Costs of A Local Air Quality Regulation on Dairies in the San Joaquin Valley

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Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4–6, 2013

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Abstract

This research estimates the costs of a local air quality rule (Rule 4570) adopted in the San Joaquin Valley in 2006 to reduce Volatile Organic Compounds (VOCs) emissions from dairies. Using a panel of farm-level cost data from dairies throughout California, I estimated the effects of the regulation on feed, labor, and other operating costs.

Regulatory Background

Table 1: Mitigation Measures in Rule 4570 for Dairies

Numbers of Measures		Descriptions of Measures	Estimated Costs		Adoption rate
# Listed	# Required		*2006 Analysis*	*2010 Analysis*	*2010 Analysis*
			($/cow/year)		*(%)*
7	5	***Feed***			
		a) Feed according to Natural Resource Council Guidelines	NS	12	14
		b) Store grain in a weather-proof structure	NS	40.21[a]	50
		c) Remove wet feed from bunks	5.3	0.38	13
2	1	***Silage***			
		a) Cover the surface of silage piles	10	3.65[a]	41
1	1	***Milk Parlor***			
		a) Flush or hose milk parlor	NS	NS	100
5	3	***Freestall barn***			
		a) Remove manure not dry from stalls	5.3	1.78	27
9	7	***Corral***			
		a) Clean manure from corrals at least four times per year	42.4	5.16	6
		b) Scrape or flush concrete lanes in corrals every seven days	NA	0.1	60
		c) Inspect water pipes and troughs and repair leaks	NA	0.18	64
		d) Harrow, rake or scrape corrals to maintain dry surface	NA	0.51	41
		e) Install shade structures with light-permeable roofing	NA	10.55[a]	39
2	1	***Solid Manure Handling***			
		a) Cover dry manure pile within 72 hours of removal from housing	3.65	NS	100
4	1	***Liquid Manure Handling***			
		b) Use solid separator	NS	17.22[a]	38
4	1	***Land Application***			
		a) Land-incorporate manure within 72 hours	NS	NS	100

Notes: Dairy CAFs can design their own mitigation measures for all source categories. "NS" indicates that the mitigation measure was estimated to be already employed by most affected dairy CAFs, and "NA" indicates no estimates were provided. [a] The estimated costs include annualized capital costs.

Methodology

I identify the effects of Rule 4570 on dairies using a difference-in-differences (DD) framework.

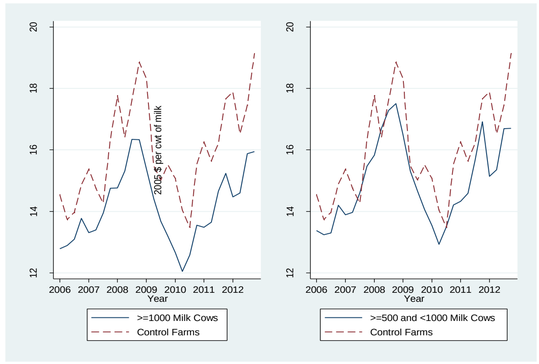
(1) $y_{it} = \delta^a D_{it}^a + \delta^b D_{it}^b + \alpha_i + \lambda_t + S_{rt}\theta + X_{it}\beta + \varepsilon_{it} \qquad i = 1, ..., N; \qquad t = 1, .., T,$

y_{it} denotes the value of one of the cost variables of dairies. D_{it}^a indicates the original rule and D_{it}^b indicates the amended rule, which took effect in 2011. This model also includes a set of dairy fixed effects and time fixed effects. S_{rt} denotes region-specific time trends and is a vector of farm-specific X_{it} explanatory variables, such as the number of milk cows and fat test percentage.

Data

	Annual Average Cost					Cost Share			
Year	Total	Feed	Hired Labor	Operating	Marketing	Feed	Hired Labor	Operating	Marketing
					($/cwt)				(%)
2006	13.73	7.06	1.55	2.68	0.52	51.4	11.3	19.5	3.8
	(2.18)	(1.25)	(0.49)	(0.71)	(0.11)				
2007	14.52	7.83	1.53	2.69	0.51	53.9	10.5	18.5	3.5
	(2.46)	(1.63)	(0.48)	(0.69)	(0.11)				
2008	16.68	9.64	1.60	2.83	0.53	57.8	9.6	17.0	3.2
	(3.19)	(2.17)	(0.55)	(0.79)	(0.17)				
2009	15.12	8.52	1.61	2.74	0.50	56.3	10.6	18.1	3.3
	(3.36)	(2.05)	(0.60)	(0.89)	(0.13)				
2010	13.58	7.51	1.56	2.72	0.49	55.3	11.5	20.0	3.6
	(2.71)	(1.53)	(0.58)	(0.85)	(0.12)				
2011	15.30	9.48	1.51	2.7	0.49	62.0	9.9	17.6	3.2
	(3.01)	(1.96)	(0.58)	(0.85)	(0.13)				
2012	16.29	10.61	1.48	2.63	0.48	65.1	9.1	16.1	2.9
	(3.50)	(2.47)	(0.57)	(0.89)	(0.13)				

Total Cost of Milk Production: 2006–2012



Results

Rule 4570 relies mainly on management practices, rather than control devices, to prevent emissions from dairies. Most mitigation measures were expected to result in higher labor costs, and fuel or electricity costs. I estimated the effects of the regulation on major categories of operational costs.

	Total Costs	Feed Costs	Hired Labor Costs	Operating Costs	Milk Marketing Costs
Rule 4570	-0.173	-0.079	-0.001	0.052	-0.002
	(0.123)	(0.069)	(0.023)	(0.040)	(0.006)
Rule 4570: Amended	0.106	-0.285*	0.199***	0.225**	0.022*
	(0.234)	(0.148)	(0.063)	(0.090)	(0.011)
Number of Milk Cows (1,000)	-1.375***	-0.516***	-0.261***	-0.560***	-0.001
	(0.364)	(0.161)	(0.074)	(0.126)	(0.016)
Number of Dry Cows (1,000)	5.766***	3.101***	0.966***	1.497***	-0.017
	(1.784)	(0.876)	(0.294)	(0.564)	(0.024)
Milk Yield (cwt/milk cow/month)	-0.631***	-0.270***	-0.062***	-0.102***	0.004
	(0.053)	(0.037)	(0.009)	(0.011)	(0.002)
Fat Test (%)	1.246***	0.743***	0.144**	0.351***	0.025**
	(0.358)	(0.217)	(0.062)	(0.134)	(0.012)
SNF Test (%)	-0.511	-0.141	-0.011	-0.239**	-0.019
	(0.385)	(0.254)	(0.100)	(0.116)	(0.014)
Region-Regulation trend	Yes	Yes	Yes	Yes	Yes
Farm fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4277	4277	4277	4277	4277
Farms	220	220	220	220	220
R-squared (within farm)	0.639	0.723	0.197	0.239	0.082

Notes: All costs are in 2005 dollars per cwt of milk. LCAFs indicate large confined animal facilities and MCAFs indicate medium confined animal facilities. * p<0.10, ** p<0.05, *** p<0.01.

Above: A Covered Silage Pile

In addition, I allow the effects of the regulation to vary across years. Other controls, as shown in the preceding table, are also included in the following table of regression results. In 2012, I estimated the effect of the rule to equivalent to a 16% increase in hired labor costs for covered dairy farms.

	Total Costs	Feed Costs	Hired Labor Costs	Operating Costs	Milk Marketing Costs
Rule 4570: 2007	-0.231*	-0.147*	0.021	0.018	-0.005
	(0.136)	(0.082)	(0.026)	(0.045)	(0.006)
Rule 4570: 2008	-0.409**	-0.351***	-0.036	0.065	-0.008
	(0.179)	(0.124)	(0.035)	(0.055)	(0.010)
Rule 4570: 2009	-0.122	0.099	-0.017	0.039	0.009
	(0.190)	(0.113)	(0.035)	(0.056)	(0.009)
Rule 4570: 2010	0.105	0.136	0.030	0.070	0.001
	(0.159)	(0.099)	(0.030)	(0.052)	(0.006)
Rule 4570: 2011	0.099	-0.144	0.154**	0.143	0.001
	(0.277)	(0.171)	(0.068)	(0.097)	(0.010)
Rule 4570: 2012	0.010	-0.436*	0.230**	0.249**	0.040**
	(0.364)	(0.237)	(0.089)	(0.115)	(0.016)
Observations	4277	4277	4277	4277	4277
Farms	220	220	220	220	220
R-squared (within farm)	0.640	0.726	0.197	0.238	0.086

Notes: All costs are in 2005 dollars per cwt of milk. LCAFs indicate large confined animal facilities and MCAFs indicate medium confined animal facilities. * p<0.10, ** p<0.05, *** p<0.01.

Summary

Preliminary estimation results indicate that neither Rule 4570 nor the amended version of it affected the costs of milk production. The rule had some negative effects on feed costs and some positive effects on hired labor and operating costs.