Milk Marketing Order Winners and Losers

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ABSTRACT

Do milk marketing orders affect various demographic groups differently? To answer this question, we use supermarket scanner data to estimate an incomplete demand system for dairy products. Based on these estimates, we simulate substitution effects among dairy products and the welfare impacts of price changes resulting from changes in milk marketing orders for various consumer groups. While we find little difference in own- and cross-price substitution elasticities of demand, the welfare effects of price changes vary substantially across demographic groups, with some losing and others winning from this government program. Families with young children suffer from marketing orders, while wealthier childless couples benefit. Additionally, we find that households with lower incomes pay a larger percentage of their income due to marketing orders than those with higher income levels.

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Milk marketing orders raise the price of fresh milk and lower the price of processed milk from the single-price, competitive level. Some cynics have suggested that by so doing, these laws harm orphans who consume fresh milk while benefiting yuppies who consume brie and premium ice creams. To determine who benefits and who loses from the price changes due to marketing orders, we estimate an incomplete system of demands for dairy products and calculate the welfare effects of marketing orders.

The U.S. dairy industry has been regulated for nearly 70 years. These regulations affect the price and consumption of dairy products. During our sample period, 1997-1999, milk marketing orders were the most important direct regulations of the price of dairy products.[1] During the 1990s, production was affected by 31 federal marketing orders and 4 state orders, of which only the Virginia and California orders replaced the federal orders.

During the period of our data set, 1997-1999, milk marketing orders affected prices for various classes of fluid milk by setting minimum farm-level prices for milk.[2] Federal marketing

[1] Two other programs that affect milk markets are price supports and trade restrictions. In our sample period – the late 1990's – price supports had no direct effect on market prices because support prices were below the price levels that cleared the open market. During the 1990's, import restrictions on dairy products involved a two-tier tariff. With trade liberalization, the level of imports of dairy products has increased and the dairy industry continues to move towards free trade. Sumner (1999) describes how marketing orders also may stimulate net exports.

[2] Berck and Perloff (1985) present a theory of how marketing order prices are set and how they affect milk prices.

orders establish four classes of fluid milk. Class I is the milk used for fluid consumption.[3] Class II milk is used to produce soft dairy products such as ice cream, cottage cheese, and yogurt. Class III milk goes into hard dairy products such as butter and cheese. Class III-A milk is used to manufacture nonfat dry milk. The California state marketing order includes five classes of milk, creating separate classes for ice cream and other frozen products and for butter and dry milk.

By studying a system of demands for dairy products, we can determine how changes in prices that would result from a change in marketing orders affect the short-run consumption of various dairy products by consumers and the associated welfare impacts. We estimate the effects of marketing orders on the dairy product purchase decisions and the welfare impacts by estimating an incomplete demand system for dairy products that incorporates demographic variables. We calculate the own- and cross-elasticities of demand for dairy products and the equivalent variation from eliminating the marketing orders for different consumer groups. We also calculate the regulation burden on households with different income levels. We next discuss previous dairy demand studies. Then, we present the model and discuss our estimation technique. Finally, we use our estimates to calculate elasticities and simulate the welfare effects.

Literature

Previous studies estimated the demand for dairy products and the purchasing decisions of various demographic groups using different estimation models than we use. None of these studies examined the welfare implications of marketing orders on these groups.

Jensen (1995); Haines, Guilkey, and Popkin (1988); and Blaylock and Smallwood (1983) estimated the effect of consumer characteristics on dairy product expenditure. Using data from

[3] Only grade A milk may be used for the Class I market. When milk marketing orders were introduced in the 1930s, one of the justifications was to reduce the variability in the availability of Grade A milk. However, today nearly all of the milk produced in the United States meets the Grade A standards, so this rationale is outdated.

the U.S. National Food Consumption Survey and limited dependent variable models, each of these studies found that dairy product demands vary with regions of the country, the presence of children, ethnicity, income level, and education level.

Demand elasticities for broad categories of dairy products and the effect of demographic characteristics have been estimated using the U.S. National Food Consumption Survey in several articles. Park, Holcomb, Raper and Capps (1996) and Huang and Lin (2000) estimate the own-price elasticity of demand for milk and cheese, and total dairy products respectively. They find estimates between –0.01 and –0.8, and conclude that income level may affect these elasticities. Heien and Wessells (1988) and Gould, Cox and Perali (1990) estimate the own-price elasticity of demand for milk to lie between –0.32 and –0.67, and suggest that age, gender, ethnicity, education and other demographics may impact these price elasticities of demand. These studies suggest that demographic variables influence the demand for dairy products, but the effects on price elasticities appear to be small.

Bergtold, Akobundu, and Peterson (2004) use scanner data in a multistage, weakly separable, translog demand system to estimate demand elasticities for disaggregate dairy products. They report uncompensated expenditure elasticities for several dairy products including: cheese -0.17, shredded cheese 0.47, imitation cheese -0.39, whole milk -0.28, low-fat milk 0.01, and ice cream 0.04. This study did not include demographic variables in the empirical model, which could create biased estimates due to omitted variables. Including expenditure on a subset of goods (such as food) as a regressor also can cause endogeneity bias (Deaton 1986; Attfield 1985, 1991; LaFrance 1991b).

Estimates of the income elasticity of demand for dairy products vary widely in the previous literature. Some other authors found positive elasticities. Park, Holcomb, Raper and

Capp (1996) estimated income elasticities for non-poverty consumers of 0.22 for cheese and 0.27 for milk. Huang and Lin (2000) and Heien and Wessells (1990) estimated total food expenditure elasticities for all dairy products, and milk, cheese and butter respectively. They estimated food expenditure elasticities between 0.67 and 1.06. Other studies found slightly negative or essentially zero income or expenditure elasticities. Gould, Cox, and Perali (1990) estimated food expenditure elasticities that are very slightly negative for milk, and Bergtold, Akobudu, and Petersen (2004) found expenditure elasticities to be slightly negative or near zero for several dairy products.

Other studies have examined the effects on consumers of eliminating or changing milk marketing orders. Some estimate that eliminating the New England Dairy Compact, which acted much like a marketing order, would result in a 4% - 70% decrease in fresh milk prices (Cotterill 2003). LaFrance and de Gorter (1985) and Dardis and Bedore (1990) estimated that consumer surplus losses due to marketing orders averaged nearly $700 million dollars annually during the 1970s and the mid-1980s. Dardis and Bedore (1990) pointed out that the consumers with the lowest incomes are the hardest hit by this type of price discrimination policy.

This study departs from the existing literature in three important ways. First, we estimate a theoretically justified incomplete demand system for dairy products (instead of estimating a "complete" system and arbitrarily leaving out products). Second, we obtain more accurate elasticity estimates than in previous studies by using individual scanner data, controlling for the impacts of retail sales taxes in calculating real, after-tax prices facing consumers, and modeling the demands for dairy products as an incomplete system of demand equations. Third, we measure household-level welfare effects of changes in milk marketing orders by including demographic factors specific to individual households. The next section describes the incomplete demand system and its main properties.

Incomplete Demand System

Because we do not have data on all goods that consumers purchase, we estimate an incomplete demand system. Most previous studies have estimated "complete" demand systems where they excluded unobserved goods or aggregated them without sound theoretical justification. Instead, we use an incomplete system that is consistent with utility theory and hence which provides consistent estimates of elasticities and welfare measures.

We use a generalized Almost Ideal Demand System (AIDS) that is linear and quadratic in prices and linear in income (hereafter, the LQ-IDS). The structure of this model was presented in LaFrance (1990) and recently has been shown to be a special case of a very general extension of the AIDS model to incomplete systems (LaFrance 2004). This model is flexible with respect to both price and income effects. The theoretical subsystem of demand equations for the LQ-IDS model can be written as

$$\boldsymbol{q} = \alpha + \boldsymbol{As} + \boldsymbol{Bp} + \gamma\left(m - \alpha'\boldsymbol{p} - \boldsymbol{p}'\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}'\boldsymbol{Bp}\right), \tag{1}$$

where $\boldsymbol{q}$ is the vector of quantities demanded, α and γ are vectors of parameters, $\boldsymbol{A}$ is a matrix of parameters, $\boldsymbol{B} = \boldsymbol{B}'$ is a symmetric, negative definite matrix of parameters, $\boldsymbol{p}$ is the vector of normalized final consumer prices for dairy products, m is normalized income, and $\boldsymbol{s}$ is a vector of demographic variables.[4] All prices and income have been normalized by a linear homogeneous

[4] The two primary differences between an incomplete and a complete demand system are that the budget constraint is an inequality and the demand for the n+1st good is not forced to have exactly the same functional form as the goods that are included in the formal model. Incomplete systems can be made complete by identifying the demand for expenditure on other goods, y, through the budget identity, $y = m - \boldsymbol{p}'\boldsymbol{q}$. Here, we have that

$$y = -\tfrac{1}{2}\boldsymbol{p}'\boldsymbol{Bp} + (1 - \gamma'\boldsymbol{p})(m - \alpha'\boldsymbol{p} - \boldsymbol{p}'\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}'\boldsymbol{Bp}).$$

function of the prices of other goods, $\pi(\tilde{\boldsymbol{p}})$, where $\tilde{\boldsymbol{p}}$ is a vector of market prices other than those for dairy products. The class of normalized expenditure functions that generates this demand model is

$$e(\boldsymbol{p}, \tilde{\boldsymbol{p}}, \boldsymbol{s}, u) = \alpha' \boldsymbol{p} + \boldsymbol{p}' \boldsymbol{A}\boldsymbol{s} + \tfrac{1}{2}\boldsymbol{p}' \boldsymbol{B}\boldsymbol{p} + \theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u) e^{\gamma' \boldsymbol{p}}, \tag{2}$$

where $\theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u)$ is increasing in u but otherwise cannot be identified (LaFrance 1985; LaFrance and Hanemann 1989). Equivalently, the class of indirect utility functions theoretically consistent with this demand model is

$$v(\boldsymbol{p}, \tilde{\boldsymbol{p}}, m, \boldsymbol{s}) = \upsilon\left[\left(m - \alpha' \boldsymbol{p} - \boldsymbol{p}' \boldsymbol{A}\boldsymbol{s} - \tfrac{1}{2}\boldsymbol{p}' \boldsymbol{B}\boldsymbol{p}\right) e^{-\gamma' \boldsymbol{p}}, \tilde{\boldsymbol{p}}, \boldsymbol{s}\right]. \tag{3}$$

Either of these claims can be verified by applying Hotelling's lemma to Equation (2) or Roy's identity to Equation (3) to produce the incomplete demand system in Equation (1).

Price and Income Elasticities

The matrix of derivatives of the demands with respect to the deflated prices is

$$\frac{\partial \boldsymbol{q}}{\partial \boldsymbol{p}'} = \boldsymbol{B} - \gamma\left(\alpha' + \boldsymbol{s}' \boldsymbol{A}' + \boldsymbol{p}' \boldsymbol{B}\right), \tag{4}$$

with typical element,

$$\frac{\partial q_i}{\partial p_j} = \beta_{ij} - \gamma_i \left(\alpha_j + \sum_{k=1}^{K} a_{jk} s_k + \sum_{k=1}^{n} \beta_{jk} p_k\right). \tag{5}$$

The own- and cross-price elasticities of demand are therefore defined by

$$\varepsilon_{q_i}^{p_j} = \frac{p_j}{q_i}\frac{\partial q_i}{\partial p_j} = \frac{p_j}{q_i}\left[\beta_{ij} - \gamma_i \left(\alpha_j + \sum_{k=1}^{K} a_{jk} s_k + \sum_{k=1}^{n} \beta_{jk} p_k\right)\right] \quad \forall\ i, j = 1, \ldots, n. \tag{6}$$

In matrix notation, we let $P = \mathrm{diag}[p_i]$, $Q = \mathrm{diag}[q_i]$ represent $n \times n$ matrices with main diagonal elements p_i and q_i respectively for i=1,…, n and all the off-diagonal elements equal to

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This demand equation also belongs to the generalized AIDS class.

zero. We also define $E_q^p = [\varepsilon_{q_i}^{p_j}]$ as an $n \times n$ matrix of price elasticities. The diagonal elements are own-price elasticities, when $i = j$, and the off-diagonal elements are the cross-price elasticities, when $i \neq j$. Using the matrix notation we can write Equation (6) in the form

$$\boldsymbol{E}_{\boldsymbol{q}}^{\boldsymbol{p}} = \boldsymbol{Q}^{-1} \frac{\partial \boldsymbol{q}}{\partial \boldsymbol{p}'} \boldsymbol{P} = \boldsymbol{Q}^{-1} \left[\boldsymbol{B} - \gamma \left(\alpha' + \boldsymbol{s}' \boldsymbol{A}' + \boldsymbol{p}' \boldsymbol{B} \right) \right] \boldsymbol{P} . \tag{7}$$

Similarly, the derivatives of the demands with respect to deflated income are $\partial \boldsymbol{q} / \partial m = \gamma$, so that the income elasticities of demand are

$$\varepsilon_{q_i}^m = \frac{m}{q_i} \frac{\partial q_i}{\partial m} = \frac{\gamma_i m}{q_i} \quad \forall \ i = 1,...,n . \tag{8}$$

If we define the vector $\mathrm{e}_{\boldsymbol{q}}^m = [\varepsilon_{q_1}^m \cdots e_{q_n}^m]'$, then we can rewrite (8) in matrix notation as

$$\varepsilon_{\boldsymbol{q}}^m = m \boldsymbol{Q}^{-1} \gamma . \tag{9}$$

Welfare Measurement

To determine the impact of a change in the prices of dairy products on consumer welfare, we need to compare the scalar quasi-utility level at the initial prices, $\theta_0 \equiv \theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u_0)$, where

$$\theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u_0) \equiv \left[m - \left(\alpha_0' \boldsymbol{s} + \alpha' \boldsymbol{p}_0 + \boldsymbol{s}' \boldsymbol{A}' \boldsymbol{p}_0 + ½ \boldsymbol{p}_0' \boldsymbol{B} \boldsymbol{p}_0 \right) \right] e^{-\gamma' \boldsymbol{p}_0} , \tag{10}$$

with initial prices for dairy products equal to $\boldsymbol{p}_0$, to the scalar quasi-utility level at the final prices, $\theta_1 \equiv \theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u_1)$, where

$$\theta(\tilde{\boldsymbol{p}}, \boldsymbol{s}, u_1) \equiv \left[m - \left(\alpha_0' \boldsymbol{s} + \alpha' \boldsymbol{p}_1 + \boldsymbol{s}' \boldsymbol{A}' \boldsymbol{p}_1 + ½ \boldsymbol{p}_1' \boldsymbol{B} \boldsymbol{p}_1 \right) \right] e^{-\gamma' \boldsymbol{p}_1} , \tag{11}$$

with final prices for dairy products equal to $\boldsymbol{p}_1$. Given that consumer prices for dairy products change from $\boldsymbol{p}_0$ to $\boldsymbol{p}_1$, the equivalent variation, *ev*, is the change in income at the original price vector, $\boldsymbol{p}_0$, that is just necessary to bring the consumer to the new quasi-utility level at the final price vector, $\boldsymbol{p}_1$,

$$\theta_1 = \left(m - \alpha' \boldsymbol{p}_1 - \boldsymbol{p}_1^{'}\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}_1^{'}\boldsymbol{Bp}_1\right)e^{-\gamma' \boldsymbol{p}_1} = \left(m + ev - \alpha' \boldsymbol{p}_0 - \boldsymbol{p}_0^{'}\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}_0^{'}\boldsymbol{Bp}_0\right)e^{-\gamma' \boldsymbol{p}_0}. \quad (12)$$

Solving for *ev* then gives

$$ev = \left(m - \alpha' \boldsymbol{p}_1 - \boldsymbol{p}_1^{'}\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}_1^{'}\boldsymbol{Bp}_1\right)e^{\gamma'(\boldsymbol{p}_0 - \boldsymbol{p}_1)} - \left(m - \alpha' \boldsymbol{p}_0 - \boldsymbol{p}_0^{'}\boldsymbol{As} - \tfrac{1}{2}\boldsymbol{p}_0^{'}\boldsymbol{Bp}_0\right). \quad (13)$$

The compensating variation for this model can be shown to satisfy $cv = ev \times e^{\gamma'(\boldsymbol{p}_1 - \boldsymbol{p}_0)}$. As a result, we focus on the equivalent variation measure of consumer welfare.

Effects of Demographics on Elasticities and Welfare

To evaluate the impacts of a marginal change in a demographic variable on the price elasticities of demand for dairy products, we must take two separate forces into account. Any change in a demographic variable both shifts and rotates the demand function for each dairy product when it is depicted in the usual way with price on the vertical axis and quantity on the horizontal axis. To see why, first note that the rate of change in the demand for the i^{th} good with respect to the i^{th} price is

$$\frac{\partial q_i}{\partial p_i} = \beta_{ii} - \gamma_i \left(\alpha_i + \sum_{k=1}^{K} a_{ik} s_k + \sum_{j=1}^{n} \beta_{ij} p_j\right). \quad (14)$$

Using Equation (14) and the elasticity definition from Equation (6), the own-price elasticity of demand is

$$\varepsilon_{p_i}^{q_i} = \frac{p_i}{q_i}\frac{\partial q_i}{\partial p_i} = \frac{p_i}{q_i}\left[\beta_{ii} - \gamma_i \left(\alpha_i + \sum_{k=1}^{K} a_{ik} s_k + \sum_{j=1}^{n} \beta_{ij} p_j\right)\right]. \quad (15)$$

The *shift* in the demand curve is the rate of change in the demand for the i^{th} good with respect to the k^{th} demographic variable,

$$\frac{\partial q_i}{\partial s_k} = a_{ik} - \gamma_i \sum_{j=1}^{n} a_{jk} p_j . \quad (16)$$

Depending on the relative sign and size of the elements of the matrix ***A***, the relative levels of the dairy product prices $\boldsymbol{p}$, and the sign and size of the income coefficients γ, an individual demand function's shift can be positive, negative, or zero at any given data point.

We also need to examine how the demand curve rotates. The second-order cross effect of the i^{th} price and the k^{th} demographic variable on the i^{th} good is

$$\frac{\partial^2 q_i}{\partial p_i \partial s_k} = -\gamma_i a_{ik} \,. \tag{17}$$

This term shows the *rotation* in the demand curve. The sign of this term depends on the sign of the i^{th} income coefficient and the coefficient for the k^{th} demographic variable in the demand equation for the i^{th} good. For example, if the good is normal and $\alpha_{ik} > 0$, then $\partial^2 q_i/\partial p_i \partial s_k < 0$. In general the shift and rotation effects could (but need not) work in opposite directions and offset each other at a given point in ($\boldsymbol{q}$, $\boldsymbol{p}$, m, $\boldsymbol{s}$) space.

The net impact of a marginal change in the demographic variable s_k on the i^{th} own-price elasticity of demand, $\varepsilon_{p_i}^{q_i}$, can be expressed simply in terms of the percentage change in the own-price elasticity with respect to a percentage change in the demographic variable,

$$\frac{s_k}{\varepsilon_i^i}\frac{\partial \varepsilon_{p_i}^{q_i}}{\partial s_k} = \frac{s_k}{\varepsilon_i^i}\left[\frac{p_i}{q_i}\left(\frac{\partial^2 q_i}{\partial p_i \partial s_k}\right) - \frac{p_i}{q_i^2}\left(\frac{\partial q_i}{\partial p_i}\right)\left(\frac{\partial q_i}{\partial s_k}\right)\right]$$

$$= \underbrace{s_k \cdot \left(\frac{\partial^2 q_i / \partial p_i \partial s_k}{\partial q_i / \partial p_i}\right)}_{\%\ \text{rotation}} - \underbrace{\frac{s_k}{q_i} \cdot \left(\frac{\partial q_i}{\partial s_k}\right)}_{\%\ \text{shift}}. \tag{18}$$

Thus, the sign and size of the percentage change in the own-price elasticity of demand due to a change in a demographic variable depends on the net difference between the *percentage rotation* and the *percentage shift*. In general, this difference can be positive, negative, or zero for a given dairy product at any given point in ($\boldsymbol{q}$, $\boldsymbol{p}$, m, $\boldsymbol{s}$) space.

On the other hand, the marginal effect of a change in the k^{th} demographic variable on the equivalent variation for the change in dairy product prices from $\boldsymbol{p}_0$ to $\boldsymbol{p}_1$ is

$$\frac{\partial ev}{\partial s_k} = \sum_{j=1}^{n} a_{jk} \left[p_{j0} - p_{j1} e^{\gamma'(\boldsymbol{p}_0 - \boldsymbol{p}_1)} \right]. \tag{19}$$

This marginal effect depends on all of the coefficients on s_k in the subsystem of demands for dairy products, the relative prices changes, and the vector of income coefficients. Because equations (16)–(19) are functions of the demographic variables, we expect that the elasticities of demand will vary differently than the welfare effects as the prices consumers pay for dairy products change. That is what we find in our empirical work.

Data and Variables

We use weekly Information Resources Incorporated's (IRI) Infoscan™ scanner data from January 1, 1997 through December 30, 1999 for 23 U.S. cities.[5] The city populations range from 50,000 to 10 million. Each region of the country is represented with several cities. IRI records purchase price and quantity information at the Universal Product Code (UPC) level for a panel of customers for a number of grocery stores in each city. We aggregate these household data to city-level average household quantities purchased per week. There are 16,384 possible regimes for each household in each week, if we aggregate products up to 14 dairy products. If we do not aggregate the goods, then there are thousands of UPC codes, and hence millions of regimes to consider. There is no existing econometric method that can estimate such an unaggregated problem consistently within a utility theoretic framework. Thus, we aggregate across households to avoid having to estimate a system with a very large number of zero observations.

[5] Atlanta, Boston, Cedar Rapids (IA), Chicago, Denver, Detroit, Eau Claire (WI), Grand Junction (CO), Houston, Kansas City, Los Angeles, Memphis, Midland (TX), Minneapolis/St. Paul, New York, Philadelphia, Pittsburgh, Pittsfield (MA), San Francisco/Oakland, Seattle/Tacoma, St. Louis, Tampa/St. Petersburg, and Visalia (CA).

We aggregate the thousands of individual dairy UPC codes into 14 product categories: non-fat milk, 1% milk, 2% milk, whole milk, dairy cream including half and half, coffee creamers, butter and margarine, ice cream including frozen yogurt and ice milk, cooking yogurt (plain and vanilla yogurt), flavored yogurt (all other yogurt that is not categorized as cooking yogurt), cream cheese, shredded and grated cheese, American and other processed cheese, and natural cheese. The dependent variable in the incomplete demand system is the average quantity per purchasing household in each city in each week for each of the 14 dairy categories. For each category, we sum the quantities of each UPC code in that category and divide by the number of households that purchased any product in that category during the week.

For each of the dairy product categories in each city and for each week, we calculated a fixed quantity-weighted average price to represent the average weekly price for each product category. For a generic city, the formula for the j^{th} product category in the t^{th} week is

$$p_{jt} = \sum_{i_j=1}^{n_j} \left(\frac{\overline{q}_{i_j}}{\Sigma_{k_j=1}^{n_j} \overline{q}_{k_j}} \right) p_{i_j t},\ j = 1,\dots,14\,, \tag{20}$$

where, p_{jt} is the average price for dairy product category j in week t, n_j is the number of unique UPC codes for that product category, $\overline{q}_{i_j}$, $i_j = 1,\dots,n_j$, is the average quantity purchased in the given city of UPC code i_j in product category j throughout all of the weeks in the sample period, and $p_{i_j t}$ is the retail price of good i_j in week t. Each of these average prices is then multiplied by one plus the respective state's retail sales tax on food items to adjust the price for these tax effects. These price indices are then deflated by the regional after-tax consumer price index for all items less food for all urban consumers, not seasonally adjusted (hereafter, nonfood CPI).[6]

[6] If the general ad valorem retail sales tax rate in the state is τ, then the after-tax nonfood CPI is $(1 + \tau)$CPI. Retail sales tax rates are taken from the Council of State Governments (1997-1999)

Thus, the prices used in our estimation represent the combination of thousands of prices from the specific product level. We calculated the coefficient of variation, the standard deviation of price divided by the mean, for each product category to examine the amount of variation in price. We found coefficients of variation of 1% milk at .2, 2% milk at .13, non-fat milk at .14, whole milk at .12, cream at .16, coffee creamer at .12, natural cheese at .1, processed cheese at .16, shredded cheese at .16, cream cheese at .14, butter at .22, ice cream at .16, cooking and flavored yogurt at .12. These coefficients of variation suggest a significant amount of variation in prices.

Our data set also includes each household's income bracket. There are eight income brackets with midpoints ranging from $7,500 to $200,000.[7] We constructed a weekly estimate of the city-level average household income by taking the sum of the products of the proportion of households in each income bracket times the midpoint of that income bracket. In each city and week in the sample, the population proportions that were used to calculate the city-level income distribution were calculated as the fractions of households who had purchased at least one dairy product in that city during that week. We deflated the city-level average household income with the after-tax nonfood CPI. Finally, we divided these measures of deflated average annual household income associated with each week by 52 to construct estimates of the deflated average weekly income per household for each city and week in our sample.

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and the regional nonfood CPI's are from the Bureau of Labor Statistics (1997-1999), where 1982 is the base year. We linearly interpolate monthly nonfood CPI data to obtain weekly series. We matched each of our IRI cities to one of four CPI regions: Northeast, South, Midwest, and West.

[7] The last category is top coded as income at or above $100,000 per year. We arbitrarily set $200,000 as the conditional mean of the top income category. This amount is roughly the mean income level of all U.S. households that earned at least $100,000 per year in the years 1997-1999. We calculated this national average conditional mean income using the full household income samples in the March supplement of the Continuing Population Survey for each of these three years.

The data set also includes several demographic characteristics for each household. We constructed city-level aggregate measures of these demographic variables similar to the weekly average income per household variable. That is, if a household purchased any dairy product in a given week, we included that household's demographic characteristics to calculate city-level aggregates, so that the demographic variables vary week-to-week and city-by-city as averages of dairy-product purchasing households' demographic characteristics.

Table 1 shows the sample means and standard errors of the continuous variables and the proportions of households with the discrete characteristics that are included in the demand system. Not shown in the table, but included in the empirical model, are dummy variables that capture city-level fixed effects. Demographic variables included in the model include the proportions of households by ethnic group, home ownership, employment status, occupation, and households with children under 18, with young children (ages 0-5.9), medium aged children (ages 6-11.9), or older children (ages 12-17.9), and city-level weekly averages of the number of young, medium and older children for all households, the number of children in each of the three age groups, years of education, household weekly income, number of members in each household, and the ages of the heads of household.

In the next section, we discuss our incomplete dairy demand system estimates. By the way we constructed our data, we are answering the question: "What is the demand system for dairy products of households that consume dairy products?" While that is a reasonable question to pursue, one might alternatively want to answer, "What is the demand system for all consumers, including those who consume and those who do not consume dairy products?" If one tried to uses estimates based on the restricted sample to answer the second question, there may be sample selection biases.

While those are a real concern, the biases may not be large because most families do purchase dairy products. Over 96 percent of households buy milk (Cornick, Cox, and Gould 1994, using 1991-1992 Nielsen Household Purchase Panel data). Similarly, 82 percent (Yen and Jones 1997, U.S.D.A. Nationwide Food Consumption Survey 1987-1988) or 83 percent (Gould 1992, BLS Consumer Expenditure Survey 1987) of households buy cheese. In our sample, essentially every household consumes one or another dairy product: milk, 99 percent; cheese, 99% (ranging between 82 and 91 percent for the various types); ice cream, 85 percent; flavored yogurt, 79 percent; butter, 64 percent; and cream, 61 percent.

Demand System Estimates

We estimate the incomplete demand system, Equation (1), by nonlinear three stage least squares (NL3SLS) to account for the joint determination of city-level average quantities and prices. The instruments that we use in the first stage price equations include city-level fixed effects, the demographic and income variables in the demand equations, the current and lagged deflated wholesale price of milk by city, the Herfindahl-Hirschman market power index (HHI) for the city, the squares of average household income, the wholesale milk price, and the HHI, and interactions between the race, home ownership, and income variables with the wholesale milk price and the HHI. This set of instruments produced coefficients of multiple determination in our sample ranging from 0.691 to 0.956 for the deflated average prices.[8]

In Equation (1), each structural parameter enters each demand equation through the supernumerary income term, $m - \alpha' \boldsymbol{p} - \boldsymbol{p}' \boldsymbol{A} \boldsymbol{s} - \frac{1}{2} \boldsymbol{p}' \boldsymbol{B} \boldsymbol{p}$. In this expression, market prices interact with each parameter. Amemyia (1985) showed that best NL3SLS estimators are obtained if (and only if) the set of instrumental variables can be expressed as a linear combination of the expected

[8] We also tried additional instruments, such as the market shares of each of the eight largest firms in each city and the squared market share variables, with similar results.

values of the partial derivatives of the structural equations with respect to the structural parameters, conditional on the instrument set. To meet this requirement, we need a set of instrumental variables for each demand equation that includes a constant, city-level fixed effects dummies, demographic variables including average weekly household income, predicted prices, own- and cross-product second-order interactions between predicted prices, and interactions between predicted prices and the city dummies and the demographic variables. Thus, we need 856 instruments for the 819 structural parameters with a total of 3583 cross-section/time-series observations per demand equation and 14 demand equations, for a total of 50,162 observations. We use TSP© version 4.5 to estimate the NL3SLS system and use White's robust heteroskedasticity consistent standard errors for all of the parameter estimates, elasticities, and hypothesis tests.

Table 2 presents summary statistics for each of the 14 dependent variables and the individual equations' regression error variances and goodness of fit measures. Because the empirical model is nonlinear in the parameters and the right-hand-side explanatory variables, the R^2 measure that we report is the squared correlation between the observed and predicted dependent variables. The high R^2 measures show that this demand model fits the data reasonably well.

Coefficients

We estimate the LQ-IDS demand model for the 14 dairy product categories using a large number of demographic variables. It is not practical to report all of the coefficient estimates in a table. Many of the demographic coefficients are statistically significantly different from zero at the 5% level in some but not all equations and are collectively strongly statistically significant. Rather than try to describe the effects of all of the demographic variables on the quantities demanded variable by variable, we turn to their effects on price elasticities of demand and the equivalent variation measure of the welfare effects of marketing orders.

Price Elasticities

As the prices of dairy products change due to milk marketing orders, households that consume dairy products alter the mix of dairy products that they demand. Table 3 shows the own- and cross-price elasticities for various categories of dairy products calculated at the mean of the variables (from table 1). Each cell shows the price elasticity for a change in the product listed at the top of the column.

All of the own-price elasticities are negative, statistically significant, and inelastic with the exception of 1% milk. The own-price elasticity of 1% milk is –2.05. However, statistically this elasticity may not be very much above –1 (the asymptotic standard error is 0.47). The magnitudes of our other own-price elasticity point estimates are similar to those in previous literature. The own-price elasticities of demand for the four types of fresh milk (1%, 2%, no-fat, and whole) range from –0.628 for no-fat milk to -2.05 for 1% milk. The other dairy products are generally even less elastic. The least elastic product is butter, which has an own elasticity of -0.295. There are roughly equal numbers of positive and negative cross-price elasticities of demand, but all of these elasticities are very close to zero—generally below 0.15 in absolute value, and none larger than 0.3 in absolute value. Indeed, most of the cross-price elasticities are not statistically different from zero at a 5% level of significance.

Even though the coefficients on many of the demographic variables are significantly different from zero at the 5% level, the own-price elasticities of demand do not vary much across demographic groups. We calculated the elasticities for a variety of different demographic groups and compared them. In almost no case did the elasticities vary by more than a few percentage points. As we discussed in the theory section, a change in a demographic variable may cause a demand curve to shift and rotate in such a way that the elasticities do not vary substantially, which is what happens here.

Table 4 reports the income elasticities evaluated at the mean for households that consume dairy products. All of the income elasticities are negative and eight are statistically different from zero at the 5% significance level. From inspection, we again conclude that the income elasticities vary only slightly across demographic characteristics. Our income elasticity estimates fall generally in the range of other estimated income elasticities for dairy products. But, as one would expect, they tend to differ from the previous estimates of food expenditure elasticities for dairy product demands in a conditional (that is, in a weakly separable) system of demand equations.

Welfare Effects from Eliminating Marketing Orders

Even though elasticities do not vary substantially across demographic groups, the welfare effects of price changes do vary substantially across these groups. If we were to eliminate the marketing order so that fresh milk prices fell while processed prices rose, consumers in some demographic groups would gain while others would lose.

We illustrate how eliminating a milk marketing order differentially affects the equivalent variation, *ev*, for households that consume all the dairy products with various demographic characteristics. We report the equivalent variation as the weekly change in income that a consumer is willing to accept in lieu of experiencing the price changes. Consumers benefit from the price changes when the equivalent variation is positive and suffer a loss when the equivalent variation is negative.

When the New England Dairy Compact ended in 2001, fresh milk prices fell by about a fifth. To illustrate the effects of eliminating the federal marketing order, we examine cases where retail fluid milk prices drop by 20%.[9] This change in fluid milk prices is consistent with the farm-level price effects due to milk marketing orders estimated by LaFrance and deGorter (1985) and the pass through effects on retail prices estimated by LaFrance (1991a, 1993).

A drop in the price of fresh milk would be offset by a rise in the prices of processed milk products as raw milk shifts from processed dairy products to fresh milk use. In tables 5 and 6, we consider five scenarios ranging from the prices of manufactured products remaining constant to rising up to 20% (the same absolute percentage value as the decrease in the fluid milk prices). One might argue that a relatively small change is more plausible, given that the retail prices of manufactured dairy products remained nearly constant when the New England Dairy Compact was terminated in 2001. Almost certainly, therefore, the relatively large (15% and 20%) price increases for manufactured dairy products that we consider in the table are unlikely to occur.

Table 5 shows how the quantities demanded (evaluated at the mean of the explanatory variables in table 1) by dairy consumers would vary for each of the scenarios. As expected, the quantities demanded for fresh milk products rise and those for processed dairy products fall. In all of the scenarios, the quantity demanded of 1%, 2%, non-fat, and whole milk increase substantially, by nearly 32.9%, 12.3%, 8.8% and 9.2% respectively. In the scenarios when processed prices rise, the quantities demanded for these products drop by relatively modest amounts except for cream cheese (where the decrease is between .3% and 16.4% depending on the scenario), cooking yogurt (fell by between 2.4% and 14%), and flavored yogurt (dropped by between .1% and 10.7%).

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[9] Our simulation experiments show that smaller or larger cuts have proportional effects. For example, a 10% cut in fluid milk prices has almost exactly half as large an *ev* effect as a 20% decrease.

Given these increases in milk demands and drops in processed product demands in the scenarios with large processed price increases, we expect some dairy consumers to benefit and others to lose. Table 6 shows how welfare changes across demographic groups, where we hold all the demographic characteristics but one at their mean levels and then change one characteristic at a time.

The table shows, of course, that if the retail prices of processed milk products remain unchanged, then all milk consumers benefit from a drop in the price of fresh milk. The larger the percentage increase in the prices of manufactured products, the worse off is each demographic group. If the prices of processed dairy products were to rise sufficiently, then virtually all consumers would be harmed.

The first row of table 6 shows the equivalent variation for a family that buys these dairy products and has the average demographic characteristics. Given that the price of fresh milk falls 20%, the "typical" household's weekly equivalent variation is $1.44 if the prices of processed goods do not change, -17¢ if they rise by 10%, and -$1.75 if they rise by 20%.

The next two rows show how the results vary with race holding the values of the other demographic characteristics fixed at their mean levels. The second row of table 6 shows the equivalent variation for a white household, while the third row of table 6 shows the equivalent variation for a comparable non-white family, where we set the variable for white equal to zero and the variables for black, Asian, and Hispanic equal to the proportion of the sample of each non-white group divided by the fraction of household that is non-white. The conditional sample means of the equivalent variations for the nonwhite family (third row) are 96¢ for 0% change in processed goods, -48¢ for a 10% change, and -$1.88 for a 20% change. The corresponding equivalent variations for a white family (second row) are $1.50, -13¢, and -$1.70. Thus, depending on the change in processed goods prices, non-white families benefit less or are harmed more than are white families.

That the welfare response to price changes varies with race may be partially related to varying incidences of lactose intolerance across races. In the United States, the prevalence of lactose intolerance varies substantially by race. The rates are relatively low for whites: 5% for Caucasians of northern European and Scandinavian descent (although 70% for North American Jews). The rates are higher for many non-white groups: 45% for African American children and 79% for African American adults, 55% for Mexican American males, to 90% for Asian Americans, and 98% for Southeast Asians (Nutrigenomics 2005).

Table 6 also shows how welfare changes as we vary one variable at a time for income, education, presence of children, and whether the household has a child in each age group. Where the processed prices rise by 5% or less, lower income families benefit more than wealthier families from eliminating the marketing order. Similarly, more educated families fare better than less educated ones (though the differences are very small). Families with children under six years of age or with older children between 12 and 18 years of age benefit more than others from eliminating marketing orders.

Perhaps the most striking experiments are those in the last two rows of table 6, where we compare the equivalent variations of two types of families by varying several characteristics at once. In the next to last row, we examine a family with three small children. The parents are 35 years old, they have a deflated income of $20,000, the wife is not employed, the husband works in a non-professional occupation, they have three children under the age of six, and they rent their dwelling. In contrast, in the last row, is a childless couple. They are 30 years old, have a higher income of $60,000, are working professionals, and own their dwelling.

The family with children gains more from the elimination of the marketing order than virtually any other group, presumably because their children consume relatively large amounts of fresh milk. Even if the price of processed milk increases more than 10%, they benefit from eliminating the marketing order and reducing the price of fresh milk by 20%. In contrast, the childless, wealthier couple only benefits if the increase in processed milk prices is less than 5%. Moreover, even if there is no increase in the processed milk price, the benefit to the young family is 82% greater than that for the childless couple.

In general, if the 20% drop in the fresh milk price is offset by a 0% or 5% increase in the processed products prices, virtually all consumer groups benefit. With an implausibly high 15% or 20% increase, all groups lose. If the fall in the fresh milk price is offset by a moderate (10%) rise in the processed prices, there are winners and losers. The average family loses, as do most other groups. In contrast, those with young children gain.

How large are the welfare effects? The losses or gains per household tend to be relatively small. The equivalent variation per household is less than a couple of dollars per week or generally less than $100 per year. However, as there are 111 million U.S. households, the loss to society may be substantial.

Finally, our simulations show that milk marketing order regulations are very regressive. We define the "regulatory burden" of the marketing order as a household's annual equivalent variation (from removing the marketing order) divided by its annual income. We look at the regulatory burden associated with a 20% decrease in fluid milk prices and a 5% increase in manufacturing prices.

In figure 1, we compare how the regulatory burden falls with income for white and for non-white families. The equivalent variation of removing the marketing order is positive at low incomes—consumers benefit from removing it—so there is a regulatory burden (loss) from imposing the marketing order. For the white families, the burden falls from 0.61% at an income of $7,500, to 0.44% at $10,000, 0.19% at $20,000, 0.11% at $30,000, 0.04% at $50,000, 0.01% at $75,000. At higher incomes, the burden is slightly negative, ranging from -0.002% at $85,000 to –0.04 at $200,000.

The curve for the non-white families lies strictly below that for white families, but both curves fall with income. At $7,500, the regulatory burden of a non-white family is about half that of a white family. At the average real income, $25,000, the regulatory burden is about a third for the non-white family as for a white one. Perhaps this difference has to do with higher rates of lactose intolerance among non-whites.

Summary and Conclusions

Using supermarket scanner data, we estimate an incomplete dairy demand system of households that consume dairy products to determine the effects of changing the milk marketing order regulations on various demographic groups. We calculate the price elasticities and the equivalent variations associated with price changes. The price elasticities describe the substitutability between dairy products as prices change. The equivalent variation measures the changes in welfare associated with the price changes.

An important qualification of our study is that we only estimate the effects on supermarket purchases (it is conceivable that a somewhat different pattern holds for restaurant purchases). A second concern is the sample selection problem that may arise because a small share of households does not purchase dairy products. (We plan to work on this latter problem in our future research.)

There is very little variation in price elasticities across demographic groups. Nonetheless, there are substantial differences across demographic groups in welfare effects from eliminating market orders.

When the New England Dairy Compact ended in 2001, fresh milk prices fell by about a fifth and other milk product prices were virtually unchanged (though we would have expected at least a small increase). Under those conditions, all consumers benefit from eliminating marketing orders. In particular, poorer, families with young children tend to gain more than richer, families with no children or older children.

If eliminating the market order results in a drop in fresh milk prices that is offset by half as large an increase in processed product prices, households that consume relatively more fresh milk gain, and those that consume relatively more processed products lose. Families with young children are likely to gain, while wealthier childless couples are more likely to lose. That is, as predicted, orphans suffer from marketing orders while yuppies benefit. Eliminating marketing orders can cause household welfare to rise by up to a $100 or so a year. While these amounts are relatively small per household, they constitute a large potential social gain when aggregated over the more than hundred million households that buy dairy products.

Finally, marketing orders are very regressive. Households with lower income levels pay a larger percentage of their income due to the milk marketing order regulations than do those with higher income levels.

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Table 1. Summary Statistics of the Households that Purchase Dairy Products

Variable	Mean	Standard Error
Household (hh) size	2.816	0.176
Weekly income	471.839	84.690
Own house	0.826	0.074
Race/ethnicity		
Share white	0.880	0.110
Share black	0.054	0.075
Share hispanic	0.045	0.063
Share asian	0.014	0.032
Male head of household		
Age	54.200	2.080
Years of education	12.900	0.492
Share unemployed	0.030	0.012
Share employed part time	0.037	0.010
Share employed full time	0.650	0.051
Share nonprofessional occupation	0.356	0.113
Share technical education	0.110	0.058
Female head of household		
Age	53.551	2.124
Years of education	13.373	0.398
Share unemployed	0.226	0.046
Share employed part time	0.170	0.035
Share employed full time	0.366	0.051
Share nonprofessional occupation	0.430	0.076
Share technical education	0.068	0.039
Children		
Children present in hh	0.350	0.058
Average number of young children ages 0-5.9	0.133	0.041
Average number of middle children ages 6-11.9	0.249	0.050
Average number of older children ages 12-18	0.307	0.064
Share of hh with children with young children	0.309	0.059
Share of hh with children with middle children	0.524	0.039
Share of hh with children with older children	0.562	0.060

Table 2. Equation Summary Statistics

Dairy Product	Average Quantity Purchased		Regression Equation	
	Mean (ounces)	Standard Error	Error Variance	R^2
1% Milk	151.409	77.692	3553.0	.41
2% Milk	137.592	24.049	107.7	.81
Nonfat Milk	127.630	25.798	101.8	.85
Whole Milk	121.439	27.128	169.4	.77
Cream	15.298	3.080	3.9	.59
Coffee	30.249	5.194	12.6	.53
Natural Cheese	13.417	2.418	2.2	.63
Processed Cheese	15.780	2.2551	2.1	.68
Shredded Cheese	11.834	1.759	1.1	.64
Cream Cheese	11.405	1.641	1.9	.30
Butter	18.302	3.929	11.0	.29
Ice Cream	79.484	12.936	90.1	.46
Cooking Yogurt	22.060	5.937	25.9	.26
Other Yogurt	33.882	4.480	9.7	.52

Notes: "Cooking yogurt" is defined as plain and vanilla yogurt. "Other yogurt" is yogurt of all other flavors.

Table 3. Price Elasticities of Demand for Dairy Products of Households that Consume Dairy Products Calculated at the Mean of the Explanatory Variables

Dairy Product	Milk 1%	Milk 2%	Milk No-Fat	Milk Whole	Fresh Cream	Coffee Additives	Natural Cheese	Processed Cheese	Shredded Cheese	Cream Cheese	Butter	Ice Cream	Yogurt Cooking	Yogurt Flavored
Milk 1%	-2.052*	0.019	0.110*	0.168*	-0.038	-0.046*	0.051	0.016	-0.043	0.011	0.095	0.016	-0.113*	0.011
Milk 2%	0.018	-0.742*	0.079*	0.022	-0.050*	-0.045	0.163*	0.105*	0.025	-0.013	0.032*	-0.098*	0.045	-0.031
Milk No-Fat	0.115*	0.084*	-0.628*	-0.022	0.089*	0.091*	-0.048	-0.098*	0.008	-0.013	-0.062*	-0.023	0.211*	0.000
Milk Whole	0.181*	0.025	-0.022	-0.652*	-0.036	-0.072*	-0.222*	-0.098*	-0.047	0.006	0.001	0.023	-0.069	0.030
Fresh Cream	-0.063	-0.084*	0.139*	-0.056	-0.407*	0.022	0.101	0.274*	0.118*	0.173*	0.004	-0.016	-0.139	0.035
Coffee Additives	-0.071*	-0.070	0.130*	-0.103*	0.020	-0.496*	-0.014	0.007	-0.056	-0.082*	-0.016	0.137*	0.019	0.144*
Natural Cheese	0.042	0.140*	-0.039	-0.176*	0.052	-0.007	-0.641*	0.132*	0.040	-0.015	0.014	0.104	-0.035	0.052
Processed Cheese	0.013	0.094*	-0.083*	-0.082*	0.147*	0.004	0.137*	-0.734*	-0.009	-0.122*	-0.019	0.275	0.057	-0.028
Shredded Cheese	-0.038	0.020	0.006	-0.038	0.060*	-0.031	0.039	-0.008	-0.404*	-0.082*	0.022	0.036	0.068	0.044
Cream Cheese	0.014	-0.019	-0.018	0.006	0.149*	-0.076*	-0.026	-0.194*	-0.138*	-0.515*	0.064*	0.128*	-0.225*	-0.012
Butter	0.093	0.033*	-0.056*	0.001	0.003	-0.009	0.019	-0.019	0.029	0.045*	-0.295*	0.136*	0.047	-0.038*
Ice Cream	0.010	-0.062*	-0.013	0.013	-0.006	0.058*	0.077	0.196*	0.028	0.057*	0.087*	-0.741*	0.187*	0.090*
Yogurt Cooking	-0.196*	0.079	0.348*	-0.111	-0.147	0.023	-0.071	0.113	0.142*	-0.276*	0.084	0.520*	-0.911*	-0.070
Yogurt Flavored	0.011	-0.035	-0.001	0.029	0.023	0.103*	0.066	-0.034	0.057	-0.009	-0.044*	0.154*	-0.044	-0.808*

Notes: The table shows the price elasticity given that the price of the good shown in the column changes. An asterisk denotes that we can reject the null hypothesis that the elasticity is zero at the 5% significance level.

Table 4. Income Elasticities for Dairy Products of Households that Consume Dairy Products

Dairy Product	Income Elasticity	Standard Error
1% Milk	-0.558	0.468
2% Milk	-0.221*	0.058
Milk No-Fat	-0.239*	0.059
Milk Whole	-0.484*	0.075
Fresh Cream	-0.205*	0.098
Coffee Additives	-0.071	0.087
Natural Cheese	-0.209*	0.077
Processed Cheese	-0.040	0.066
Shredded Cheese	-0.115	0.068
Cream Cheese	-0.109	0.091
Butter	-0.676*	0.127
Ice Cream	-0.406*	0.082
Yogurt Cooking	-0.327	0.182
Yogurt Flavored	-0.151*	0.071

Note: An asterisk denotes that we can reject the null hypothesis that the elasticity is zero at the 5% significance level.

Table 5. Percent Change in Quantity Given Fresh Milk Prices Fall 20% and Processed Product Prices Increase by Various Amounts
(Evaluated at the Mean of the Explanatory Variables)

Dairy Product	Processed Product Prices Increase				
	0%	5%	10%	15%	20%
1% Milk	32.9	32.7	32.6	32.4	32.2
2 % Milk	12.2	12.9	13.5	14.2	14.8
Milk No-Fat	8.8	9.6	10.3	11.1	11.9
Milk Whole	9.2	6.8	4.4	2.0	-0.4
Fresh Cream	1.3	2.1	2.9	3.7	4.5
Coffee Additives	2.2	0.6	-1.1	-2.7	-4.4
Natural Cheese	0.6	-0.9	-2.4	-3.9	-5.4
Processed Cheese	1.1	-0.3	-1.7	-3.1	-4.6
Shredded Cheese	1.0	-0.3	-1.6	-2.8	-4.1
Cream Cheese	0.3	-3.8	-8.0	-12.2	-16.4
Butter	-1.4	-1.8	-2.2	-2.6	-3.0
Ice Cream	1.0	1.2	1.3	1.5	1.7
Yogurt Cooking	-2.4	-5.3	-8.2	-11.1	-14.0
Yogurt Flavored	-0.1	-2.7	-5.4	-8.0	-10.7

Table 6. Equivalent Variation ($/week) by Demographic Groups of Households that Consume Dairy Products Given Fresh Milk Prices Fall 20% and Processed Product Prices Rise by Various Percentages

Demographic Group	Processed Product Prices Increase				
	0%	5%	10%	15%	20%
Mean	1.44	0.63	-0.17	-0.97	-1.75
White	1.50	0.68	-0.13	-0.92	-1.70
Non-white	0.96	0.23	-0.48	-1.18	-1.88
Income=$10,000	1.73	0.80	-0.12	-1.03	-1.92
Income=$30,000	1.33	0.56	-0.19	-0.94	-1.68
Income=$50,000	0.94	0.33	-0.27	-0.86	-1.44
Income=$70,000	0.54	0.09	-0.35	-0.78	-1.19
Income=$90,000	0.15	-0.14	-0.42	-0.69	-0.95
Education=10 Years	1.19	0.47	-0.25	-0.95	-1.64
Education=16 Years	1.41	0.53	-0.33	-1.18	-2.03
Young Child (0-5.9)	1.68	0.76	-0.15	-1.04	-1.93
Middle Child (6-11.9)	0.84	0.17	-0.50	-1.16	-1.80
Older Child (12-18)	2.00	1.13	0.28	-0.56	-1.39
No Children	1.69	0.84	0.00	-0.83	-1.65
Family with 3 Children[a]	1.25	0.70	0.16	-0.38	-0.90
Childless Couple[b]	0.22	-0.37	-0.96	-1.54	-2.10

[a] Heads of household are 35 years old, they have a real income of $20,000, the wife is not employed, the husband works in a non-professional occupation, they have three children under 6 years of age, and they rent their dwelling.

[b] Heads of household are 30 years old, they have a real income of $60,000, both are working professionals, and they own their dwelling.

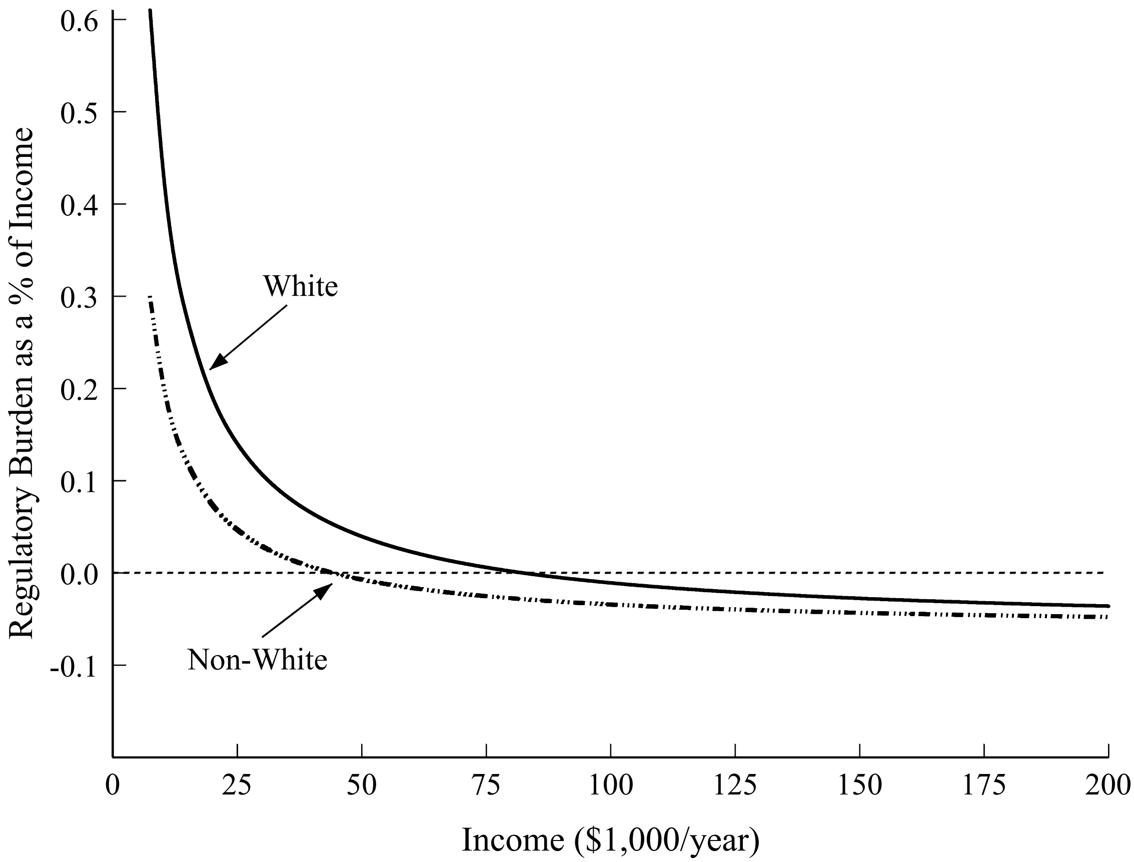

Figure 1. Regulatory Burden as a Percentage of Income for Various Income Levels