IDFA Exh. 40

William Schiek Testimony
Dairy Product Manufacturing Costs

William Schiek Background

- Dairy Institute of California, a dairy processor trade association located at 1127 11th Street, Suite 718, Sacramento, California 95814.
  - Executive Director, January 2020 –present.
  - Economist, June 1997-December 2019.
- Purdue University, Department of Agricultural Economics.
  - Assistant Professor, August 1991-May 1997.
- New York –New Jersey Milk Market Administrator
  - Economist, August 1984-August 1989
  - Cooperative Relations Specialist, June 1982-August 1984.
- Education
  - University of Florida, Ph.D. (1991), M.S (1988) - Food and Resource Economics.
  - Cornell University, B.S. (1982) – Applied Economics and Business Management.

Project Goal and Background

- This project was undertaken to estimate dairy manufacturing costs from existing CDFA and other data, and to project what costs would be in more recent time periods where CDFA manufacturing cost data is not available.
- CDFA collected manufacturing cost data from California plants for many years beginning in 1989. From 2002-2016 CDFA conducted and audited cost information on an annual, calendar year basis.
- Current federal order make allowances were established utilizing CDFA manufacturing cost data and Dr. Stephenson's cost survey representing mostly 2006 costs. There is precedent for USDA using both survey data and CDFA cost data to establish make allowances in Class III and Class IV price formulas.

Approach

- A time series of CDFA manufacturing cost data was used to project 2022 costs for cheddar cheese, NFDM, and butter costs using trend and Ordinary Least Squares (OLS) regression analysis.
- For regression analysis of cheddar, NFDM and butter MFG costs, explanatory variables capturing changes in *energy, labor, general material costs, and productivity growth* were examined, as well as dummy variables to account for one-time temporary or permanent structural shifts in the data.
- Whey MFG Costs are calculated by adding an incremental drying cost ($0.03/lb.) to the NFDM cost estimate. $0.03 is the approximate difference between whey and NFDM manufacturing costs.

Table 1. CDFA Reported Manufacturing Costs 2002-2016

	CDFA Survey Weighted Average Costs			
Year	Cheddar Cheese	Dry Whey 1/	Butter	NFDM
		---------- dollars per pound ----------		
2002	$0.1632		$0.1235	$0.1464
2003	$0.1706	$0.2675	$0.1299	$0.1560
2004	$0.1769	$0.2673	$0.1368	$0.1543
2005	$0.1914	$0.2851	$0.1408	$0.1659
2006	$0.1988	$0.3099	$0.1373	$0.1664
2007	$0.2003		$0.1316	$0.1568
2008	$0.2099		$0.1553	$0.1931
2009	$0.1966		$0.1811	$0.1984
2010	$0.1921		$0.1781	$0.2070
2011	$0.2029		$0.1775	$0.1942
2012	$0.2171		$0.1688	$0.1999
2013	$0.2291		$0.1724	$0.1997
2014	$0.2355		$0.1843	$0.2011
2015	$0.2394		$0.1842	$0.2078
2016	$0.2454		$0.1938	$0.2082

1/ Dry Whey Costs were reported for 2003-2006 only, too few plants were available to report after 2006.

Approach

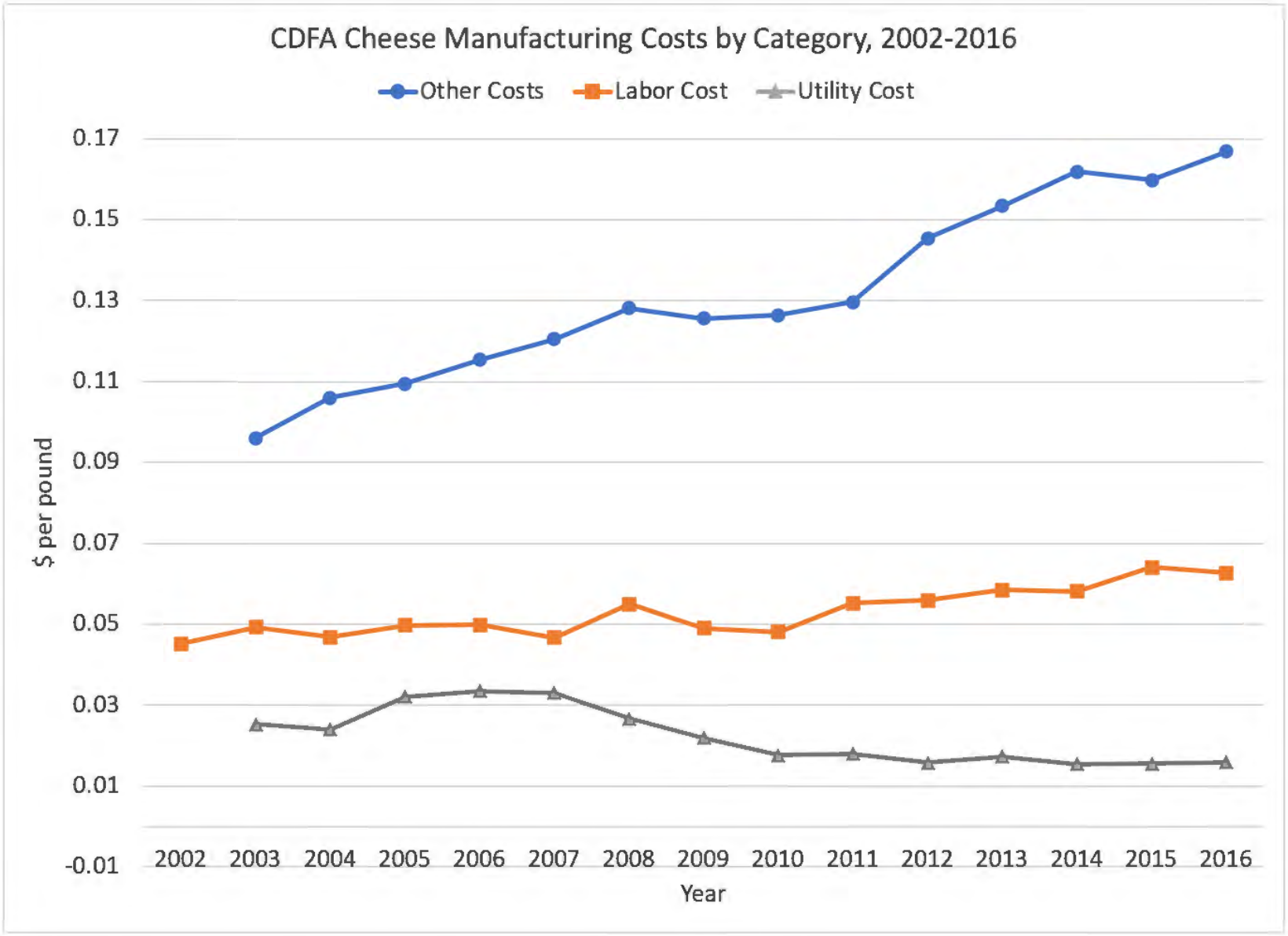
- CDFA dairy manufacturing cost data for 2003-2016 were used to estimate both utility costs and other costs for butter, NFDM, and cheddar cheese.
- To deal with collinearity among some of the explanatory variables and the limited number of observations, separate models of utility costs, labor costs, and other manufacturing cost were estimated for each product.
- Manufacturing cost linear trend models were also estimated for cheese, butter and nonfat dry milk.
- Data from 2002-2016 were used to estimate the labor cost component costs and for estimation of manufacturing cost trends.
- For each product, the predicted values of each of the estimated cost components were summed to obtain a total manufacturing cost estimate.

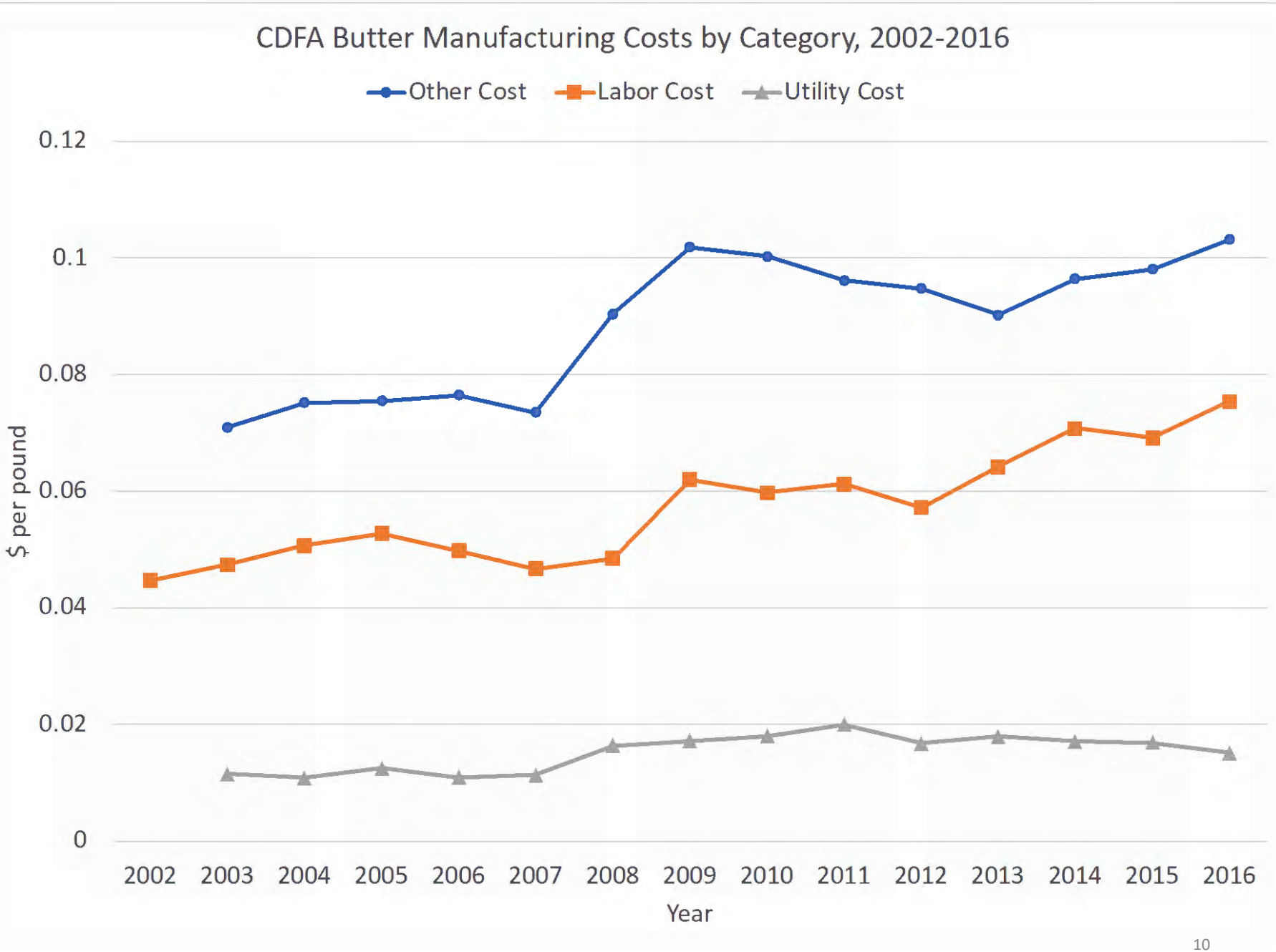
Model Data Descriptions

- In utility cost equations, published price series for California industrial energy prices (natural gas and electricity) from the US Department of Energy, Energy Information Agency (EIA) are included as explanatory variables to represent plant energy costs.
- In labor cost equations, a published series on average California wage rates for nonsupervisory manufacturing workers from the US Department of Labor, Bureau of Labor Statistics (BLS) is used to represent plant labor costs, and BLS data for nonfarm labor productivity was included to account for increased productivity's impact on labor costs over time.
- The other cost category used here for each commodity is all manufacturing costs that are not labor or utility costs. The U.S. Producer Price Index for intermediate goods from BLS, is included to represent the impact of general changes in prices material inputs on other costs, and the Total Factor Productivity Index for Food, Beverage and Tobacco Manufacturers is included to capture in the impact productivity changes.

Dummy Variables

- Some changes in the dependent variables are not explained by changes in energy prices, wage rates, price indices or productivity. Some of these changes persist for a short period (2-3 years), while others are more sustained.
- To capture the impact of these shifts, dummy variables, which are binary variables that have a value of 0 or 1, are included as explanatory variables.
- These variables can correspond to known causes or structural shifts in costs, such as those associated with a new plant startup, or to those whose cause is unknown, which are simply referred to a structural changes.


CDFA Cheese Manufacturing Costs by Category, 2002-2016
Other Costs
Labor Cost
Utility Cost
0.17
0.15
0.13
0.11
0.09
0.07
0.05
0.03
0.01
-0.01
$ per pound
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


CDFA Butter Manufacturing Costs by Category, 2002-2016
Other Cost
Labor Cost
Utility Cost
0.12
0.1
0.08
0.06
0.04
0.02
0
$ per pound
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

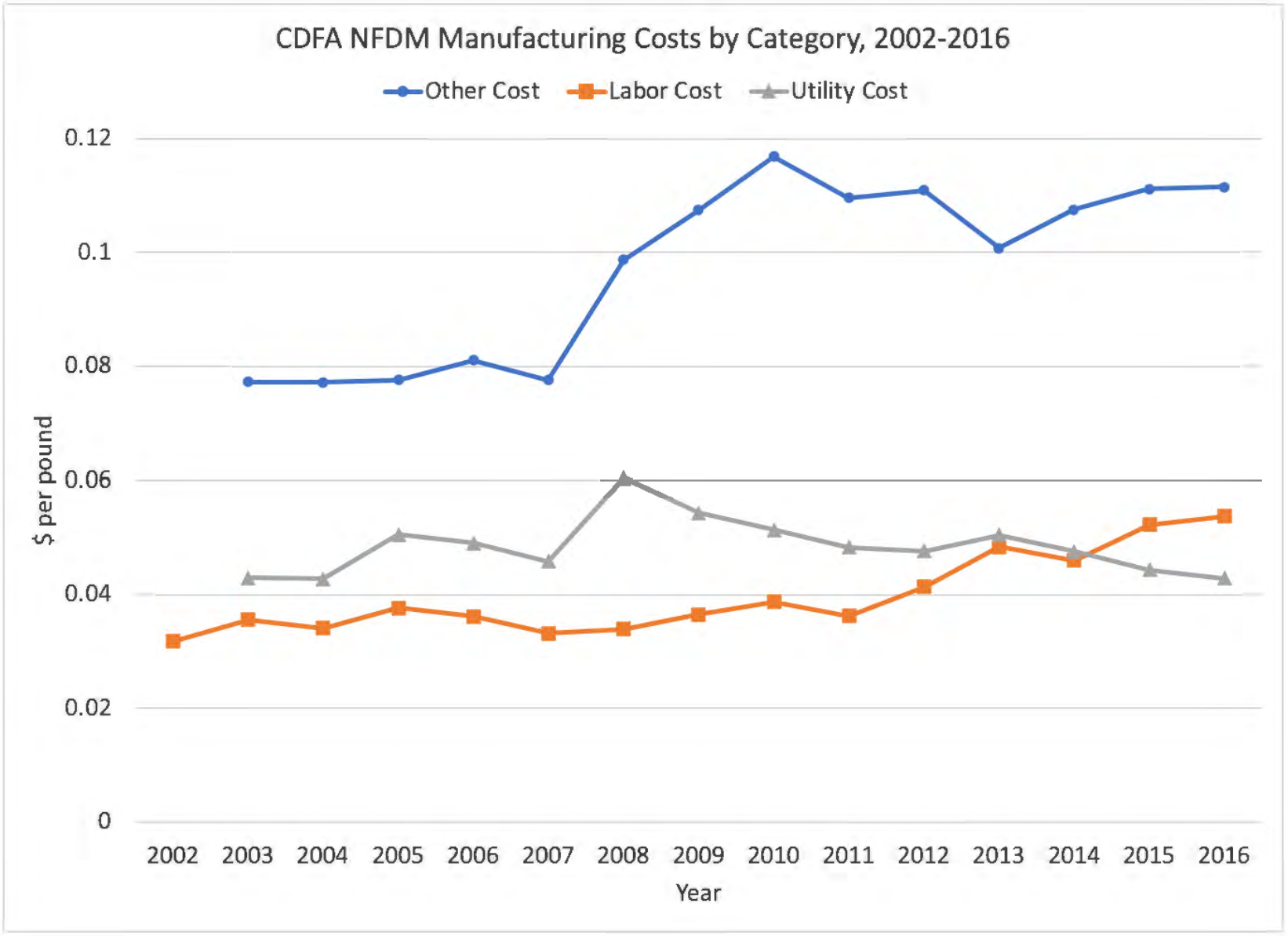

CDFA NFDM Manufacturing Costs by Category, 2002-2016
Other Cost
Labor Cost
Utility Cost
0.12
0.1
0.08
0.06
0.04
0.02
0
$ per pound
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Table 4.

Dummy Variables Used in Dairy Manufacturing Cost Models

Year	Excess Whey	Bstruc	New pt	Sewer rate	Nstruc
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	1	0	0	0	0
2006	1	0	0	0	0
2007	1	0	0	0	0
2008	0	0	1	0	0
2009	0	1	1	1	0
2010	0	1	0	1	0
2011	0	1	0	1	0
2012	0	1	0	1	1
2013	0	1	0	1	1
2014	0	1	0	1	1
2015	0	1	0	1	1
2016	0	1	0	1	1
2017	0	1	0	1	1
2018	0	1	0	1	1
2019	0	1	0	1	1
2020	0	1	0	1	1
2021	0	1	0	1	1
2022	0	1	0	1	1

Excess whey = dummy varriable that accounts for higher sewar costs associated with unique whey disposal issues.

Bstruc = a labor structural change dummy that represents a discrete upward shift in butter labor cost.

New pt = a dummy variable that represents higher costs associated with start-up of large new plants.

Sewer rate = a dummy variable that represents a discreet upward shift in butter plant sewer costs.

Nstruc = a labor structural change dummy that accounts for a discrete upward shift in NFDM plant labor cost.

Model and Trend Results

- The estimated equations generally showed good fit and strong overall correlations
- Adjusted R-square (measure of fit where 1.0 is a perfect fit) were better than 0.7 for all but one of the model equations.
- F-statistics for the estimated equations were all statistically significant at the 5% level.
- For t-tests of explanatory variable parameter estimates, 17 of 24 were significant at the 10% level or better.
- Correlation coefficients between the total predicted manufacturing costs and actual CDFA audited manufacturing costs were 0.92 for cheese, 0.96 for butter, and 0.91 for NFDM (where a value of 1.0 denotes perfect correlation.
- These high correlations suggest that the model does a good job predicting actual costs.

Table A-1. Cheese Manufacturing Cost Model

		F-stat	Adj R Square
Labor Cost	= a11+ b11(MFG Wage)** + c11(Lab Pro) +e11	**	77
Utility Cost	= a12 + b12(NatGas)** + c12(Electric)* + d12(Excess whey) +e12	**	70
Other Cost	= a13**+ b13(US PPI)** +c13(Food TFP)** +e13	**	89
TOTAL MFG COST	= LABOR COST + UTILITY COST + OTHER MFG COST		

** Estimated parameter or regression statistic significant at the 5% level

* Estimated parameter or regression statistic significant at the 10% level

Where: aij represent estimated constant term, bij thru dij represent estimated parameters associated with explanatory variables, and eij represent error terms.

MFG Wage = average hourly earnings for California nonsupervisory manufacturng workers, BLS

Lab Pro = US Non-farm labor productivity annual index, BLS, US Dept. of Labor

NatGas = California Industrial Users price for natural gas, EIA, US Dept. of Energy

Electric = California Industrial Users price for Electricity, EIA, US Dept. of Energy

Excess whey = dummy varriable that accounts for higher sewar costs associated with unique whey disposal issues

US PPI = US Producer Price Index for Intermediate Goods, a proxy for changes in other plant costs

Food TFP =US Total Factor Productivity Index for Food, Beverage and Tobacco Manufacturing, BLS US Dept. of Labor

Table A-8. Butter Manufacturing Cost Model.

		F-stat	Adj R Square
Labor Cost	= a21+ b21(MFG Wage)** + c21(US Lab Pro) + d21(Bstruc)* +e21	**	88
Utility Cost	= a22 + b22(NatGas)* + c22(Sewer rate)** + d22 (new pt) +e22	**	80
Other Cost	= a23*+ b23(US PPI)** +c23(Food TFP)* +d23(New pt)**	**	79
TOTAL MFG COST	= LABOR COST + UTILITY COST + OTHER MFG COST		

** Estimated parameter or regression statistic significant at the 5% level or lower
* Estimated parameter or regression statistic significant at the 10% level or lower

Where: aij represent estimated constant term, bij thru dij represent estimated parameters associated with explanatory variables, and eij represent error terms.

MFG Wage = average hourly earnings for nonsupervisory MFG workers, BLS
Lab Pro = US Non-farm labor productivity annual index, BLS, US Dept. of Labor
NatGas = California Industrial Users price for natural gas, EIA, US Dept. of Energy
Bstruc = a dummy variable representing a discrete upward shift in labor costs
Sewer rate = a dummy variable representing a discreet upward shift in sewer utilitiy costs
New Pt = a dummy variable representing higher costs associated with start-up of large new plants
US PPI = US Producer Price Index for Intermediate Goods, a proxy for changes in other plant costs
Food TFP = US Total Factor Productivity Index for Food, Beverage and Tobacco Manufacturing, BLS US Dept. of Labor

Table A-15. Nonfat Dry Milk (NFDM) Manufacturing Cost Model

		F-stat	Adj R Square
Labor Cost	= a31+ b31(MFG Wage)** + c31(Lab Pro)* + d31(Nstruc)** +e31	**	89
Utility Cost	= a32** + b32(NatGas) + c32 (New pt)** +e32	**	58
Other Cost	= a33+ b33(US PPI)** +c33(Food TFP) +d33(New pt) +e33	**	71
TOTAL MFG COST	= LABOR COST + UTILITY COST + OTHER MFG COST		

** Estimated parameter or regression statistic significant at the 5% level or lower
* Estimated parameter or regression statistic significant at the 10% level or lower

Where: aij represent estimated constant term, bij thru dij represent estimated parameters associated with explanatory variables, and eij represent error terms.

MFG Wage = average hourly earnings for California nonsupervisory manufacturing workers, BLS
Lab Pro = US Non-farm labor productivity annual index, BLS, US Dept. of Labor
Nstruc = a labor structural change dummy that represents a discrete upward shift in labor cost
NatGas = California Industrial Users price for natural gas, EIA, US Dept. of Energy
New pt = a dummy variable representing higher costs associated with start-up of large new plants
US PPI = US Producer Price Index for Intermediate Goods, a proxy for changes in other plant costs
Food TFP = US Total Factor Productivity Index for Food, Beverage and Tobacco Manufacturing, BLS, US Dept. of Labor

Table 3.

Parameter Estimates from Cheese, Butter, and Nonfat Dry Milk Manufacturing Cost Models

Product	----- Cheddar Cheese -----			----- Butter -----			----- NFDM -----		
Equation	Labor	Utility	Other	Labor	Utility	Other	Labor	Utility	Other
Parameter									
Constant	0.0116	0.0256	0.4294 **	0.0209	0.0045	0.2209 *	0.0137	0.0408 **	0.1983
MFG Wage	0.0049 **			0.0061 **			0.0050 **		
Lab Pro	-0.0004			-0.0007			-0.0006 *		
NatGas		0.0028 **			0.0008 *			0.0008	
Electric		-0.0024 *							
US PPI			0.0016 **			0.0008 **			0.0011 **
US Food TFP			-0.0044 **			-0.0020 *			-0.0020
Excess whey		0.0013							
Bstruc				0.0088 *					
Sewer rate					0.0071 **				
New pt					0.0015	0.0113 **		0.0094 **	0.0089
Nstruc							0.0056 **		

* Estimated parameter is significant at the 10 percent level.

** Estimated parameter is significant at the 5 percent level.

Forecasts of Manufacturing Costs

- Parameter estimates from the model were multiplied by the corresponding values of the explanatory variables to obtain predicted values for utility, labor, and other costs for cheddar cheese, butter and NFDM both with and beyond the 2003-2016 range of the CDFA cost data.
- The cost component predicted values for each cost component were summed to obtain total manufacturing costs for each commodity.
- Dry whey predicted manufacturing costs were obtained by adding 3 cents per pound to the predicted value of total manufacturing costs for NFDM.
- Forecasted manufacturing cost values for cheese, butter and NFDM are all around 10 cents per pound higher than the CDFA manufacturing costs for 2006, which was the CDFA data used to establish current make allowances.

Table 5a. (Model Predicted Values and Forecasts Extracted from Table 5.)

Manufacturing Costs: Model Predicted Values , All Commodities

Model Predicted Estimates/Forecasts				
Year	Cheese	Whey 1/	Butter	NFDM
	dollars per pound			
2006	$0.1866	$0.1965	$0.1378	$0.1665
2016	$0.2435	$0.2432	$0.1931	$0.2132
2017	**$0.2439**	**$0.2487**	**$0.1990**	**$0.2187**
2018	**$0.2547**	**$0.2565**	**$0.2056**	**$0.2265**
2019	**$0.2521**	**$0.2546**	**$0.2037**	**$0.2246**
2020	**$0.2536**	**$0.2568**	**$0.2067**	**$0.2268**
2021	**$0.2707**	**$0.2747**	**$0.2201**	**$0.2447**
2022	**$0.3006**	**$0.2953**	**$0.2364**	**$0.2653**

1/ Dry Whey Predicted Costs = Model Predicted Costs for NFDM + 3 cents/lb.

Table 5b. (Trend Values and Forecasts Extracted from Table 5.)

Manufacturing Costs: Trend Values and Forecasts, All Commodities

	Linear Trend Cost Values			
Year	Cheese	Whey 1/	Butter	NFDM
	dollars per pound			
2006	$0.1888	$0.1997	$0.1448	$0.1697
2016	$0.2415	$0.2462	$0.1945	$0.2162
2017	$0.2467	$0.2509	$0.1994	$0.2209
2018	$0.2520	$0.2555	$0.2044	$0.2255
2019	$0.2573	$0.2602	$0.2094	$0.2302
2020	$0.2625	$0.2648	$0.2143	$0.2348
2021	$0.2678	$0.2695	$0.2193	$0.2395
2022	$0.2731	$0.2741	$0.2243	$0.2441

1/ Dry Whey Trend Costs = Trend Costs for NFDM + 3 cents/lb.

Model Forecasts and Trends

- Model forecast values of manufacturing costs are lower than trend values in some years, higher in others.
- Deviations correspond to what is happening with price levels for energy, labor, and materials, as would be expected.
- The model forecasts do a better job of capturing input price level changes than the trend.
- Much of the increase in the model forecasts of manufacturing costs compared to current make allowances occurs in 2021 and 2022 when general inflation in the US economy accelerated.

Model Forecasts and Trends: Comparisons

- The model forecasts indicate that manufacturing costs have increased by the following percentages since 2006:

- 2022 model forecasts v. 2006 CDFA actual:
  - Cheese + 51.2%
  - Whey + 50.4% (model forecast v. 2006 NFDM cost plus 3 cents/lb.)
  - Butter + 72.2%
  - NFDM + 59.4%

Comparisons

- The above forecasts are generally consistent with company data submitted by various manufacturers during the hearing:

- AMPI: 47% increase in the cost of manufacturing bulk cheese from 2008 to 2022. [Hearing Exhibit 146]
- Land O'Lakes: 70.26% increase in the cost of manufacturing butter and NFDM from 2007 to 2022. [Hearing Exhibit 144]
- Northwest Dairy Association: 80% increase in the cost of manufacturing cheese, whey, butter and NFDM. [Hearing Exhibit 159]