DIVISION OF AGRICULTURAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF CALIFORNIA

Statistical Supplement to:

Production Functions and Supply Applications for California Dairy Farms

by IRVING HOCH

GIANNINI FOUNDATION OF AGRICULTURAL ECONOMICS

July 1976

STATISTICAL SUPPLEMENT TO:

PRODUCTION FUNCTIONS AND SUPPLY APPLICATIONS FOR CALIFORNIA DAIRY FARMS

This Statistical Supplement contains additional information extending the results presented in Giannini Foundation Monograph Number 36 (University of California, Berkeley). For economy of effort and presentation, the Monograph presents only limited information on standard errors and t ratios for estimated equations. This Supplement remedies that limitation by presenting those statistics as well as information on sample size and number of independent variables appearing in each equation. In addition, it presents more detail on a number of coefficient estimates; in particular, results obtained prior to introduction of firm effects are presented here for the various production equations employed.

The Supplement is organized in three sections: Section 1 presents additional information on Equations 1 through 6; Section 2 extends the results for Equation 7; and Section 3 extends results for the feed regressions used in estimating some of the feed quantities.

Because the information here should be of considerable interest primarily to the production specialist and econometrician, it is being presented as a Supplement rather than an appendix to the Monograph.

TABLE OF CONTENTS

LIST OF TABLES

Section 1: Equations 1 Through 6

This section extends the presentation of results in the Monograph and its Appendices by exhibiting standard errors and t ratios for each of Equations 1 through 6 for both Case 1 (before firm effects introduced) and Case 2 (after firm effects introduced). Supplement Table 1 shows, by sample, the number of dummy variables for each set of dummies employed and then uses the information to indicate the maximum number of dummies that may appear for each sample. The maximum number of independent variables is then obtained by adding to this value the number of factors of production for a given equation. By equation, the number of factors was:

Equation	Factor
1	2
2	2
3	1
4	3
5	5
6	5

The following Supplement Tables extend the results for Equation 1 shown in Tables 7 and 8 of the Monograph; those for Equation 2 in Table 18; those for Equation 3 in Table 27; and those for Equation 4 in Table 29. Selected results for Equation 5 appear in the Monograph as Tables 31 and 32, while the full set of coefficients is presented as Appendix Table B.1. The latter table is reproduced here, followed by corresponding values of standard errors and t ratios for the individual samples. Similarly, selected results for Equation 6 appear in the Monograph as Table 34, while Appendix Table B.6 presents individual coefficient estimates by sample. That table is reproduced here, followed by corresponding standard errors and t ratios.

For all of the equations, information is also given on R^2, number of independent variables, and sample size (number of observations).

SUPPLEMENT TABLE 1

Number of Dummy Variables for Equations 1 Through 6 by Region and Sample

Region[a] and sample	Number of dummy variables					Maximum number of independent dummy variables[c]	
	Firms	Years	Breeds	Dairy Herd Improvement Association (DHIA) and months[b]	Total	Excluding firms	Including firms
Sacramento Valley							
Market	64	6	4	13	87	20	83
Manufacturing	20	6	4	13	43	20	39
Left survey	21	6	3	13	43	19	39
Northern and Sierra Mountains	29	6	4	13	52	20	48
San Joaquin Valley							
Northern Market	46	6	4	13	69	20	65
Southern Market	51	6	4	13	74	20	70
Manufacturing	20	6	3	13	42	19	38
North Coast	29	3	4	13	49	17	45
Bay Area							
Northern	67	5	4	13	89	19	85
Southern	41	5	4	13	63	19	59
Southern California							
Central	63	5	3	13	84	18	80
Peripheral	23	5	3	13	44	18	40

[a]Counties covered by specific samples were:

Sacramento Valley: *Market, Manufacturing, and Left survey*--Butte, Colusa, Glenn, Placer, Sacramento, Shasta, Solano, Sutter, Tehama, Yolo, and Yuba.

Northern and Sierra Mountains: Lassen, Nevada, Plumas, and Siskiyou.

San Joaquin Valley: *Northern Market*--Madera, Merced, San Joaquin, and Stanislaus. *Southern Market*--Fresno, Kern, Kings, and Tulare. *Manufacturing*--entire region.

North Coast: Del Norte, Humboldt, and Mendocino.

Bay Area: *Northern*--Marin, Napa, and Sonoma. *Southern*--Alameda, Contra Costa, Monterey, Santa Clara, and Santa Cruz.

Southern California: *Central*--Los Angeles, Orange, Riverside, San Bernardino, and San Diego. *Peripheral*--Imperial, San Luis Obispo, Santa Barbara, and Ventura.

[b]Dummy variable for DHIA plus 12 months.

[c]One dummy from each set must be excluded to avoid exact collinearity.

SUPPLEMENT TABLE 2

Detailed Results for Equation 1 by Region and Sample

Region[a] and sample	Elasticity estimates: Feed cost Z_1	Elasticity estimates: All other inputs Z_2	Standard errors of estimate: Feed cost Z_1	Standard errors of estimate: All other inputs Z_2	t ratios: Feed cost Z_1	t ratios: All other inputs Z_2	R^2	Number of independent variables	Sample size
	Before firm effects introduced								
Sacramento Valley									
Market	.816	.220	.023	.027	35.46	8.20	.893	22	1,330
Manufacturing	.813	.270	.046	.050	17.75	5.36	.840	22	404
Left survey	.379	.632	.057	.060	6.60	10.46	.926	21	318
Northern and Sierra Mountains	.809	.256	.034	.044	23.79	5.82	.873	22	529
San Joaquin Valley									
Northern Market	.838	.160	.019	.020	44.63	7.91	.955	22	1,446
Southern Market	.884	.132	.020	.023	43.93	5.75	.975	22	1,232
Manufacturing	.766	.278	.033	.042	23.30	6.70	.956	21	496
North Coast	.888	.055	.046	.052	19.29	1.06	.867	19	381
Bay Area									
Northern	.661	.409	.020	.024	33.53	16.97	.939	21	1,388
Southern	.734	.325	.029	.029	25.11	11.36	.954	21	836
Southern California									
Central	.752	.263	.020	.021	37.28	12.23	.969	20	898
Peripheral	.684	.391	.047	.048	14.47	8.19	.942	20	341
	After firm effects introduced								
Sacramento Valley									
Market	.330	.477	.026	.041	18.28	8.07	.953	85	1,330
Manufacturing	.942	.292	.070	.117	13.39	2.50	.879	40[b]	404
Left survey	.259	.506	.062	.087	4.19	5.81	.950	41	318
Northern and Sierra Mountains	.595	.125	.048	.065	12.31	1.93	.921	50	529
San Joaquin Valley									
Northern Market	.709	.181	.027	.031	26.49	5.86	.969	67	1,446
Southern Market	.736	.175	.027	.035	27.07	5.04	.984	72	1,232
Manufacturing	.673	.412	.050	.072	13.46	5.69	.971	39[b]	496
North Coast	.510	.392	.072	.120	7.04	3.26	.917	47	381
Bay Area									
Northern	.545	.367	.031	.060	17.35	6.17	.958	87	1,388
Southern	.576	.322	.040	.056	14.48	5.76	.974	60[b]	836
Southern California									
Central	.484	.214	.031	.038	15.67	5.65	.981	81[b]	898
Peripheral	.469	.107	.058	.078	8.13	1.36	.969	41[b]	341

[a]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b]Besides base dummy, one additional firm dummy is eliminated because of collinearity.

SUPPLEMENT TABLE 3

Detailed Results for Equation 2 by Region and Sample

Region[a] and sample	Elasticity estimates: Feed in TDN[b] X_1	Elasticity estimates: All other inputs Z_2	Standard errors of estimate: Feed in TDN[b] X_1	Standard errors of estimate: All other inputs Z_2	t ratios: Feed in TDN[b] X_1	t ratios: All other inputs Z_2	R^2	Number of independent variables	Sample size
Before firm effects introduced									
Sacramento Valley									
Market	.806	.268	.024	.027	33.842	9.984	.888	22	1,330
Manufacturing	.840	.293	.048	.050	17.662	5.910	.839	22	404
Left survey	.449	.593	.060	.062	7.483	9.565	.895	21	318
Northern and Sierra Mountains	.802	.280	.035	.045	23.175	6.173	.879	22	529
San Joaquin Valley									
Northern Market	.875	.155	.019	.020	45.197	7.739	.956	22	1,446
Southern Market	.893	.151	.021	.024	41.725	6.377	.973	22	1,232
Manufacturing	.824	.272	.036	.042	23.061	6.431	.955	21	496
North Coast	.895	.098	.041	.045	21.692	2.169	.882	19	381
Bay Area									
Northern	.722	.389	.021	.024	34.294	16.107	.940	21	1,388
Southern	.699	.390	.031	.029	22.588	13.510	.949	21	836
Southern California									
Central	.753	.264	.021	.022	36.529	12.080	.968	20	898
Peripheral	.646	.432	.049	.049	13.290	8.863	.938	20	341
After firm effects introduced[c]									
Sacramento Valley									
Market	.499	.341	.026	.040	19.073	8.502	.953	85[d]	1,330
Manufacturing	.980	.226	.072	.118	13.710	1.922	.881	40[d]	404
Left survey	.334	.400	.069	.086	4.841	4.651	.954	41	318
Northern and Sierra Mountains	.651	.113	.048	.063	13.427	1.810	.924	50	529
San Joaquin Valley									
Northern Market	.736	.186	.028	.031	26.179	6.024	.969	67	1,446
Southern Market	.729	.214	.029	.035	25.492	6.072	.983	72[d]	1,232
Manufacturing	.625	.455	.051	.074	12.358	6.179	.970	39[d]	496
North Coast	.565	.398	.074	.118	7.633	3.382	.919	47	381
Bay Area									
Northern	.597	.271	.033	.068	17.955	4.006	.959	87[d]	1,388
Southern	.598	.296	.041	.057	14.424	5.214	.974	60[d]	836
Southern California									
Central	.476	.220	.031	.038	15.514	5.799	.981	81[d]	898
Peripheral	.439	.120	.057	.079	7.711	1.523	.969	41[d]	341

[a] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b] Total digestive nutrients.

[c] This table corresponds to Table 18 in *Production Functions and Supply Applications for California Dairy Farms*, University of California, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 51.

[d] Besides base dummy, one additional firm dummy is eliminated because of collinearity.

SUPPLEMENT TABLE 4

Detailed Results for Equation 3 by Region and Sample[a]

Region[b] and sample	Elasticity estimates for all inputs combined, Z_0	Standard errors of estimate	t ratios	R^2	Number of independent variables	Sample size
	Before firm effects introduced					
Sacramento Valley						
Market	1.077	0.011	95.661	.889	21	1,330
Manufacturing	1.122	0.028	40.448	.830	21	404
Left survey	1.009	0.022	46.075	.925	20	318
Northern and Sierra Mountains	1.132	0.024	48.090	.867	21	529
San Joaquin Valley						
Northern Market	1.016	0.007	155.650	.950	21	1,446
Southern Market	1.057	0.006	178.167	.971	21	1,232
Manufacturing	1.081	0.013	84.816	.955	20	496
North Coast	1.003	0.027	37.155	.850	18	381
Bay Area						
Northern	1.093	0.008	135.980	.940	20	1,388
Southern	1.059	0.011	95.528	.953	20	836
Southern California						
Central	1.026	0.006	158.064	.967	19	898
Peripheral	1.078	0.026	41.445	.883	19	341
	After firm effects introduced					
Sacramento Valley						
Market	0.844	0.034	25.026	.953	84	1,330
Manufacturing	1.425	0.083	17.165	.875	39[c]	404
Left survey	0.721	0.078	9.235	.950	40	318
Northern and Sierra Mountains	0.806	0.059	13.763	.918	49	529
San Joaquin Valley						
Northern Market	0.908	0.027	33.833	.967	66	1,446
Southern Market	0.992	0.025	39.388	.983	71[d]	1,232
Manufacturing	1.115	0.049	22.713	.972	37[d]	496
North Coast	0.908	0.105	8.676	.917	46	381
Bay Area						
Northern	1.022	0.045	22.619	.959	86	1,388
Southern	0.926	0.046	20.224	.975	59[c]	836
Southern California						
Central	0.728	0.033	21.908	.981	80[c]	898
Peripheral	0.513	0.068	7.524	.938	40[c]	341

[a]This table is an extension of Table 27 in *Production Functions and Supply Applications for California Dairy Farms*, University of California, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 74.

[b]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[c]One firm dummy eliminated because of collinearity, reducing number of independents by one.

[d]Two firm dummies eliminated because of collinearity.

SUPPLEMENT TABLE 5

Detailed Results for Equation 4 by Region and Sample[a]

Region,[b] sample, and input	Elasticity estimates	Standard errors of estimate	t ratios	R^2	Number of independent variables	Sample size
	Before firm effects introduced					
San Joaquin Valley						
Southern Market						
Roughage and pasture	.563	.017	33.76	.974	23	1,232
Concentrates	.297	.010	30.49			
All other inputs	.155	.023	6.62			
Southern California						
Central						
Roughage and pasture	.456	.015	29.90	.966	21	898
Concentrates	.375	.013	29.06			
All other inputs	.190	.021	9.13			
	After firm effects introduced					
San Joaquin Valley						
Southern Market						
Roughage and pasture	.427	.021	20.05	.984	73	1,232
Concentrates	.256	.013	20.23			
All other inputs	.211	.035	6.13			
Southern California						
Central						
Roughage and pasture	.283	.022	13.09	.981	82[c]	898
Concentrates	.239	.021	11.49			
All other inputs	.116	.035	3.31			

[a] This table is an extension of Table 29 in *Production Functions and Supply Applications for California Dairy Farms*, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 78.

[b] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[c] Besides base dummy, one additional firm dummy is eliminated because of collinearity.

SUPPLEMENT TABLE 6

Elasticity Estimates for Equation 5 by Region and Sample

Region[a] and sample	Elasticity estimates for input: Feed in TDN[b] X_1	Cow service flow X_2	Labor cost X_3	Operating cost X_4	Capital service flow X_5	Sum of elasticities	R^2
	Before firm effects introduced						
Sacramento Valley							
Market	.783	.015	.249	.094	-.109	1.032	.896
Manufacturing	.816	.068	.199	.023	.032	1.138	.837
Left survey	.406	.162	.279	.079	.119	1.045	.930
Northern and Sierra Mountains	.871	-.075	.160	.067	.046	1.069	.884
San Joaquin Valley							
Northern Market	.884	-.005	.094	.049	.009	1.031	.956
Southern Market	.875	.016	.126	.046	-.024	1.039	.973
Manufacturing	.823	.034	.109	.082	.055	1.103	.954
North Coast	.835	-.098	.266	.027	-.024	1.006	.891
Bay Area							
Northern	.726	-.021	.223	.150	.016	1.094	.942
Southern	.694	-.047	.247	.180	-.012	1.062	.954
Southern California							
Central	.724	.069	.128	.071	.016	1.008	.969
Peripheral	.687	.131	.101	.101	.083	1.103	.938
	After firm effects introduced						
Sacramento Valley							
Market	.259	.530	.007	.079	.244	1.119	.958
Manufacturing	.885	.161	.042	.045	.072	1.205	.881
Left survey	.202	.479	.099	.052	-.052	.780	.956
Northern and Sierra Mountains	.514	.249	.005	.022	.457	1.247	.929
San Joaquin Valley							
Northern Market	.307	.602	.054	.025	.071	1.059	.971
Southern Market	.757	-.005	.081	.060	.079	.972	.983
Manufacturing	.475	.325	.223	.059	.265	1.347	.970
North Coast	.756	-.205	.304	.048	.055	.958	.913
Bay Area							
Northern	.506	.248	.068	.035	-.111	.746	.959
Southern	.298	.567	.083	.012	.249	1.209	.978
Southern California							
Central	.208	.445	.019	.016	.243	.931	.984
Peripheral	.292	.283	-.039	.013	.200	.749	.971

[a]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b]Total digestive nutrients.

SUPPLEMENT TABLE 7

Standard Errors for Equation 5 by Region and Sample

Region[a] and sample	Standard errors for coefficients of: Feed in TDN[b] X_1	Cow service flow X_2	Labor cost X_3	Operating cost X_4	Capital service flow X_5	Number of independent variables	Sample size
	Before firm effects introduced						
Sacramento Valley							
Market	.024	.013	.021	.016	.017	25	1,330
Manufacturing	.051	.037	.053	.030	.032	25	404
Left survey	.061	.034	.057	.033	.039	24	318
Northern and Sierra Mountains	.036	.022	.029	.022	.024	25	529
San Joaquin Valley							
Northern Market	.021	.013	.017	.014	.013	25	1,446
Southern Market	.022	.012	.022	.013	.011	25	1,232
Manufacturing	.036	.024	.036	.021	.029	24	496
North Coast	.043	.030	.046	.027	.028	22	381
Bay Area							
Northern	.023	.016	.025	.015	.014	24	1,388
Southern	.031	.018	.030	.019	.018	24	836
Southern California							
Central	.023	.012	.020	.011	.010	23	898
Peripheral	.049	.033	.044	.030	.027	23	341
	After firm effects introduced						
Sacramento Valley							
Market	.034	.046	.028	.013	.062	88	1,330
Manufacturing	.133	.169	.106	.031	.098	43[c]	404
Left survey	.069	.098	.064	.038	.099	44	318
Northern and Sierra Mountains	.069	.076	.038	.024	.154	53	529
San Joaquin Valley							
Northern Market	.051	.060	.020	.014	.036	70	1,446
Southern Market	.043	.047	.025	.014	.025	75	1,232
Manufacturing	.074	.094	.063	.025	.104	42[c]	496
North Coast	.062	.055	.070	.038	.048	50	381
Bay Area							
Northern	.047	.072	.044	.021	.102	90	1,388
Southern	.049	.061	.036	.019	.104	63[c]	836
Southern California							
Central	.039	.046	.030	.012	.061	84[c]	898
Peripheral	.077	.097	.054	.029	.108	44[c]	341

[a] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b] Total digestive nutrients.

[c] Besides base dummy, one additional firm dummy is eliminated because of collinearity.

SUPPLEMENT TABLE 8

t Ratios for Equation 5 by Region and Sample

Region[a] and sample	t ratios for coefficients of				
	Feed in TDN[b] X_1	Cow service flow X_2	Labor cost X_3	Operating cost X_4	Capital service flow X_5
	Before firm effects introduced				
Sacramento Valley					
Market	32.245	1.104	11.829	5.873	-6.561
Manufacturing	15.920	1.809	3.759	0.758	0.997
Left survey	6.649	4.815	4.883	2.384	3.054
Northern and Sierra Mountains	24.322	- 3.410	5.461	3.034	1.935
San Joaquin Valley					
Northern Market	42.356	- 0.343	5.414	3.583	0.642
Southern Market	39.275	1.325	5.799	3.644	-2.120
Manufacturing	22.728	1.427	3.024	3.937	1.886
North Coast	19.522	- 3.290	5.813	0.988	-0.851
Bay Area					
Northern	31.888	- 1.286	8.982	9.732	1.134
Southern	22.752	- 2.658	8.328	9.530	-0.684
Southern California					
Central	31.865	5.633	6.328	6.451	1.511
Peripheral	14.029	4.032	2.286	3.334	3.035
	After firm effects introduced				
Sacramento Valley					
Market	7.583	11.545	0.245	6.001	3.905
Manufacturing	6.644	0.950	0.397	1.457	0.734
Left survey	2.954	4.890	1.557	1.402	-0.530
Northern and Sierra Mountains	7.491	3.274	0.139	0.923	2.968
San Joaquin Valley					
Northern Market	5.972	10.098	2.646	1.773	1.952
Southern Market	17.540	- 0.100	3.217	4.404	3.144
Manufacturing	6.404	3.468	3.510	2.415	2.553
North Coast	12.124	- 3.712	4.318	1.237	1.151
Bay Area					
Northern	10.804	3.455	1.541	1.678	-1.082
Southern	6.067	9.337	2.282	0.641	2.395
Southern California					
Central	5.407	9.738	0.634	1.324	3.987
Peripheral	3.785	2.929	-0.725	0.445	1.847

[a] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b] Total digestive nutrients.

SUPPLEMENT TABLE 9

Estimates for Equation 6 by Region and Sample[a]

Region[b] and sample	Estimated value						
	c	a_1	a_2	a_3	a_4	a_5	R^2
	Before firm effects introduced						
Sacramento Valley							
Market	0.090*	0.864*	-0.054	0.230*	-0.167*	-0.003	.906
Manufacturing	-0.172*	1.279*	0.274*	0.394	-1.088*	-0.125	.823
Left survey	-0.165*	0.169	0.471*	0.562*	-0.366*	-0.200*	.940
Northern and Sierra Mountains	-0.074*	0.826*	0.184*	-0.260	0.412*	0.008	.908
San Joaquin Valley							
Northern Market	-0.055	0.498*	0.431*	0.072*	0.048*	-0.047*	.968
Southern Market	-0.163*	1.216*	0.158*	-0.058*	0.037	*c*	.973
Manufacturing	-0.110*	1.294*	-0.076	-0.201*		0.130*	.976
North Coast	-0.197*	1.007*	0.216*	-0.938*	1.099*	0.144	.879
Bay Area							
Northern	-0.078	0.994*	0.155*		0.032	-0.003	.948
Southern	-0.046	1.072*	0.131*	0.127	-0.097	-0.027	.965
Southern California							
Central	-0.070	0.573*	0.298*	-0.064*	0.164*		.967
Peripheral	-0.070	0.778*	0.174*		0.026*	0.007*	.968
	After firm effects introduced						
Sacramento Valley							
Market	-0.183	0.455*	0.170*	0.029	0.087	-0.006	.958
Manufacturing	-0.091	1.159*	0.064	-0.502	0.201	0.122	.895
Left survey	0.238	0.343*	0.053	-0.336	0.494*	0.083	.964
Northern and Sierra Mountains	0.047	0.685*	0.163*		-0.007	-0.041*	.944
San Joaquin Valley							
Northern Market	0.141*	0.727*	0.185*	-0.035*	0.093*	-0.008	.982
Southern Market	-0.027	0.957*	0.155*		0.047*	-0.015*	.984
Manufacturing	-0.135*	1.172*	0.171	-0.204*		0.095*	.982
North Coast	-0.179	0.834*	0.351*	-0.526	0.711*	0.017	.904
Bay Area							
Northern	0.004	1.022*	0.136		-0.051	-0.010	.969
Southern	-0.256	0.860*	0.333*		0.022	-0.026*	.978
Southern California							
Central	0.118	0.955*	0.176*	-0.061*		0.007	.982
Peripheral	0.337	0.587*	0.183	0.081*	-0.117*	-0.027*	.979

[a]Equation 6 is of the form $Y = c + a_1 X_1 + a_2 Z_2 + a_3 (X_1 Z_2) + a_4 X_1^2 + a_5 Z_2^2 + \Sigma b_i D_i$ where Y is 3.4 percent equivalent milk in thousands of hundredweight; X_1 is feed in thousand pounds of total digestive nutrients; Z_2 is all other input in thousands of dollars; and D_i is a general dummy variable covering time periods, breeds, Dairy Herd Improvement Association, and firms.

[b]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[c]Blanks indicate corresponding variable did not enter regression equation.

*Statistically significant at the 5 percent level.

SUPPLEMENT TABLE 10

Standard Errors for Equation 6 by Region and Sample

Region[a] and sample	Standard errors for corresponding coefficients[b]						Number of independent variables	Sample size
	c	a_1	a_2	a_3	a_4	a_5		
	Before firm effects introduced							
Sacramento Valley								
Market	.044	.079	.046	.070	.078	.019	25	1,330
Manufacturing	.043	.156	.101	.419	.406	.131	25	404
Left survey	.038	.129	.060	.157	.172	.040	24	318
Northern and Sierra Mountains	.023	.089	.045	.154	.186	.037	25	529
San Joaquin Valley								
Northern Market	.032	.043	.026	.015	.015	.004	25	1,446
Southern Market	.024	.061	.033	.019	.035	[c]	25	1,232
Manufacturing	.026	.072	.053	.034		.019	24	496
North Coast	.042	.160	.075	.265	.256	.077	22	381
Bay Area								
Northern	.037	.060	.025		.022	.004	24	1,388
Southern	.032	.082	.033	.067	.067	.016	24	836
Southern California								
Central	.065	.068	.030	.008	.019		23	898
Peripheral	.143	.106	.046		.008	.002	23	341
	After firm effects introduced							
Sacramento Valley								
Market	.074	.089	.061	.069	.069	.020	88	1,330
Manufacturing	.061	.200	.164	.440	.449	.134	43[d]	404
Left survey	.142	.143	.105	.171	.178	.049	44	318
Northern and Sierra Mountains	.046	.112	.059		.077	.017	53	529
San Joaquin Valley								
Northern Market	.061	.060	.040	.014	.014	.005	70	1,446
Southern Market	.088	.076	.047		.019	.006	75	1,232
Manufacturing	.048	.115	.091	.049		.021	42[d]	496
North Coast	.113	.223	.165	.293	.282	.099	50	381
Bay Area								
Northern	.101	.108	.084		.041	.015	90	1,388
Southern	.132	.092	.069		.020	.008	63[d]	836
Southern California								
Central	.177	.097	.048	.010		.004	84[d]	898
Peripheral	.277	.156	.093	.029	.036	.009	44[d]	341

[a]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b]These are coefficients for the following variables: a_1 for X_1, a_2 for Z_2, a_3 for $X_1 Z_2$, a_4 for $(X_1)^2$, and a_5 for $(Z_2)^2$, where X_1 is feed in total digestive nutrients and Z_2 is all other inputs in dollars.

[c]Blanks indicate corresponding variable did not enter regression equation.

[d]One firm dummy excluded because of collinearity in addition to base firm dummy.

SUPPLEMENT TABLE 11

t Ratios for Equation 6 by Region and Sample

Region[a] and sample	t ratio for corresponding coefficient[b]					
	c	a_1	a_2	a_3	a_4	a_5
	Before firm effects introduced					
Sacramento Valley						
Market	2.037	10.893	-1.174	3.307	-2.145	-0.135
Manufacturing	3.965	8.189	2.716	0.942	-2.681	-0.950
Left survey	-4.295	1.304	7.817	3.585	-2.122	-5.050
Northern and Sierra Mountains	-3.293	9.314	4.081	-1.686	2.211	0.225
San Joaquin Valley						
Northern Market	-1.699	12.083	4.679	-2.430	6.860	-1.757
Southern Market	-6.895	20.021	4.806	-3.086	1.065	[c]
Manufacturing	-4.213	17.955	-1.432	-5.886		6.809
North Coast	-4.721	6.312	2.881	-3.546	4.286	1.882
Bay Area						
Northern	-2.132	16.463	6.140		1.466	-0.638
Southern	-1.460	13.078	3.955	1.886	-1.465	-1.665
Southern California						
Central	-1.080	8.391	9.887	-7.713	8.681	
Peripheral	-0.490	7.371	3.805		-3.097	4.554
	After firm effects introduced					
Sacramento Valley						
Market	-1.659	5.104	2.776	0.419	1.256	-0.317
Manufacturing	-1.481	5.790	0.392	-1.141	0.448	0.912
Left survey	1.672	2.401	0.511	-1.959	2.779	1.702
Northern and Sierra Mountains	1.002	6.141	2.777		-0.090	-2.433
San Joaquin Valley						
Northern Market	2.306	5.972	10.098	2.646	1.773	1.952
Southern Market	-0.300	12.585	3.299		2.451	-2.421
Manufacturing	-2.818	10.154	1.878	-4.199		4.469
North Coast	-1.590	3.744	2.127	-1.794	2.520	0.173
Bay Area						
Northern	0.041	9.448	1.620		-1.234	-0.630
Southern	-1.930	9.355	4.818		1.103	-3.148
Southern California						
Central	0.666	9.878	3.691	-6.013		1.772
Peripheral	1.215	3.760	1.957	2.751	-3.201	-3.152

[a] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[b] These are coefficients for the following variables: a_1 for X_1, a_2 for Z_2, a_3 for $X_1 Z_2$, a_4 for $(X_1)^2$, and a_5 for $(Z_2)^2$, where X_1 is feed in total digestive nutrients and Z_2 is all other inputs in dollars.

[c] Blanks indicate corresponding variable did not enter regression equation.

Section 2: Equation 7

Equation 7 introduced slope shifters in the form of firm and time effects which were components of elasticities. In practice, the elasticity for a particular time period and firm, t and f, was written:

$$\alpha_{ift} = \alpha_{i0} + \alpha_{it} + \alpha_{if}$$

where

α_{i0} = constant component

α_{it} = slope shifter for year t

and

α_{if} = slope shifter for firm f

with

i = 1, 2 covering feed and other input.

A total of 11 samples was examined using Equation 7, with 5 samples set up to cover expanding firms and 6 samples set up to cover nonexpanding firms. In the Monograph, results were presented in Tables 37, 38, 39, and 40, with additional detail appearing in Appendix Tables B.8 and B.9.

The case employing elasticity slope shifters plus firm intercept shifters was labeled Case 1, in contrast to Case 3, which employed firm effects as intercept shifters only. Some detailed results for those cases are presented here in Supplement Table 12 which extends the results shown in Table 37 of the Monograph. Supplement Table 12 presents coefficients for both feed and all other input, and R^2's, for Cases 1 and 3, respectively. (Case 2 included only slope shifters, and Case 4 excluded both slope and firm intercept shifters, corresponding to an ordinary regression of outputs on inputs. Those cases were omitted here since the information contained did not seem to justify the effort and space to present them.)

Supplement Tables 13 and 14 of this Supplement extend Table 39 of the Monograph by listing the various components of the elasticities (α_{i0}, α_{it}, and α_{if}); the standard errors; and the t ratios for the San Joaquin Valley expanding firm samples. Supplement Table 13 presents those results for the San Joaquin Valley (Northern Market) sample, and Supplement Table 14 presents them for the San Joaquin Valley (Southern Market) sample. (Corresponding results for the other nine samples can be obtained by writing the author.)

SUPPLEMENT TABLE 12

Some Detailed Results for Equation 7, All Samples[a]

Region[b] and sample	Case 1, α shifters in: Feed elasticity (average)	All other input elasticity (average)	Sum of elasticities	Number of independent variables[c]	R^2	Case 3, α shifters out: Feed elasticity	All other input elasticity	Sum of elasticities	Number of independent variables	R^2
San Joaquin Valley										
Northern Market										
Expanding	.607	.235	.842	66	.979	.710	.189	.899	32	.975
Nonexpanding	.214	.500	.714	59	.977	.468	.326	.794	30	.974
Southern Market										
Expanding	.785	.201	.986	60	.984	.788	.151	.939	30	.980
Nonexpanding	.798	.107	.905	69	.988	.670	.147	.817	33	.984
Southern California										
Expanding	.276	.190	.466	49	.978	.331	.234	.565	28	.974
Stable	.188	.075	.263	65	.981	.291	.069	.360	33	.976
Contracting	.298	.286	.585	40	.986	.220	.206	.426	27	.982
Bay Area										
Expanding	.733	.049	.782	52	.976	.780	-.018	.761	27	.971
Nonexpanding	.199	.250	.449	67	.968	.313	.367	.680	32	.961
Sacramento Valley										
Market										
Expanding	.554	.202	.756	71	.958	.499	.286	.785	34	.944
Nonexpanding	.597	.089	.686	63	.969	.389	.296	.685	31	.958

[a] This table is an extension of Table 37 in *Production Functions and Supply Applications for California Dairy Farms*, University of California, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 91.

[b] For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[c] Usually a small number of independent variables were deleted because of collinearity.

SUPPLEMENT TABLE 13

Estimated Elasticity Components for San Joaquin Valley (Northern Market)
Expanding Firm Cases[a]

Estimated elasticity component	Feed			All other inputs		
	Coefficients	Standard errors	t ratios	Coefficients	Standard errors	t ratios
Constant element, α_{i0}	1.008	0.171	5.89	.235	0.307	0.77
Time component, α_{it}						
1959	0[b]	[c]		0[b]		
1960	- .168	0.106	-1.58	.135	0.115	1.17
1961	- .396	0.118	-3.35	.370	0.125	2.96
1962	- .269	0.124	-2.18	.240	0.132	1.82
1963	- .253	0.134	-1.89	.197	0.144	1.37
1964	- .277	0.131	-2.11	.211	0.147	1.44
Firm component, α_{if}						
1	0[b]			0[b]		
2	- .407	0.231	-1.76	-.139	0.360	-0.39
3	- .240	0.224	-1.07	-.164	0.378	-0.43
4	.194	0.241	0.81	-.578	0.365	-1.58
5	- .139	0.230	-0.60	-.220	0.466	-0.47
6	0[d]			-.020	0.133	-0.15
7	.019	0.293	0.07	.161	0.524	0.31
8	- .196	0.261	-0.75	-.318	0.529	-0.60
9	- .416	0.227	-1.83	-.173	0.463	-0.37
10	- .329	0.266	-1.24	-.693	0.522	-1.33
11	- .120	0.254	-0.47	-.042	0.390	-0.11
12	- .267	0.251	-1.06	-.435	0.373	-1.17
13	- .055	0.213	-0.26	-.056	0.380	-0.15
14	- .483	0.261	-1.85	-.024	0.486	-0.05

[a]This table is an extension of the left-hand side of Table 39 in *Production Functions and Supply Applications for California Dairy Farms*, University of California, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 94.

[b]Omitted to avoid collinearity, *ex ante*.

[c]Blanks indicate not applicable.

[d]Omitted to avoid collinearity, *ex post*.

SUPPLEMENT TABLE 14

Estimated Elasticity Components for San Joaquin Valley (Southern Market)
Expanding Firm Cases[a]

Estimated elasticity component	Feed			All other inputs		
	Coefficients	Standard errors	t ratios	Coefficients	Standard errors	t ratios
Constant element, α_{i0}	0.384	0.250	1.54	1.193	0.307	3.88
Time component, α_{it}						
1959	0[b]	[c]		0[b]		
1960	0.318	0.239	1.33	-0.454	0.314	-1.44
1961	0.485	0.225	2.15	-0.620	0.290	-2.14
1962	0.616	0.209	2.95	-0.795	0.274	-2.90
1963	0.505	0.213	2.37	-0.657	0.275	-2.39
1964	0.437	0.229	1.91	-0.636	0.293	-2.17
Firm component, α_{if}						
1	0[b]			0[b]		
2	0[d]			-0.288	0.316	-0.91
3	-0.083	0.216	-0.38	-0.264	0.275	-0.96
4	0.131	0.213	0.61	-0.672	0.332	-2.03
5	-0.095	0.195	-0.48	-0.373	0.267	-1.40
6	-0.357	0.250	-1.43	0[d]		
7	-0.094	0.273	-0.35	-0.273	0.338	-0.81
8	0.118	0.199	0.59	-0.885	0.328	-2.70
9	0.155	0.227	0.68	-0.673	0.316	-2.13
10	0.406	0.263	1.55	-0.675	0.349	-1.93
11	0.001	0.266	0.00	-0.765	0.366	-2.09
12	-0.096	0.199	-0.48	-0.706	0.382	-1.85

[a]This table is an extension of the right-hand side of Table 39 in *Production Functions and Supply Applications for California Dairy Farms*, University of California, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 94.

[b]Omitted to avoid collinearity, *ex ante*.

[c]Blanks indicate not applicable.

[d]Omitted to avoid collinearity, *ex post*.

Section 3: Feed Regressions

For a two–stage process for 30–40 percent of the overall sample, feed was estimated from a regression of the remaining feed observations on exogenous and predetermined variables. As an initial step, feed was regressed on cows milking and cows dry. As a final step, feed was regressed on those independents plus 4 season dummies, 3 breed dummies, body weight, value per head, and year dummies, with a maximum of 20 independent variables specified. Coefficients for the initial step appear as Appendix Table A.6 of the Monograph, while selected results for the final step appear as Appendix Table A.7. The following Supplement Tables present coefficients, standard errors, and t ratios for each of the individual samples employed, consisting of 10 samples, including 2 combined cases. Appendix Table A.8 and Table 6 present results for the 10 samples combined into 1 overall sample.

SUPPLEMENT TABLE 15

Feed Regressed on Cows Milking and Cows Dry Only (Initial Step)[a] by Region and Sample

Region[b] and sample	Number of observations	R^2	Constant	Coefficient		Standard error		t ratio	
				Cows milking	Cows dry	Cows milking	Cows dry	Cows milking	Cows dry
Sacramento Valley									
Market *Manufacturing*	567	.921	- 27.022	25.516	16.273	0.445	1.740	57.393	9.355
Left survey	142	.920	57.556	26.480	5.734	1.129	4.834	23.456	1.186
Northern and Sierra Mountains	266	.927	103.663	23.065	12.286	0.569	1.823	40.536	6.738
San Joaquin Valley									
Northern market	560	.979	-227.145	25.940	24.630	0.323	1.682	80.243	14.647
Southern market	693	.956	82.671	24.831	13.837	0.375	1.618	66.240	8.550
Manufacturing	182	.978	-102.778	24.179	8.719	0.508	2.530	47.610	3.446
North Coast	66	.888	140.432	21.913	10.722	1.066	2.405	20.553	4.459
Bay Area									
Northern	619	.957	136.656	23.192	12.075	0.318	1.508	72.969	8.007
Southern	660	.975	68.885	24.387	21.312	0.310	1.360	78.762	15.668
Southern California									
Central *Peripheral*	1,099	.987	-143.913	29.273	19.328	0.229	0.778	127.992	24.847
Average:									
10 market samples	*c*		8.901	24.878	14.492				

[a]This table is an extension of Appendix Table A.6 in *Production Functions and Supply Applications for California Dairy Farms*, Giannini Foundation Monograph No. 36 (Berkeley, 1976), p. 122.

[b]For geographic coverage, see Supplement Table 1, *supra*, p. 3.

[c]Blanks indicate not relevant.

SUPPLEMENT TABLE 16

Feed Regressed on Extended Set of Independent Variables--Coefficients (Final Step)[a] by Region and Sample

	Sacramento Valley		Northern and Sierra Mountains	San Joaquin Valley			North Coast	Bay Area		Southern California
	Market and Manufacturing	Left survey		Northern Market	Southern Market	Manufacturing		Northern	Southern	
Number of observations	567	142	266	560	693	182	66	619	660	1,099
Number of independent variables	17	18	18	18	18	18	15	17	16	16
R^2	.941	.944	.048	.984	.989	.983	.944	.975	.981	.989
Constant	-741.258	-1,478.683	411.048	-2,738.055	-508.031	-1,462.597	-1,392.723	-831.096	-1,220.101	-3,522.273
Coefficients										
X_1: number of cows milking	19.821*	26.886*	13.128*	18.293*	15.101*	26.817*	14.265*	19.368*	14.391*	29.583*
X_2: number of cows dry	20.237*	2.057	14.571*	23.845*	15.262*	12.694*	13.332*	16.239*	20.948*	18.477*
X_3: expected milk per cow (pounds per day)	3.953	5.751	- 4.555	- 11.629	- 5.169	19.469*	- 10.352	5.925	- 9.577*	3.807
X_4: expected milk total (hundred pounds per day)	12.849*	- 0.341	34.515*	18.090*	27.570*	- 12,030	25.380	9.000*	23.363*	- 0.771
Season dummies[b]										
X_5: current summer	121.131*	- 23.303	5.340	135.006*	5.007	3.056	165.992	- 22.129	44.641	- 52.265
X_6: current winter	38.398	13.124	0.866	70.714	8.023	- 31.984	76.924	- 63.032	- 5.536	- 11.423
X_7: lagged summer	44.311	11.349	- 55.207	115.801	- 52.195	- 67.069	54.565	- 59.099	2.449	18.318
X_8: lagged winter	29.306	20.898	5.127	61.630	31.210	61.778	140.384	20.837	18.326	- 105.110*

(Continued on next page.)

SUPPLEMENT TABLE 16--continued.

	Sacramento Valley		Northern and Sierra Mountains	San Joaquin Valley			North Coast	Bay Area		Southern California
	Market and Manufacturing	Left survey		Northern Market	Southern Market	Manufacturing		Northern	Southern	
Breed dummies[b]										
X_9: Guernsey	-114.354	372.068*	-143.715*	-444.671*	-106.935	- 39.972	-418.853	-163.770*	[c]	-746.980*
X_{10}: Jersey	- 81.977	- 28.196	-160.994*	224.670	-276.240*	321.252	-217.843	- 51.291	18.974	
X_{11}: mixed	- 21.322	328.509*	-100.149*	114.402	-214.334*	41.431	-322.697	- 42.903	-70.554*	-216.162*
X_{12}: body weight (hundred pounds)	17.660	139.867*	- 17.493	93.546	35.626*	54.897	117.457	51.969*	60.902*	122.664*
X_{13}: value per head (dollars)	1.641*	- 1.263	- 0.174	6.903*	2.632*	0.913	5.117	1.364*	3.585*	4.964*
Year dummies[b]										
X_{14}: 1965	- 18.681		172.831*							438.642*
X_{15}: 1964	-110.231*		- 0.075	-312.805*	-498.314*	- 51.152	-462.242*	-191.679*	-48.819	12.805
X_{16}: 1963	- 76.577	37.011	32.653	- 62.483	-474.831*	- 22.923	-241.273*	-134.335*	-77.251*	159.661
X_{17}: 1962	- 22.330	192.716	73.365	- 0.622	-342.108*	- 21.596		95.937*	- 3.449	61.795
X_{18}: 1961		152.118	82.561	-167.493	-363.578*	- 84.146		6.460	- 7.769	
X_{19}: 1960		-129.414		-151.941	-405.376*	69.091				
X_{20}: 1959		- 4.197								

[a]This table is an extension of Appendix Tables A.7 and A.8 in *Production Functions and Supply Applications for California Dairy Farms*, Giannini Foundation Monograph No. 36 (Berkeley, 1976), pp. 124 and 125.

[b]Omitted dummies: remaining months, both current and lagged season; Holstein, 1958, and earlier.

[c]Blanks indicate years not in equation.

*Statistically significant at the 5 percent level.

SUPPLEMENT TABLE 17

Feed Regressed on Extended Set of Independent Variables--Standard Errors and t Ratios (Final Step) by Region and Sample

	Sacramento Valley		Northern and Sierra Mountains	San Joaquin Valley			North Coast	Bay Area		Southern California
	Market and Manufacturing	Left survey		Northern Market	Southern Market	Manufacturing		Northern	Southern	
	Standard errors of estimate									
Coefficients										
X_1: number of cows milking	1.771	4.982	3.187	1.621	0.754	2.467	4.483	1.151	1.253	0.904
X_2: number of cows dry	1.581	4.682	1.728	1.601	0.837	2.758	2.297	1.229	1.223	0.729
X_3: expected milk per cow (pounds per day)	4.819	8.854	5.541	6.288	3.109	6.258	15.338	4.391	3.726	5.092
X_4: expected milk total (hundred pounds per day)	5.009	15.016	10.689	3.746	2.186	8.589	17.426	3.448	2.910	1.967
Season dummies[a]										
X_5: current summer	44.165	111.409	40.549	63.166	23.321	48.241	121.526	29.830	29.377	38.824
X_6: current winter	42.438	91.244	27.379	67.207	28.110	52.598	104.633	42.363	32.372	44.389
X_7: lagged summer	46.193	106.933	40.820	74.459	27.289	56.484	129.238	41.951	33.270	40.703
X_8: lagged winter	32.780	79.982	27.042	54.214	23.843	39.167	127.072	32.675	28.971	41.364
Breed dummies[a]										
X_9: Guernsey	63.072	178.755	66.746	107.049	67.881	61.530	234.470	43.877	*b*	133.432
X_{10}: Jersey	61.283	166.400	56.384	505.593	48.866	184.680	189.835	45.141	156.743	
X_{11}: mixed	35.456	108.756	43.709	82.320	31.396	51.240	179.218	25.701	30.849	48.863
X_{12}: body weight (hundred pounds)	16.796	47.061	15.947	53.035	16.249	33.080	60.438	13.408	19.500	28.966
X_{13}: value per head (dollars)	0.423	1.027	0.442	1.778	0.743	1.095	3.552	0.501	0.903	1.579
Year dummies[a]										
X_{14}: 1965	72.084		51.349							136.524
X_{15}: 1964	42.946		44.390	103.561	36.551	74.653	119.624	42.704	40.427	95.207
X_{16}: 1963	39.090	144.712	41.121	92.739	35.577	74.190	107.779	32.961	38.923	94.783
X_{17}: 1962	38.431	122.979	42.438	87.925	35.621	74.305		32.934	36.520	95.074
X_{18}: 1961		130.985	49.366	86.876	35.938	75.994		31.975	36.666	
X_{19}: 1960		117.279		90.963	70.475	82.515				
X_{20}: 1959		127.259								

(Continued on next page.)

SUPPLEMENT TABLE 17—continued.

	Sacramento Valley		Northern and Sierra Mountains	San Joaquin Valley			North Coast	Bay Area		Southern California
	Market and Manufacturing	Left survey		Northern Market	Southern Market	Manufacturing		Northern	Southern	
	t ratios									
Coefficients										
X_1: number of cows milking	11.190	5.397	4.120	11.285	20.033	10.871	3.182	16.831	11.485	32.736
X_2: number of cows dry	12.799	0.439	8.432	14.892	18.238	4.603	5.803	13.216	17.130	25.344
X_3: expected milk per cow (pounds per day)	0.820	0.650	-0.822	- 1.849	- 1.663	3.111	-0.675	1.349	- 2.570	0.748
X_4: expected milk total (hundred pounds per day)	2.565	-0.023	3.229	4.829	12.610	- 1.401	1.456	2.610	8.027	- 0.392
Season dummies[a]										
X_5: current summer	2.743	-0.209	0.132	2.137	0.215	0.063	1.366	- 0.742	1.520	- 1.346
X_6: current winter	0.905	0.144	0.032	1.052	0.285	- 0.608	0.735	- 1.488	- 0.171	- 0.257
X_7: lagged summer	0.959	0.106	-1.352	1.555	- 1.913	- 1.187	0.422	- 1.409	0.074	0.450
X_8: lagged winter	0.894	0.261	0.190	1.137	1.309	1.577	1.105	0.638	0.633	- 2.541
Breed dummies[a]										
X_9: Guernsey	- 1.813	2.081	-2.153	- 4.154	- 1.575	0.650	-1.786	- 3.732		- 5.598
X_{10}: Jersey	- 1.338	-0.169	-2.855	0.444	- 5.653	1.740	-1.148	- 1.136	0.121	
X_{11}: mixed	- 0.601	3.021	-2.291	1.390	- 6.827	0.809	-1.801	- 1.669	- 2.287	- 4.424
X_{12}: body weight (hundred pounds)	1.051	2.972	-1.097	1.764	2.192	1.660	1.943	3.876	3.123	4.235
X_{13}: value per head (dollars)	3.876	-1.230	-0.394	3.883	3.544	0.834	1.441	2.723	3.971	3.145
Year dummies[a]										
X_{14}: 1965	- 0.259		3.366							3.213
X_{15}: 1964	- 2.567		-0.002	- 3.020	-13.633	-0.685	-3.864	- 4.489	- 1.208	0.134
X_{16}: 1963	- 1.959	0.256	0.794	- 0.674	-13.346	-0.309	-2.239	- 4.076	- 1.985	1.684
X_{17}: 1962	- 0.581	1.567	1.729	- 0.007	- 9.604	-0.291		2.913	- 0.094	.650
X_{18}: 1961		1.161	1.672	- 1.928	-10.117	-1.107		0.202	- 0.212	
X_{19}: 1960		-1.103		- 1.670	- 5.752	0.837				
X_{20}: 1959		-0.033								

[a]Omitted dummies: remaining months, both current and lagged season; Holstein, 1958, and earlier.

[b]Blanks indicate years not in equation.