***	44**
	(13)	(15)	(18)	(14)	(13)	(21)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-1.3***	-1.3	-1.3**	-1.3**	-1.3***	-1.3**
	(.5)	(.98)	(.52)	(.52)	(.44)	(.59)
$\mathbf{I}_{\text{Public}_i} = 1$	-136***	-136**	-136**	-136***	-136***	-136**
	(40)	(47)	(58)	(44)	(40)	(62)
$Wait_j$	4.6***	4.6	4.6***	4.6***	4.6***	4.6**
	(1.5)	(2.7)	(1.6)	(1.6)	(1.4)	(2)
$\ln V_t^{\text{oil}}$	9.2***	9.2	9.2***	9.2***	9.2***	9.2
	(3)	(8.2)	(3.3)	(3.1)	(2.8)	(7.3)
N_j	-.63***	-.63	-.63***	-.63***	-.63*	-.63
	(.2)	(.35)	(.22)	(.24)	(.35)	(.49)
$\ln T_j$	-6.5***	-6.5***	-6.5***	-6.5***	-6.5***	-6.5***
	(.37)	(.64)	(.39)	(.4)	(.58)	(.95)
$\ln M_{ij}$	-1.1**	-1.1	-1.1*	-1.1*	-1.1	-1.1**
	(.51)	(.63)	(.61)	(.68)	(1.1)	(.4)
$\ln \bar{b}_j$	3***	3	3***	3***	3***	3**
	(.65)	(1.9)	(.7)	(.76)	(.76)	(1.1)
Firm Size (Emp)$_i$	.00072	.00072	.00072	.00072	.00072	.00072
	(.0011)	(.0014)	(.0016)	(.0018)	(.0032)	(.0013)
Firm Size (Rev)$_i$	.0004	.0004	.0004	.0004	.0004	.0004
	(.0017)	(.0014)	(.002)	(.002)	(.0035)	(.0018)
Year f.e.	Y	Y	Y	Y	Y	Y
Month-of-year f.e	Y	Y	Y	Y	Y	Y
N	7970	7970	7970	7970	7970	7970
R^2	.49	.49	.49	.49	.49	.49

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered as described. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 15: Markup Analysis Robustness - Impact of Family Ownership with Alternative Standard Error Clustering

Dep Var: $\hat{m}_{B,j,i}$ Standard errors clustered by:	I. None (robust)	II. State-month	III. Firm-month	IV. Firm-month of year	V. Firm-state	VI. State-year
$\mathbf{I_{Family}}_i = 1 \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$	**2.7****	**2.7***	**2.7****	**2.7****	**2.7****	**2.7****
	(1.1)	(1.3)	(1.2)	(1.2)	(1.2)	(1.1)
$\mathbf{I}_{\text{Family}_i} = 1 \cdot Wait_j$	-8.3**	-8.3**	-8.3**	-8.3**	-8.3**	-8.3**
	(3.2)	(3.7)	(3.7)	(3.7)	(3.7)	(3.3)
$\mathbf{I}_{\text{Family}_i} = 1 \cdot \ln V_t^{\text{oil}}$	-7.5	-7.5	-7.5	-7.5	-7.5	-7.5
	(5.9)	(6.1)	(7.5)	(7.2)	(8.8)	(8.4)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-3.6***	-3.6**	-3.6***	-3.6***	-3.6***	-3.6**
	(.92)	(1.3)	(1.1)	(1.1)	(1.2)	(1.5)
$\mathbf{I}_{\text{Family}_i} = 1$	26	26	26	26	26	26
	(18)	(18)	(22)	(21)	(26)	(26)
$Wait_j$	12***	12**	12***	12***	12***	12**
	(2.8)	(3.9)	(3.3)	(3.3)	(3.5)	(4.7)
$\ln V_t^{\text{oil}}$	18***	18*	18***	18***	18**	18
	(5.3)	(9)	(6.9)	(6.6)	(8)	(15)
N_j	-.66***	-.66*	-.66***	-.66***	-.66*	-.66
	(.2)	(.35)	(.22)	(.24)	(.35)	(.5)
$\ln T_j$	-6.5***	-6.5***	-6.5***	-6.5***	-6.5***	-6.5***
	(.37)	(.61)	(.39)	(.4)	(.56)	(.95)
$\ln M_{ij}$	-1.3***	-1.3*	-1.3**	-1.3*	-1.3	-1.3**
	(.51)	(.61)	(.62)	(.69)	(1.1)	(.48)
$\ln \bar{b}_j$	3***	3	3***	3***	3***	3***
	(.66)	(1.9)	(.7)	(.77)	(.76)	(1)
Firm Size (Emp)$_i$	.0013	.0013	.0013	.0013	.0013	.0013
	(.0012)	(.0016)	(.0018)	(.0022)	(.0041)	(.0022)
Firm Size (Rev)$_i$	-.000025	-.000025	-.000025	-.000025	-.000025	-.000025
	(.0019)	(.0015)	(.0023)	(.0024)	(.0044)	(.0029)
Year f.e.	Y	Y	Y	Y	Y	Y
Month-of-year f.e	Y	Y	Y	Y	Y	Y
N	7927	7927	7927	7927	7927	7927
R^2	.48	.48	.48	.48	.48	.48

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered as described. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 16: Markup Analysis Robustness - Impact of Public Ownership Varying Covariates

Dep Var: $\hat{m}_{B,j,i}$	I.	II.	III.	IV.	V.
$\mathbf{I}_{\text{Public}_i} = 1 \cdot Wait_j \cdot \ln V_t^{\text{oil}}$	**-.22**			**-3.8***	**-5.3****
	(.17)			(2.2)	(2.1)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot Wait_j$				10	15**
				(7)	(6.9)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot \ln V_t^{\text{oil}}$				35	44***
				(23)	(16)
$Wait_j \cdot \ln V_t^{\text{oil}}$		-1.8***		-.58	-1.1**
		(.5)		(.61)	(.48)
$\mathbf{I}_{\text{Public}_i} = 1$			-2.2	-99	-143***
			(3.5)	(68)	(49)
$Wait_j$		6***		2.9	3.2**
		(1.6)		(1.8)	(1.5)
$\ln V_t^{\text{oil}}$		13***		45***	8.6***
		(3.2)		(3.3)	(3.1)
N_j	-.66*	-.6*	-.55*	-1.6***	
	(.34)	(.32)	(.32)	(.39)	
$\ln T_j$	-6.4***	-6.5***	-6.4***	-8.8***	
	(.57)	(.57)	(.55)	(.51)	
$\ln M_{ij}$	-1.2	-1.2	-1.3	-2.1	
	(1.2)	(1.2)	(1.2)	(1.4)	
$\ln \bar{b}_j$	2.9***	3***	2.5***	6.2***	
	(.81)	(.82)	(.73)	(.89)	
Firm Size (Emp)$_i$	.0021	.00037	.00026	.0075**	
	(.0035)	(.004)	(.0032)	(.0038)	
Firm Size (Rev)$_i$	-.00096	.00072	.00086	-.0085*	
	(.004)	(.0044)	(.0036)	(.0048)	
Year f.e.	Y	Y	Y	N	Y
Month-of-year f.e	Y	Y	Y	N	Y
N	7970	7970	8088	7970	8087
R^2	.48	.48	.48	.26	.43

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Table 17: Markup Analysis Robustness - Impact of Public and Family Ownership with Alternative Volatility Measures

Dep Var: $\hat{m}_{B,j,i}$	Impact of public ownership			Impact of family ownership	
	I. Implied vol	II. 5-month contract 12w h-vol		I. Implied vol	II. 5-month contract 12w h-vol
$\mathbf{I}_{\text{Public}_i} =$	**-7.7*** **	**-4.6** **	$\mathbf{I}_{\mathbf{Family}_i} =$	**3.7** **	**2.7** **
$1 \cdot Wait_j \cdot \ln V_t^{\text{oil}}$			$1 \cdot Wait_j \cdot \ln V_t^{\mathbf{oil}}$		
	(2.8)	(2)		(1.7)	(1.3)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot Wait_j$	24**	13**	$\mathbf{I}_{\text{Family}_i} = 1 \cdot Wait_j$	-12**	-8.4**
	(9.5)	(6.4)		(5.6)	(3.8)
$\mathbf{I}_{\text{Public}_i} = 1 \cdot \ln V_t^{\text{oil}}$	88***	41***	$\mathbf{I}_{\text{Family}_i} = 1 \cdot \ln V_t^{\text{oil}}$	-14	-7.7
	(26)	(14)		(13)	(8.7)
$Wait_j \cdot \ln V_t^{\text{oil}}$	-.6	-1.4***	$Wait_j \cdot \ln V_t^{\text{oil}}$	-3.8**	-3.7***
	(.53)	(.46)		(1.6)	(1.2)
$\mathbf{I}_{\text{Public}_i} = 1$	-295***	-126***	$\mathbf{I}_{\text{Family}_i} = 1$	50	27
	(86)	(43)		(43)	(26)
$Wait_j$	2.6	5***	$Wait_j$	13**	12***
	(1.8)	(1.5)		(5.4)	(3.6)
$\ln V_t^{\text{oil}}$	20***	9.5***	$\ln V_t^{\text{oil}}$	39***	18**
	(6.7)	(2.8)		(15)	(8)
N_j	-.6*	-.63*	N_j	-.59*	-.66**
	(.33)	(.33)		(.32)	(.33)
$\ln T_j$	-6.4***	-6.5***	$\ln T_j$	-6.4***	-6.5***
	(.58)	(.58)		(.54)	(.55)
$\ln M_{ij}$	-1.1	-1.1	$\ln M_{ij}$	-1.4	-1.3
	(1.1)	(1.1)		(1.2)	(1.2)
$\ln \bar{b}_j$	3***	3***	$\ln \bar{b}_j$	2.9***	2.9***
	(.79)	(.8)		(.79)	(.8)
Firm Size (Emp)$_i$	-.00063	.0008	Firm Size (Emp)$_i$	.0011	.0012
	(.0026)	(.0029)		(.004)	(.004)
Firm Size (Rev)$_i$	.0019	.0003	Firm Size (Rev)$_i$	.00027	.000016
	(.0031)	(.0033)		(.0044)	(.0044)
Year f.e.	Y	Y	Year f.e.	Y	Y
Month-of-year f.e	Y	Y	Month-of-year f.e	Y	Y
N	7970	7970	N	7927	7927
R^2	.49	.49	R^2	.49	.48

Note: This table reports results from the markup estimation in Equation 6. Standard errors clustered by firm. *** $p < .01$. $1994 \leq \text{Year} \leq 2012$.

Figure 1: Iowa and Kansas Bitumen Bids Around 2006 Policy

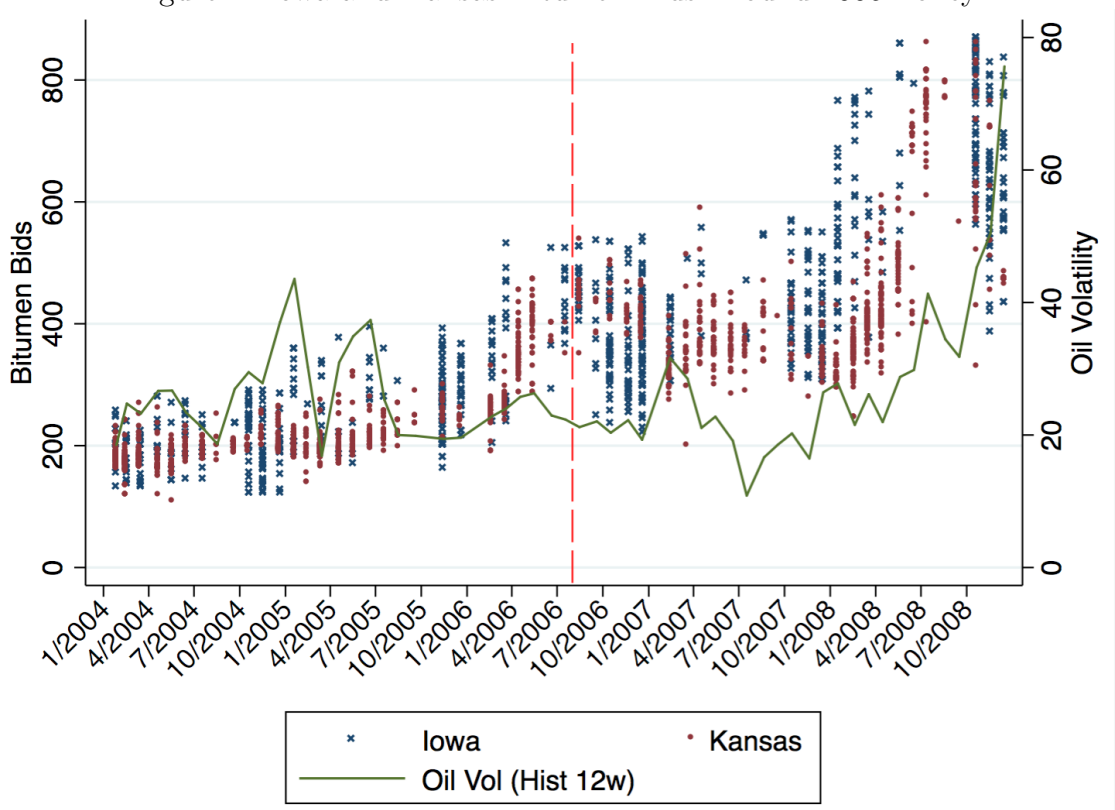


Figure 2: Bitumen Bid Markup Proxy and Crude Oil Price Volatility

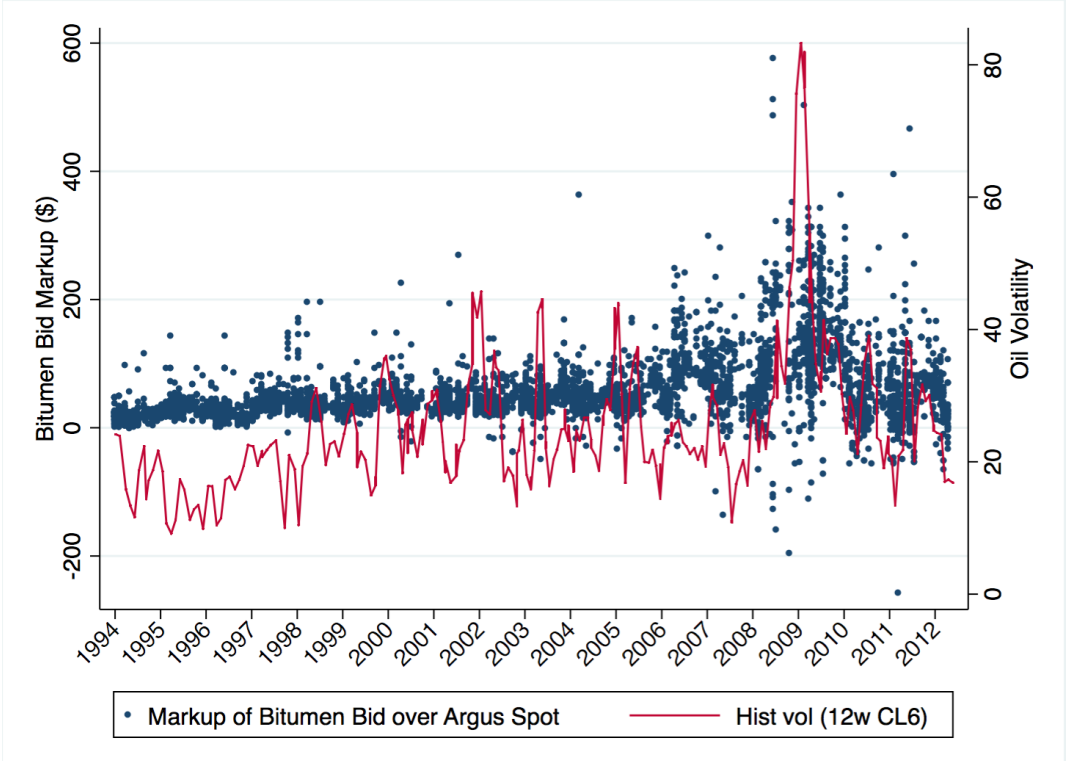
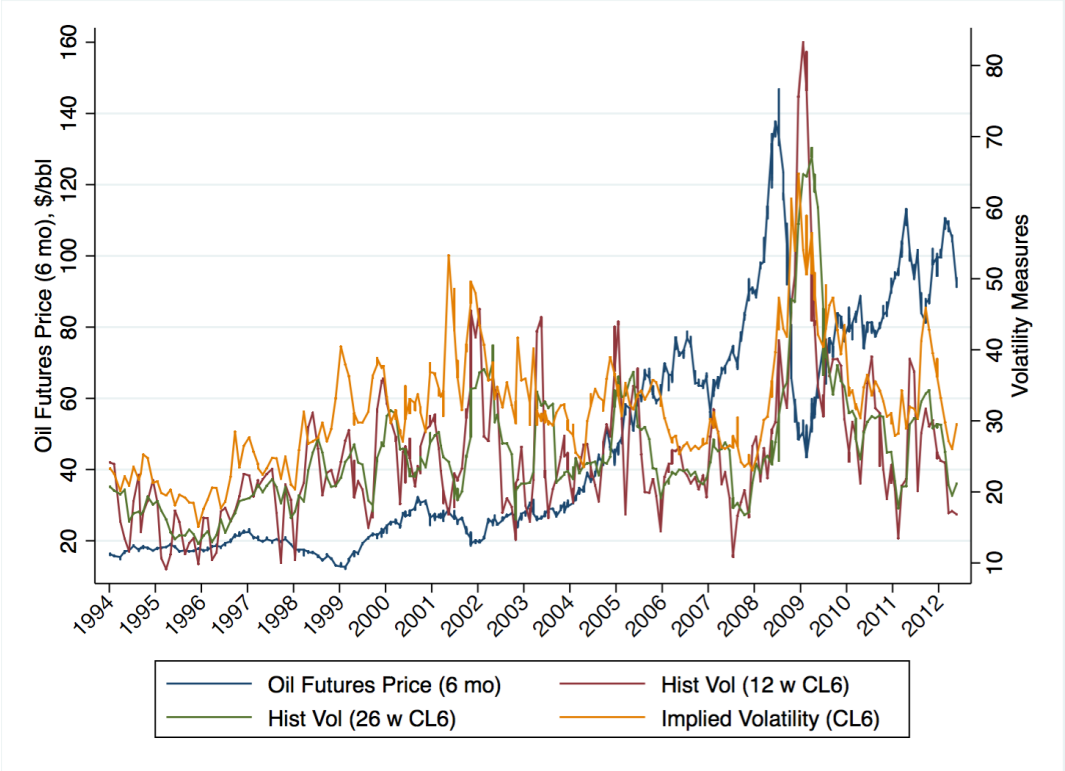


Figure 3: Crude Oil 6 mo Futures Price and Volatility Measures



Appendix B: Bitumen Cost Outcome from Risk Removal Policy

A public policy question inherent to this paper is whether or not a state can lower its asphalt paving costs by using a price index adjustment policy. If firms are risk neutral or charge simply the CAPM-implied price of risk, then this policy should have been quite costly for Kansas during my data span because on average, the oil price rose between the time of the auction and the time of work start over the period 2006-2012. On the other hand, if firms are risk averse, then the policy could be beneficial. State governments, with sufficient access to capital and long term time frames, should be risk-neutral.

Using auction and payments data, I compare how much each state paid for bitumen after the introduction of the price adjustment policy in Kansas in 2006. Pavers in Kansas are paid every two weeks as in Iowa, but they receive an asphalt price adjustment based on the AMI that month.[1] I add the adjustment per ton to the AMI at the time of the auction, and arrive at a final number for what Kansas is actually paying for bitumen. Interestingly, KDOT officials tell me that they have never attempted such an exercise, and do not have the bandwidth to assess whether their adjustment policy is better than a no-price adjustment policy alternative.

There is a remarkable coincidence of mean cost (which is the bid unit item) between Iowa and Kansas prior to the policy intervention, shown in Table 1. Even though Iowa used far more tons per project and my data includes more observations, both states had essentially the same mean cost of $210 and $205 per ton prior to the policy, and very similar median and standard deviation values. The second obvious trend is the cost escalation post-2006. Holding this constant across Iowa and Kansas, however, reveals that on a per-ton basis Kansas' policy appears to have resulted in a slightly lower cost per ton, though Table 9 itself does not offer insight into whether Kansas' $489 figure is statistically significantly less than the $513 figure for Iowa.

[1] I observe these payments, and I also see the final, cumulative payment that is the sum of these individual adjustments, which may be all positive, all negative, or a mixture. The AMI when work is completed, at the time of the final cumulative payment, is not relevant to the individual payments. Therefore to find the cumulative price adjustment per ton, I divide the total adjustment amount (a lump sum) by the total number of tons of bitumen used in the project. Pavers in the post-2006 period are required to bid the monthly AMI at the time of the auction (this is rolled into their bid item for mix).

Table 1: Evaluation of the Price Adjustment Policy: Iowa and Kansas Per Ton Bitumen Costs

	Iowa Pre-Policy	Kansas Pre-Policy	Iowa Post-Policy	Kansas Post-Policy
# Observations (=Contracts)	618	150	385	166
Mean Cost ($/ton)	**$210**	**$205**	**$513**	**$489**
Median Cost ($/ton)	$190	$177	$515	$487
Percentile of Cost: 1% ($/ton)	$118	$34	$313	$245
Percentile of Cost: 99% ($/ton)	$438	$474	$810	$844
Std. Dev. of Cost: ($/ton)	$73	$91	$83	$100
Mean Tons Used	1,246	516	1,117	1,235
Median Tons Used	872	421	754	940
Std. Dev. Tons Used	1,318	437	1,025	1,026
Mean Total Spent ($)	$262,010	$115,674	$561,804	$617,385
Std. Dev. Total Spent ($)	$318,468	$174,597	$515,652	$527,798

Note: This analysis is done only for the selection of contracts for which Kansas provided payment data, which is a random selection of the complete dataset. I excluded 2 outlier projects from this group that had adjusted prices over $900 in 2011.

A simple least squares difference-in-difference regression suggests that Kansas benefited from the policy. The results are in Table 2. The dependent variable is the price paid per ton by either DOT. This is regressed on the Argus spot price, an indicator for whether the letting happened after July, 2006, and an interaction between the auction occurring in Kansas and being after July, 2006. This last covariate produces the coefficient of interest: with Iowa as a control, did being in Kansas post policy intervention affect the price paid for bitumen per ton? I conclude that the price adjustment policy has had a statistically significant negative effect on the price paid by KDOT, but that the effect is not dramatic. The tabulation in Table 9 suggested that the policy has reduced the price paid per ton by Kansas by $24, and the regression results in Table 10 suggest that that it reduced the price by $37, or 11.6% of the average per ton bid over the period. This analysis implies that over the 166 projects post-2006, Kansas saved $5.1 million.

Table 2: Impact of Price Adjustment Policy on Price Paid for Bitumen

Dependent Variable: Per Ton Price Paid by DOT	I.
$\mathbf{I}_{\text{KS}} * \mathbf{I}_{\text{post-policy}}$	**-37.04****
	(17.59)
$\ln p_t^{\text{KSspotbinder}}$	220.08***
	(59.10)
I_j	1.49 (1.41)
$\mathbf{I}_{\text{post-policy}}$	-21.31 (119.9)
$\mathbf{I}_{\text{state}}$	25.35** (12.08)
R^2	0.914

Note: N=1276 contracts. Includes county, month and year fixed effects. Standard errors clustered at quarter-state level. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Appendix C: Maps of Paving Firm Bids and Bitumen Supplier Locations

Figure 1: Bitumen Supplier Territories - Firm Z Project Locations and the Supplier from Forward Contract Data

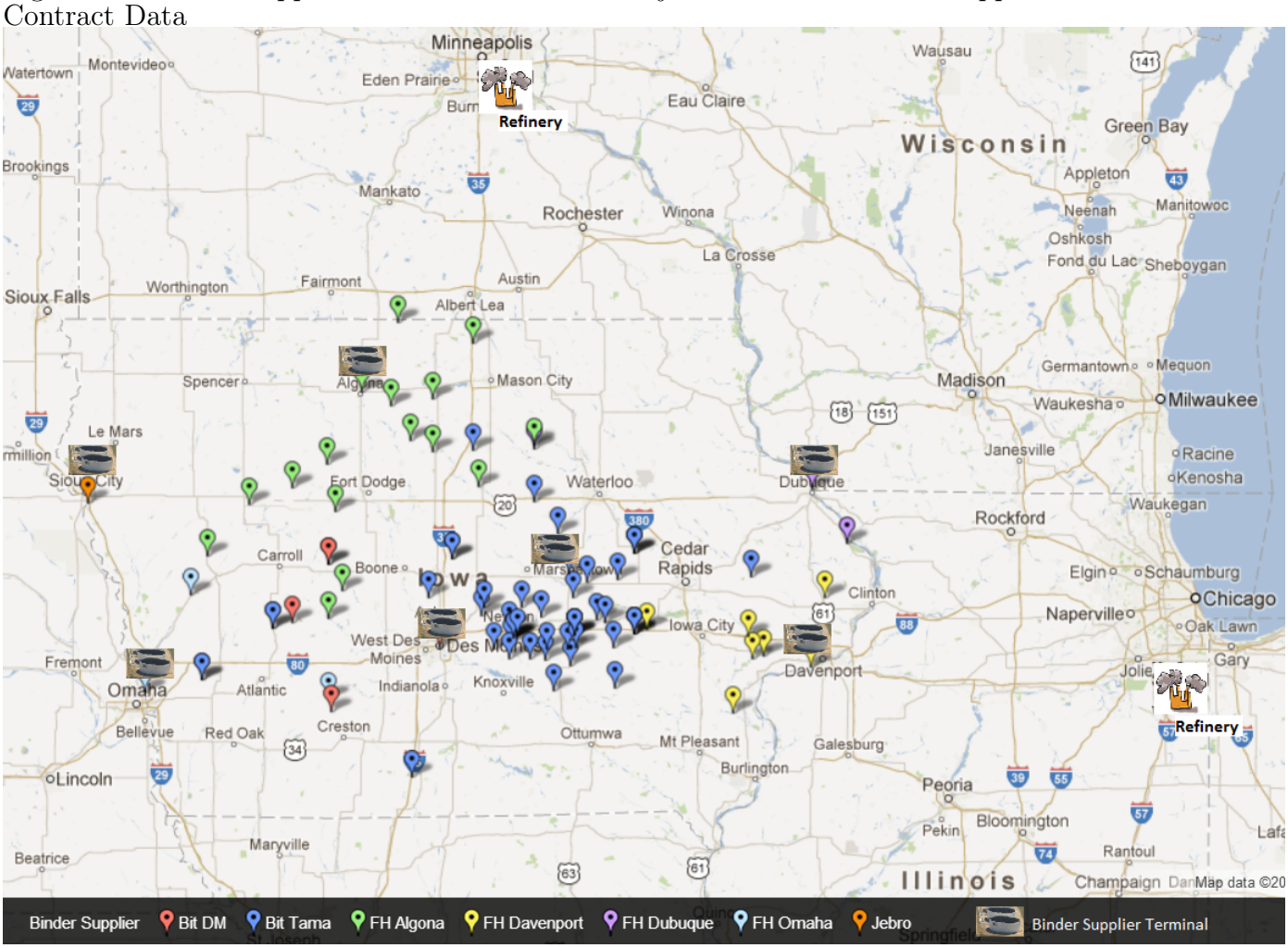


Figure 2: Mathy Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

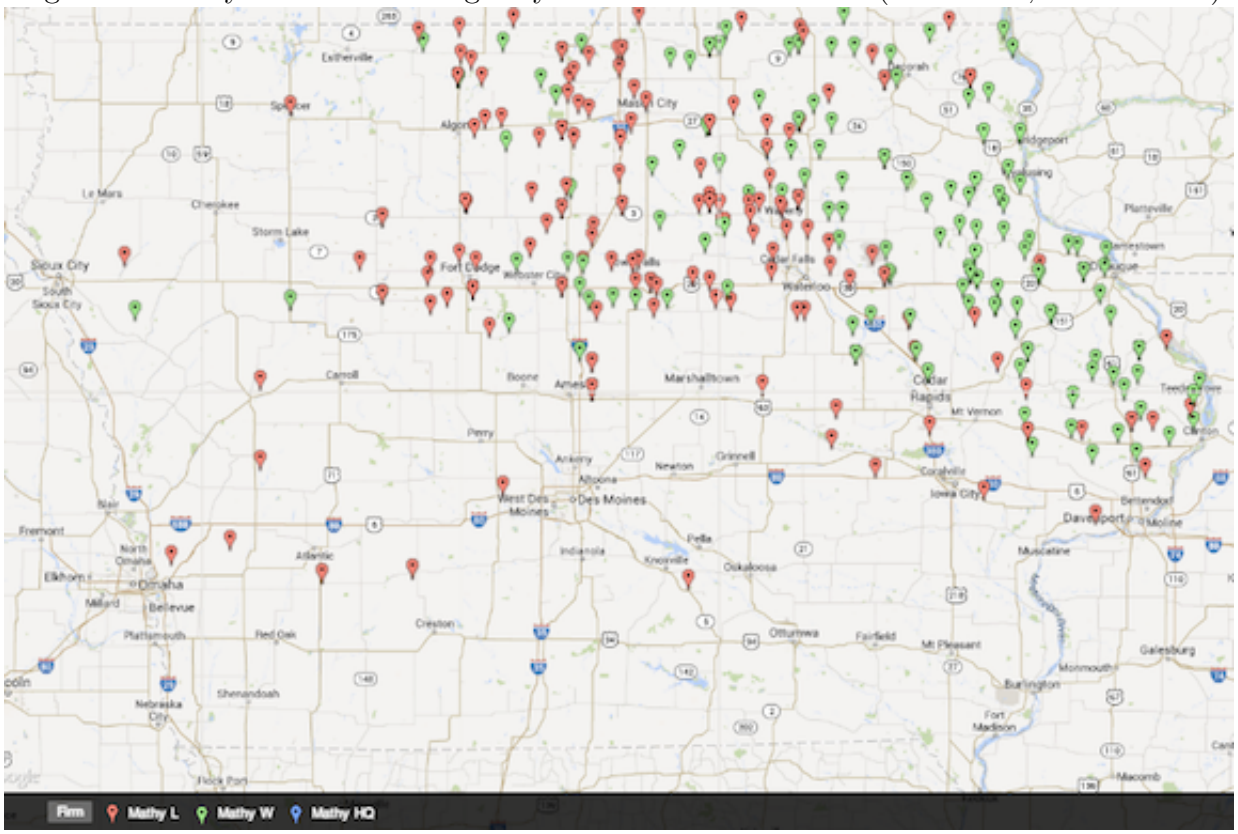


Figure 3: Manatts Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

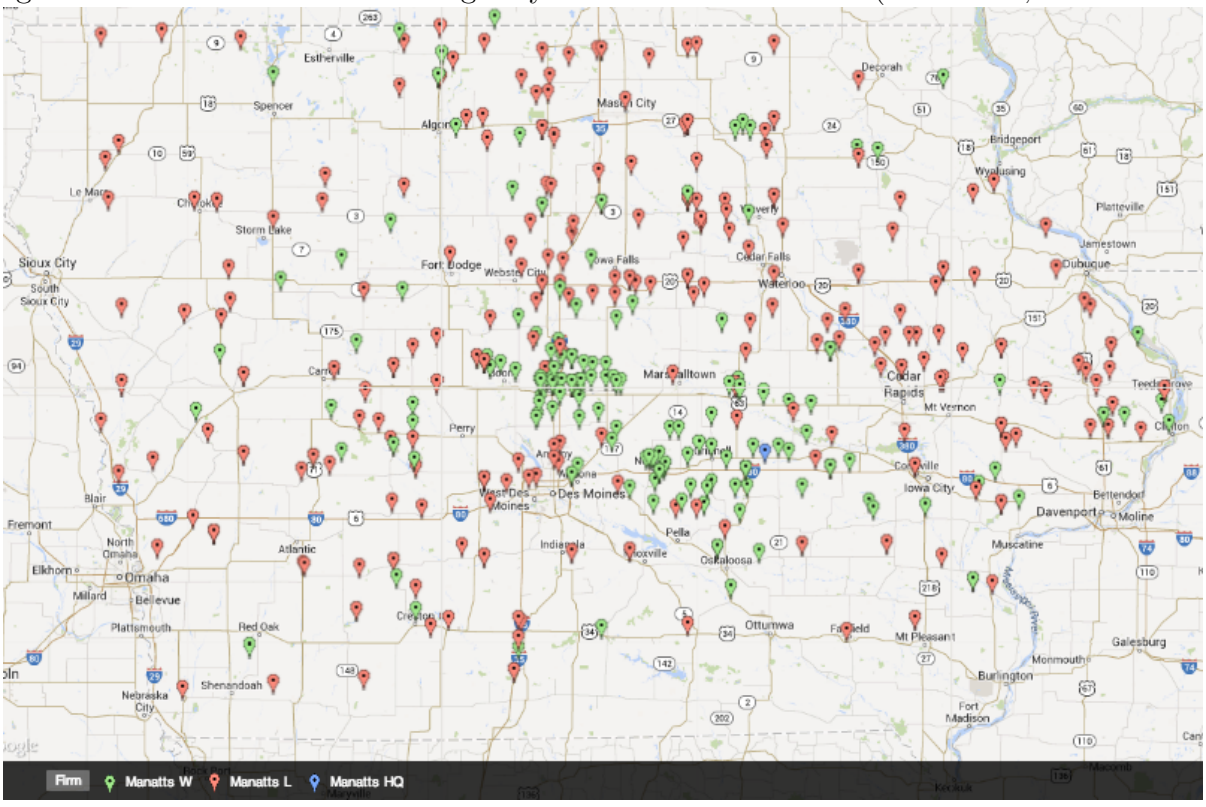


Figure 4: Henningsen Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

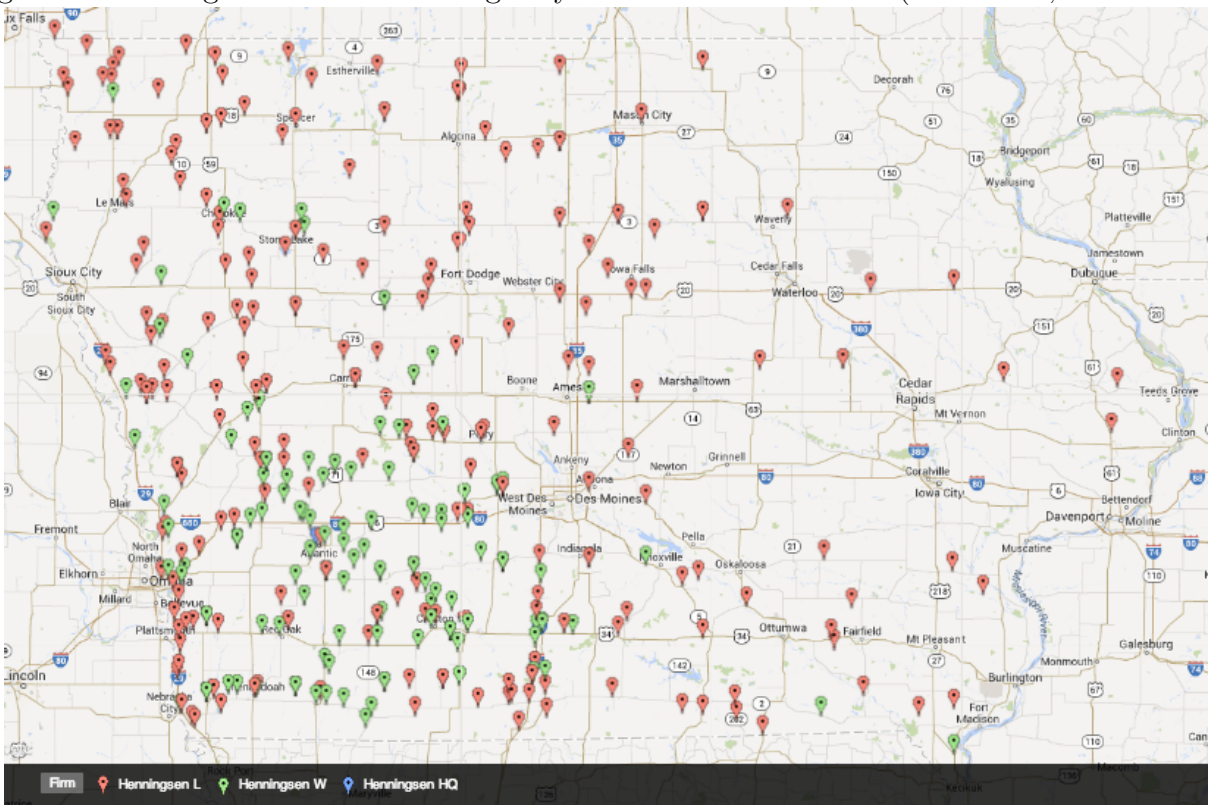


Figure 5: Western Engineering Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

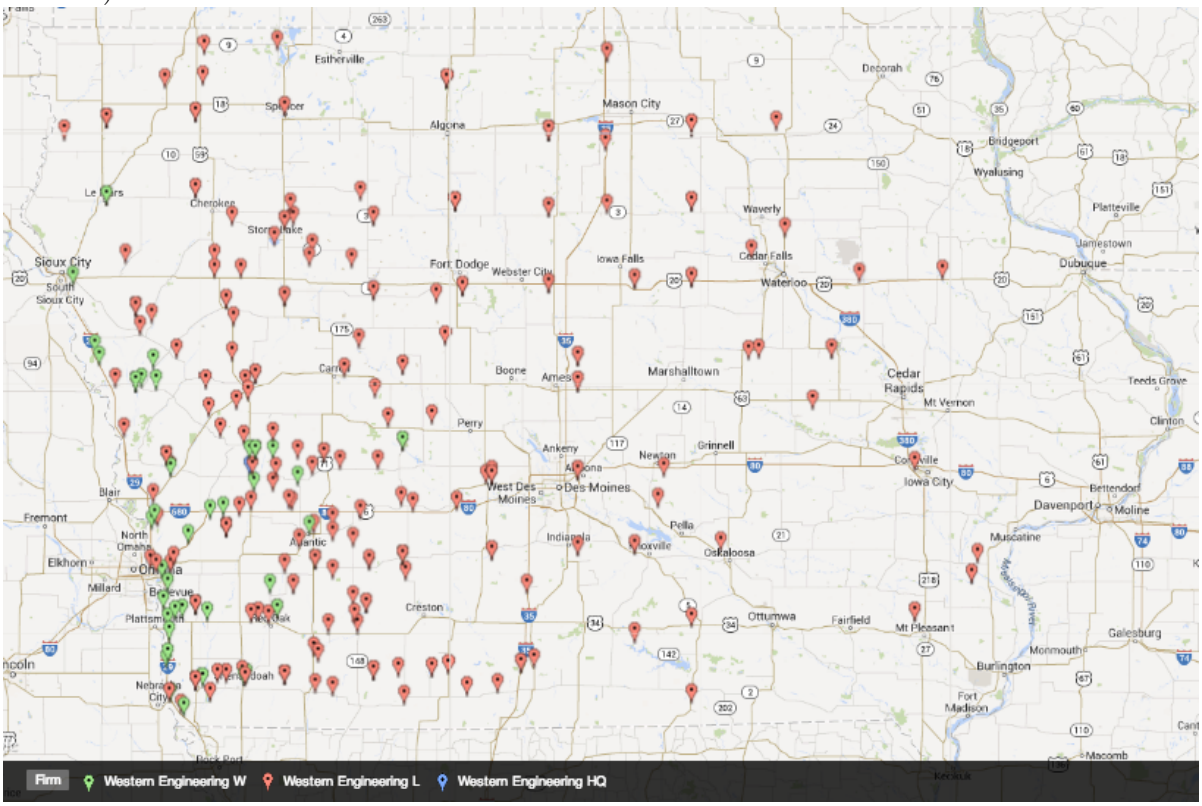


Figure 6: Rohlin Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

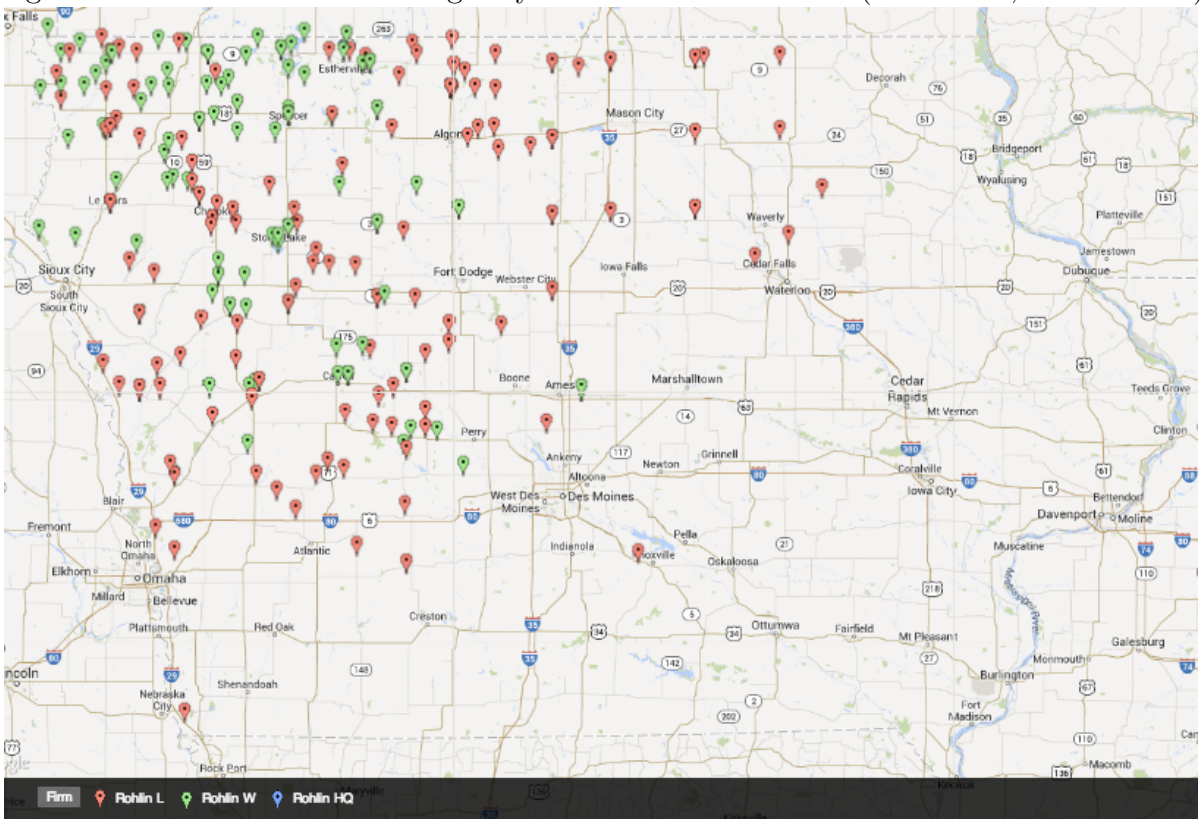


Figure 7: Castle Rock Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

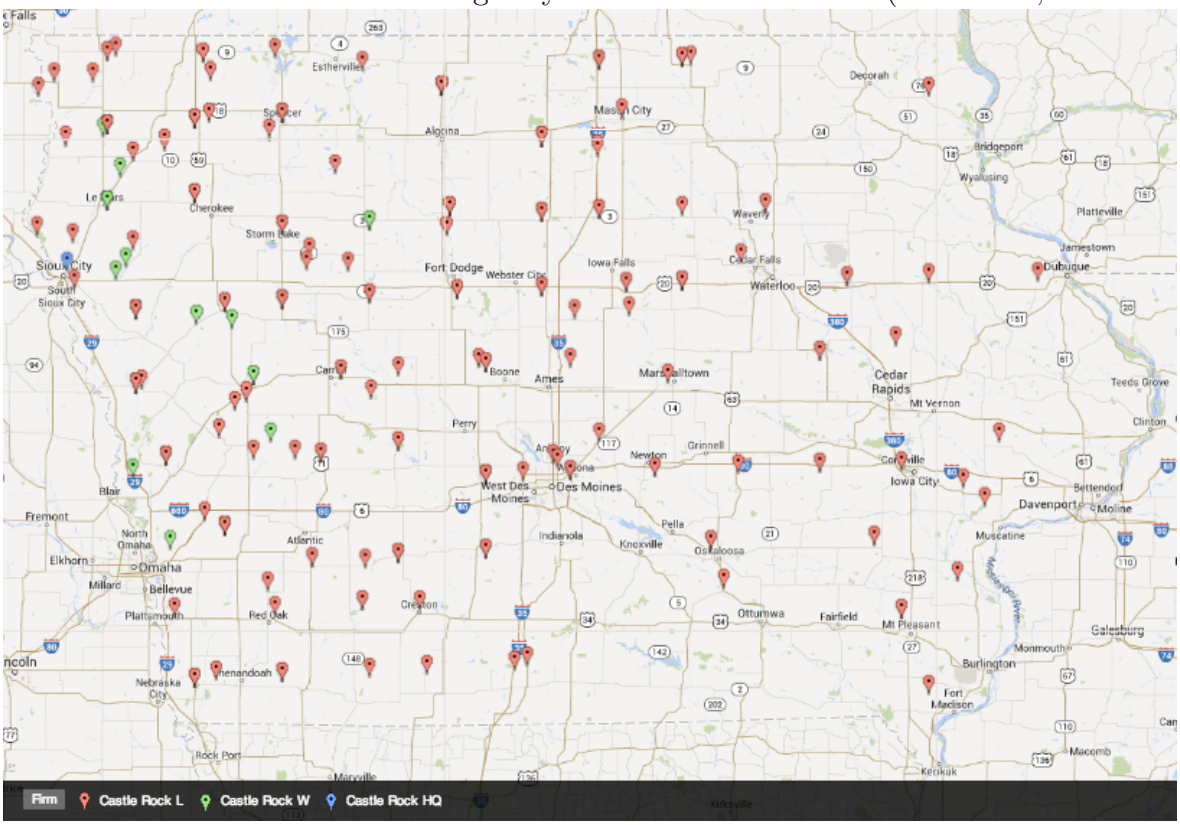


Figure 8: Cessford Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

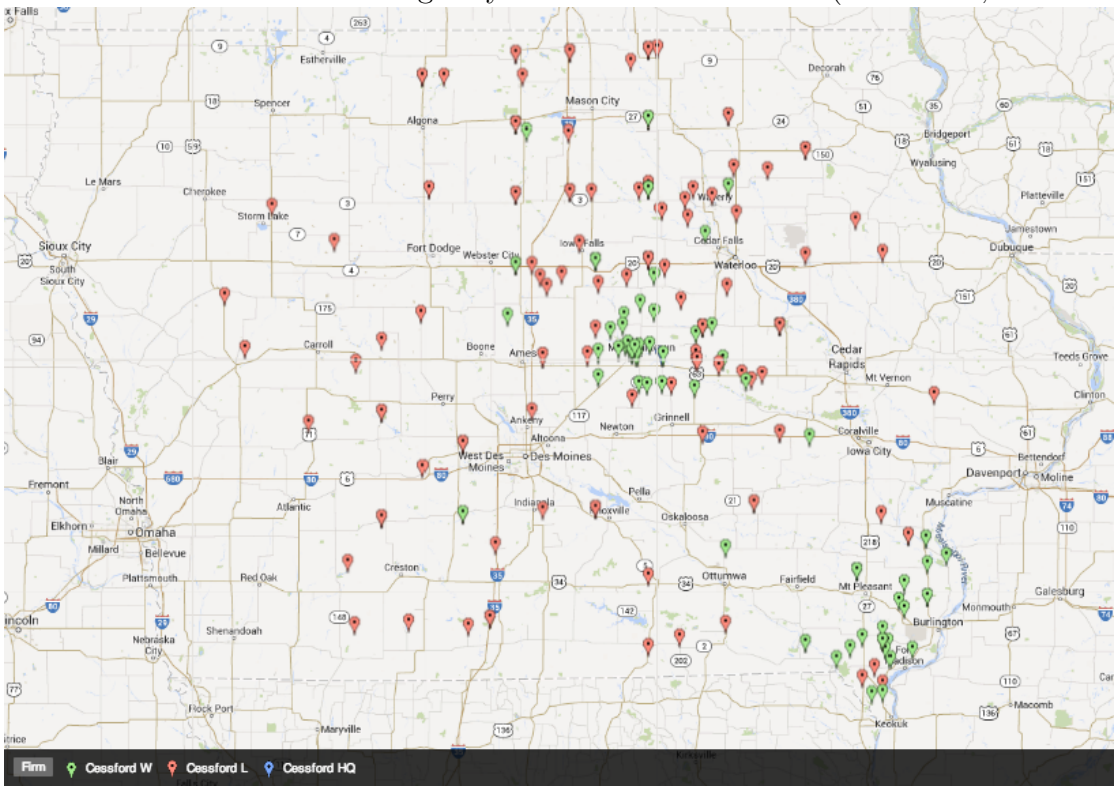


Figure 9: Heartland Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

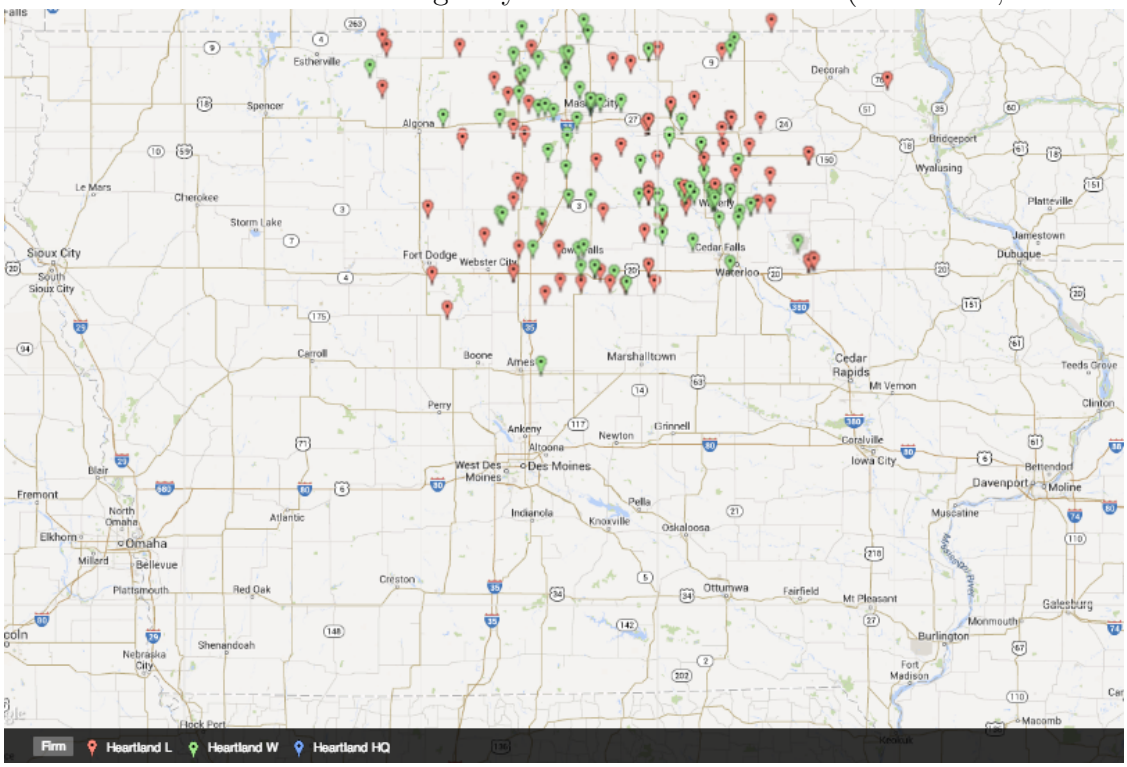


Figure 10: Hodgman Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

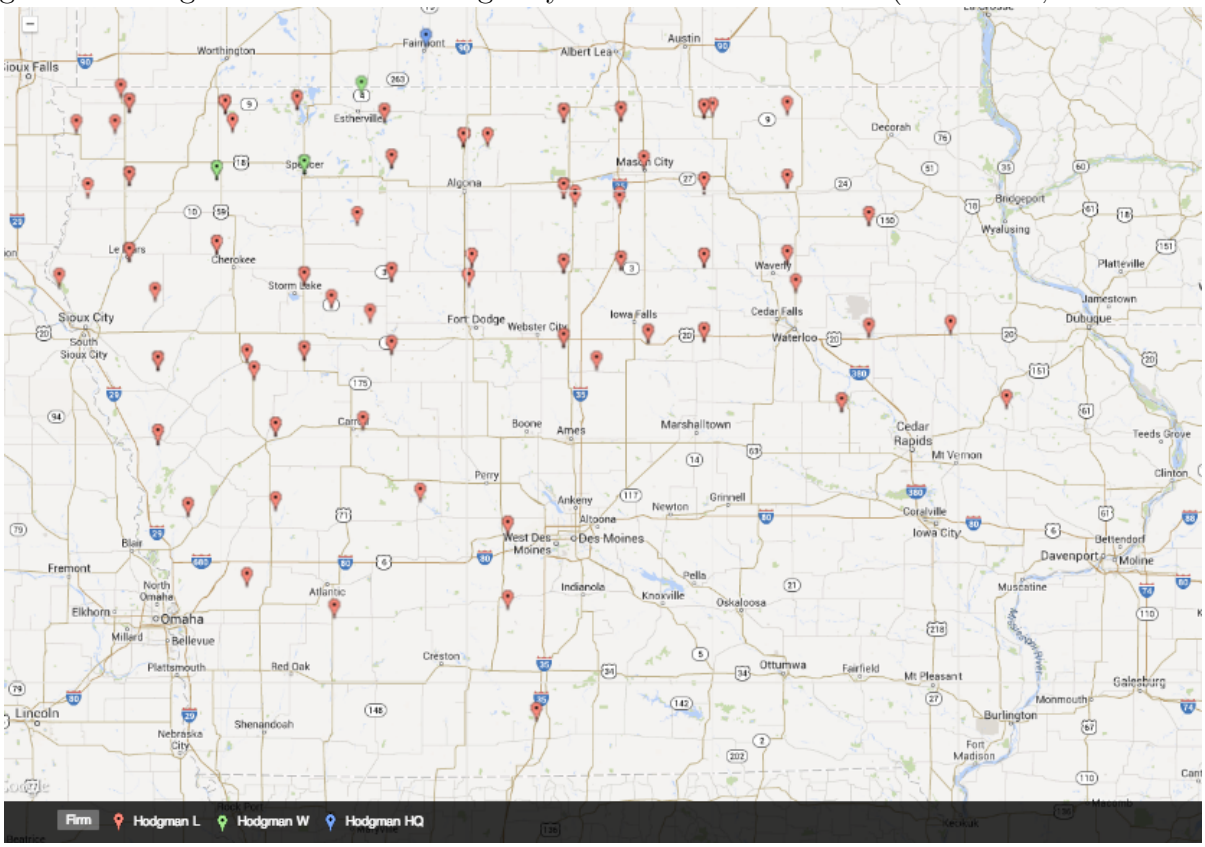


Figure 11: Norris Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

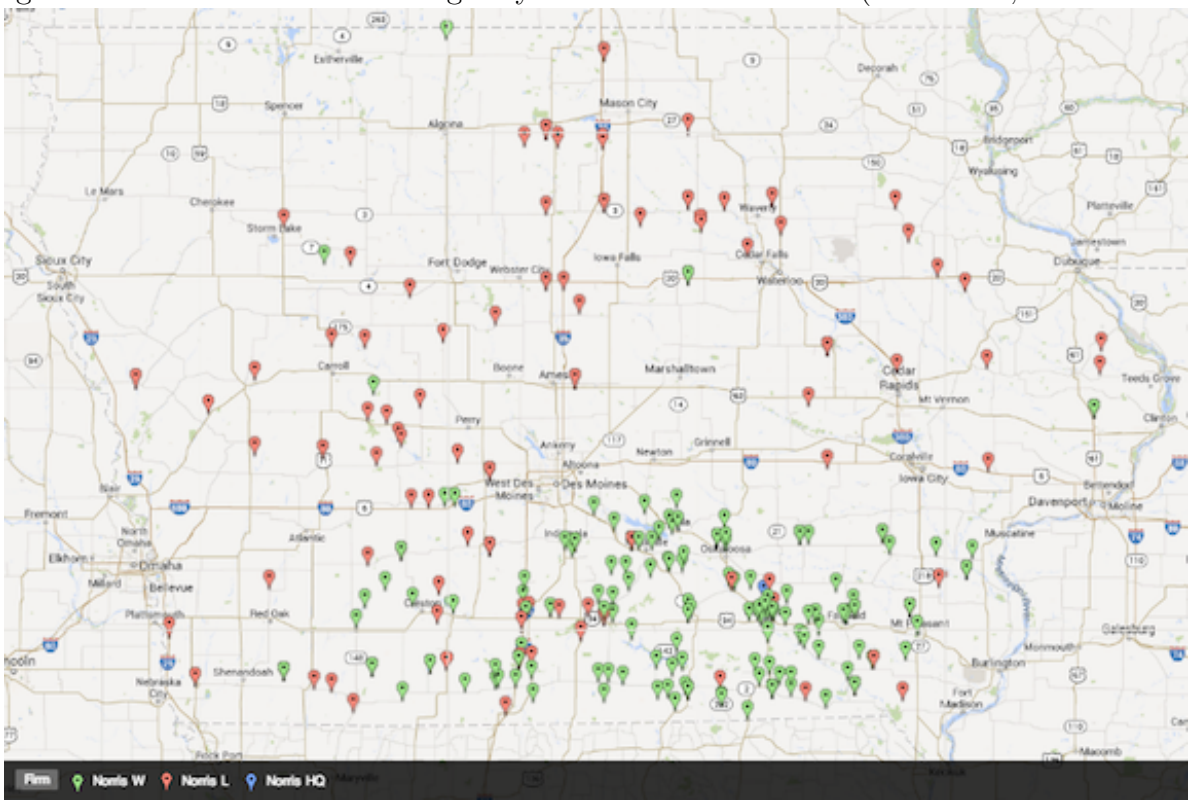


Figure 12: Cedar Valley Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

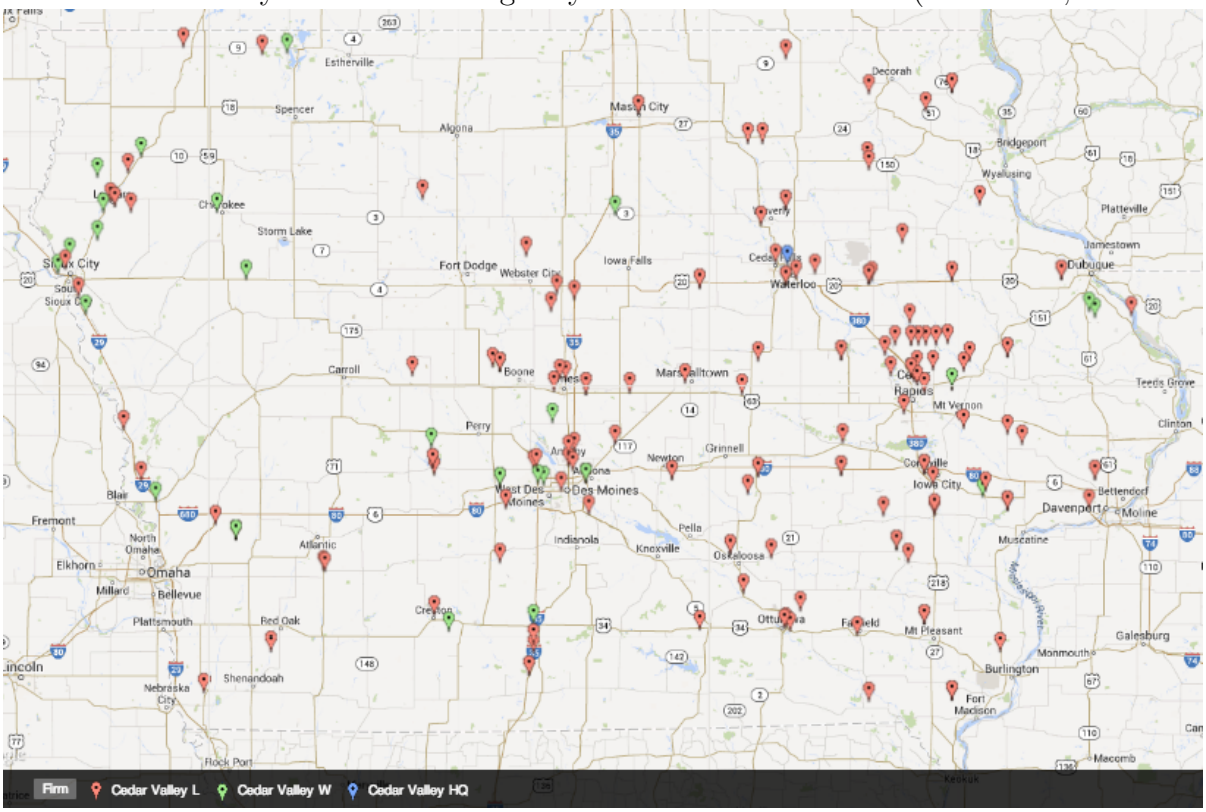


Figure 13: Peterson Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

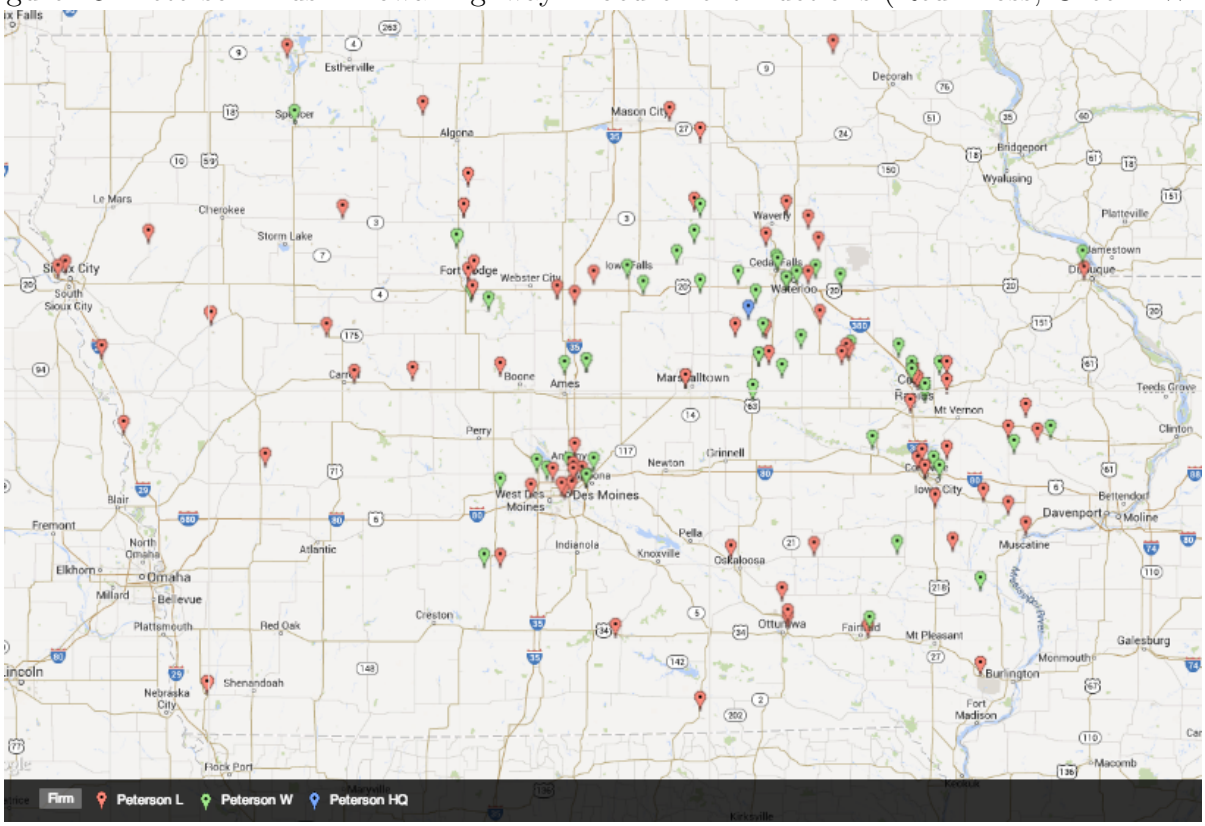


Figure 14: Knife River Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)

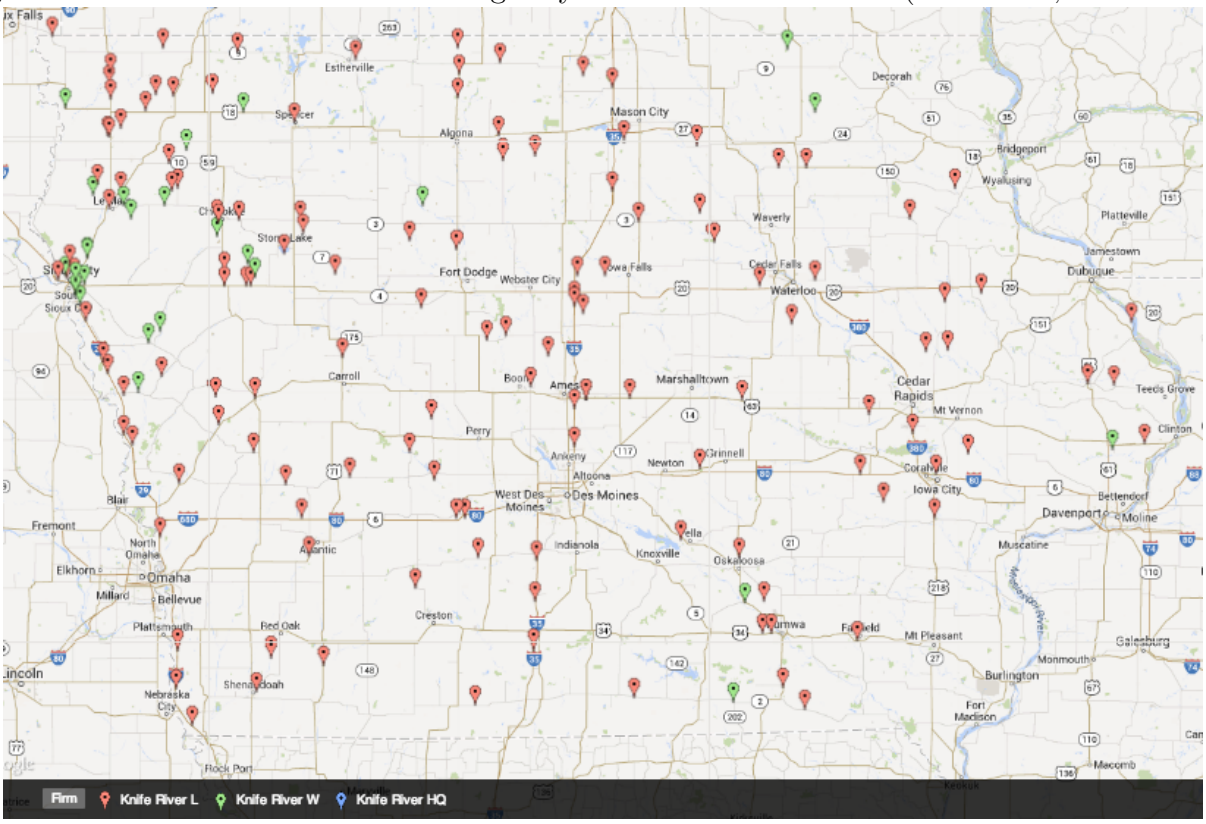


Figure 15: Des Moines Asphalt Bids in Iowa Highway Procurement Auctions (Red=Loss; Green=Win)