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File No. CT 98/2

THE COMPETITION TRIBUNAL

IN THE MATTER OF THE *COMPETITION ACT*, R.S. 1985, c.C-34, as amended, and the *Competition Tribunal Rules*, SOR/94-290, as amended (the "*Rules*");

AND IN THE MATTER OF an inquiry pursuant to subsection 10(1)(b) of the *Competition Act* relating to the proposed acquisition of ICG Propane Inc. by Superior Propane Inc.;

AND IN THE MATTER OF an Application by the Director for an order pursuant to s. 92 of the *Competition Act*.

B E T W E E N:

THE COMMISSIONER OF COMPETITION

Applicant

- and -

SUPERIOR PROPANE INC. et al.

Respondents

AFFIDAVIT OF MICHAEL R. WARD

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AFFIDAVIT OF MICHAEL R. WARD

I, Michael R. Ward, of the city of Urbana in the State of Illinois, MAKE OATH AND SAY:

1. Attached hereto and marked as Exhibit "A" is a true copy of my evidence. The contents of Exhibit "A" and the findings and opinions expressed therein are true to the best of my knowledge, information and belief.

2. I was retained by counsel for the Commissioner of Competition to provide expert

economic evidence in this matter.

3. Attached hereto and marked as Exhibit "B" is a true copy of my curriculum vitae.

4. I make this affidavit pursuant to Rule 47(1) of the *Competition Tribunal Rules*.

Sworn/Affirmed before me
at the city of Urbana in
the State of Illinois, on August 30, 1999

Ruth E. Sharpton
A Notary Public or other such officer
entitled to take oaths or affirmations in
the said jurisdiction

Michael R. Ward
Michael R. Ward

OFFICIAL SEAL
RUTH E SHARPTON
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES:01/13/00

This is Exhibit "A" to the Affidavit of Michael R. Ward,
sworn before me at the city of Urbana in the State
of Illinois this 30th day of August, 1999

Ruth E. Sharpton

A Notary Public or other such officer entitled to take oaths or
affirmations in the said jurisdiction

OFFICIAL SEAL
RUTH E SHARPTON
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1. Qualifications

I received my Bachelor's degree in Economics and Mathematics (double major) from UCLA and my Master's and Doctorate degrees in Economics from the University of Chicago. My primary field at the University of Chicago was Industrial Organization.

Following my graduate education, I worked as an Economist at the U.S. Federal Trade Commission. My role at the FTC was as an internal consultant on empirical issues in cases that were primarily staffed by other economists. In addition, I wrote FTC comments on regulations proposed by other U.S. agencies that dealt with competition issues. Finally, while at the FTC, I authored an FTC report that empirically measured the degree of competition in the U.S. long distance telecommunications industry.

After four years at the FTC, I came to the University of Illinois as an Assistant Professor of Consumer Economics. I teach undergraduate and graduate level courses that focus on the implications and measurement of market imperfections. I have authored a number of empirical studies on competition and market imperfections, related primarily to telecommunications markets. The topics range from long distance companies' ability to bypass local telephone networks, consumers' ability to switch long distance carriers, local telephone companies' ability to favor their affiliated cellular company, long distance companies' ability to price discriminate against low volume customers, consumer substitution between wireless and wireline service, and consumers' willingness to switch between traditional retailers, direct mail and online shopping.

II. Overview

I was asked by the Canadian Competition Bureau to investigate the consequences of the proposed merger between Superior and ICG. Specifically, I was asked to empirically estimate the structure of consumer and producer behavior in the propane market. Together with assumptions regarding the potential effects of entry, supply-side substitution and production efficiencies, these estimates could then be used to simulate the likely effects of the merger.

Merger simulation differs substantially from 'traditional' antitrust analysis. Traditional analysis usually begins by defining the relevant market. Substitute products can be 'in' or 'out' of the market depending on their substitutability with the merging firms' products. Inferences about the competitive effects of the merger are largely drawn from the concentration level, and other factors, of the defined market without further reference to products 'outside' of the market. For example, in the ICG/Superior merger a key question is whether alternative fuels are close enough substitutes for propane so that they can be considered in the market. If not, the market is very concentrated, implying a large anti-competitive effect. If so, the market is not very concentrated, implying a small anti-competitive effect.

In contrast, rather than forcing products to be 'in' or 'out' of the subsequent analysis, merger simulation attempts to quantify the magnitudes of all possible substitutes. While some products are likely to be closer substitutes than others, e.g., propane from regional dealers versus electricity, an attempt is made to empirically measure the substitutability of all products in the market. Once these estimates are measured, economic theory is used to infer the current price-cost margin and the price-cost margin that would result from the proposed merger. For pre-merger pricing, higher prices for one product may result in a reduction in sales for that product.

Post-merger pricing differs in that a loss of profits need not result for the merged firm if the sales foregone by one partner go to the merger partner. The merged firm will take account of this effect in its pricing decision, while the pre-merger firms probably do not. This leads the merging parties to raise prices more, if the parties products are closer substitute for each other.

While the economic theory underlying merger simulation is well understood, simulations are not often conducted because estimation of the relevant parameters may not be precise enough to draw inferences about competition with confidence. Merger simulation requires estimation of the merging firms' own- and cross-price demand elasticities, which are the percent change in each other's demand due to a one percent change in either firm's price. It also requires estimation of the degree of pricing coordination between the merging firms prior to the merger. Below, I describe the estimates of the relevant parameters used in a merger simulation for ICG and Superior.

Under a variety of assumptions, I find a moderate degree of substitutability between ICG and Superior propane. Own-price elasticities tend to be in the -1.9 to -3.9 range under various assumptions and for different propane product categories. I also find some evidence of imperfect price coordination prior to the merger. These estimates are used to estimate the price increase due to the merger. My estimates depend on assumptions about the elasticity of propane, the market demand elasticity. If the demand for propane is relatively inelastic (elasticity of -1.5), the merger is estimated to increase individual firm's prices between 6% and 21%, with average price increases between 8% and 15%, depending on the product category. However, if the demand for propane is moderately elastic (elasticity of -2.5), the merger is estimated to increase individual firm's prices between 0.5% and 6%, with average prices rising by 1% to 4%. These estimates do not include possible price reductions from merger efficiencies, entry or supply-side substitution.

III. Merger Simulation

The economic theory underlying merger simulation is well established. It is well known that firms lose profits when customers switch to a substitute product. Therefore, so long as the relevant products are not perfect substitutes, a firm sets prices high enough so that the profits lost from customer switching are just offset by an increased profit margin on the remaining customers. Profit margins tend to be smaller in markets where customers can readily switch between firms than in markets where product substitution is difficult. Hence, estimates of consumer substitutability between products are indicative of how competitive and efficient a market is likely to be.

When a firm acquires another firm that produces a substitute product, some of the customers who switch due to a price increase are likely to become customers of the new affiliate. As a result, not all of the acquiring firm's profits are lost when some of these switching customers end up purchasing from the new affiliate. Since the loss of profit from customer switching is reduced, the competitive penalty from increasing prices is reduced and the acquiring firm tends to set higher prices. How much higher will depend on both the substitutability between the merging firms' products and the substitutability between their products and other potential competitors' products. If the merging firms' products are close substitutes, the profits lost from customer switching are smaller and the merged firm tends to increase prices more. However, if other close substitutes are available, the merging firms tend to be constrained in their ability to increase prices by these substitutes. Therefore, estimating this price increase requires estimates that account for product substitution from all possible sources.

Simulating a merger entails determining how firms currently price their products and projecting how they would price once they merge. Before a merger, a profit-maximizing firm sets prices so that its percent price-cost markup equals the negative inverse of a firm's demand elasticity for a product,

$$L_c^i \equiv \frac{p_c^i - mc_c^i}{p_c^i} = -\frac{1}{\eta_c^{ii}} \qquad (1)$$

where p is price, mc is marginal cost, η is the demand elasticity, and i and c indicate the firm and the particular product category. Equation (1) is called the Lerner relationship and the price-cost markup is called the Lerner index. When marginal costs are constant and prices are linear, these price-cost margins multiplied by the number of units sold represent gross profits from which fixed costs must be subtracted in order to determine the actual profitability of the firm.. For products that consumers can more easily find suitable alternatives, a firm's demand elasticity is larger (in absolute terms) and its profit-maximizing price is closer to its marginal cost.

After a merger, the Lerner relationship is slightly altered to account for the firm selling two related products. In this case, the firm will note that some of the customers lost due to a higher price for one product will switch to its other product and make the appropriate adjustment,

$$\overline{L}_c^i \equiv \frac{p_c^i - mc_c^i}{p_c^i} = -\left(\frac{1}{\eta_c^{ii}} + \frac{w_c^j}{w_c^i \eta_c^{ij}}\right) \qquad (2)$$

where w is the budget share. Note that η_c^{ij} represents the percent change in firm i's quantity demanded due to a one percent change in firm j's price, while η_c^{ii} represents the percent change in firm i's quantity demanded due to a one percent change in its own price. When the second product is a close substitute for the first, the cross elasticity, η_c^{ij}, becomes larger and the firm can price further from its marginal costs.

Thus, in a typical merger, a firm which had previously considered switching customers as representing lost profits, now no longer does so. At least some of the switched customers now represent profits from the sales of the merger partner's product. In essence, firms who had been pricing according to equation (1), now price according to equation (2). Measuring this change requires estimation of own and cross elasticities for the merging firms in order to compare $\bar{L}_c^i$ with L_c^i. The difference between the two represents the price change due to the merger in the absence of cost savings, entry, or supply-side substitution.

It is possible that the prospect of entry or supply-side substitution will constrain the merging parties ability to increase prices. Higher post-merger prices typically increase the profitability of firms entering a market in which they have not previously been present. Similarly, with higher prices, existing firms may find it profitable to reposition their products in order to garner a greater share of the market and make their products closer substitutes for the merged firm's products. These effects could be incorporated into the merger simulation. However, it is likely that these effects are not estimable due to the lack of previous experience.

IV. The Data

The Competition Bureau provided me with data on an electronic disk which will be provided. These data include sales information for the product groups and company branches of Superior and ICG on a monthly basis. The Superior data include price and dollar sales for 93 branches and 49 product groupings for the months between January 1993 and December 1998. Liters were inferred as sales divided by price. The ICG data include liters, dollar sales and gross profits for 136 branches and 16 product groupings for the months between January 1994 and June 1998. Many branches reported sales for only a few of the product groups. Likewise, many branches appear to be located in the same geographic market. Finally, data for some ICG or Superior branches that were not in operation throughout the time period were not included.

Some matching and aggregation was required for me to estimate substitution patterns between the companies' products. I used the geographic market definitions defined by Douglas West in his affidavit executed August 17, 1999. While 74 different geographic markets were defined, data for both ICG and Superior exist for only 46 of the 74 markets. Thus, there could potentially be observations for the 54 months that the two companies' data overlap and the 46 markets in which both firms operated for a total of 2,484 possible observations. For each observation and each product group, the data included Superior's price, quantity and sales, and ICG's price, quantity, sales and gross profits. Within this matched data set, I aggregated product groups into four comparable product categories according to Table 1. Liters, dollar sales and ICG's gross profits were aggregated for all the branches and product groups within a market and product category. For both Superior and ICG, prices at the market and product category level were inferred as dollar sales divided by liters. For ICG, a cost measure was inferred as the difference between dollar sales and gross profits divided by liters.

Both the raw and the aggregated data include some anomalies. For example, some months include negative values for prices, sales and liters. I suspect that these could represent customers selling unused propane back to their supplier. Company repurchases may be recorded as negative sales for accounting purposes. If this is so, it is possible that even some of the positive values are net of some customer returns. Another anomaly was that the data series included a number of outliers. For example, some of the calculated prices took on values greater than $1 per liter or less than $0.10 per liter, which is well beyond what would seem reasonable. Plotting and testing most of the raw data series revealed that they appeared to be normally distributed, but with more observations away from the mean (e.g., four standard deviations) than would be expected.

Table 1
Aggregating Product Groups

Product Categories used in Analysis	ICG Grouping	Superior Groupings
Residential	Residential	Residential (7 groups)
Industrial	Mining, Oil, Gas, Manufacturing, Forestry	Industrial (5 groups) Forklift (2 groups) Agents (8 groups)
Auto Propane	Auto Propane	Auto Propane (15 groups)
Other	Construction Commercial Agriculture Government	Construction Roof (4 groups) Commercial (5 groups) Agriculture (3 groups)

These data anomalies represent measurement error that could limit the precision of the parameter estimates. Parameter estimates can be rendered biased, usually toward zero, by measurement error. The amount of the bias tends to be proportional to the amount of measurement error. The measurement error represents 'noise' in the data that obfuscates the 'signal.' Consequently, with greater measurement error, some of the consumer behavioral nuances that the 'signal' represent become harder to distinguish. For example, estimation may be able to uncover the average elasticity, but may not be able to uncover if or how this elasticity differs when demand is high versus when demand is low.

Two estimation strategies are employed to address measurement error problems. First, the instrumental variable methods described below can purge some of the noise. However, to the extent that some 'noise' remains, the estimates I report below will be biased, likely toward zero. Second, observations in which the values for the price and quantity variables appeared to be outliers were dropped from the estimation. For these observations, the measurement error is likely to be so large that the 'signal' cannot be discerned from the 'noise.'

A new data set from customer billing information was compiled but not used due to lack of time. New data containing ICG's price and sales information was made available to me beginning on August 24. New data containing Superior's price and sales information was made available to me beginning on August 28. Reported prices in excess of $10.00 per liter suggested that these new data also suffered from measurement error problems. Given these problems, it was not possible to analyze these data before August 30.

V. Consumer Substitution

A. Imperfect Substitutes

The models developed to estimate the structure of demand in an industry are often referred to as differentiated goods models. This is in contrast to homogeneous goods models in which product are assumed to be identical and are, consequently, perfect substitutes. Since differentiated goods differ in some perceptible way, consumers consider them to be, at best, imperfect substitutes. Below, I present an analysis of propane, a seemingly homogeneous good, using techniques developed for differentiated goods.

The relevant feature of differentiated goods models for merger analysis is that substitution is less than perfect. While substitution could be imperfect because goods differ from each other (as with differentiated goods), there are other reasons why substitution can be less than perfect. First, homogeneous goods can be purchased as a bundle with explicit and implicit services that can differ across firms. Differences in scheduled deliveries, reliability of service, contract terms, availability of complementary appliances can differentiate services from different firms.

Second, a consumer may incur switching costs when she attempts to purchase from a firm that offers a lower price than her current supplier. These switching costs could involve penalties for backing out of an agreed upon contract, replacing equipment specific to the new supplier or simply the hassle costs associated with beginning service with a new supplier. One penalty from backing out of a contract could be reselling the remaining propane to the old supplier at a discount from the original price paid. If supplier-specific equipment is required in order to commence service and the customer must bear some of the costs of installing the new supplier's equipment, these costs are considered to be switching costs. Beyond these costs are the costs, in terms of time and effort, involved in finding, contracting, and setting up service from a new supplier. It may not be worth saving a penny per liter if it will cost the consumer an hour or more of her time to do so.

Third, some consumers may not be aware of a lower price offered by a different supplier. Consumers must be aware that price differences exist in order to take advantage of price differences between firms. Retail consumers rarely know enough about the availability and prices of alternative suppliers to make a least-cost purchase decision. Especially when pricing schedules are complex, consumers would have to exert non-trivial effort to discover which price is relevant to their situation. For many consumers, ignorance is preferred.

For these three reasons, consumer substitutability between propane suppliers is likely to be less than perfect. Therefore, it is appropriate to model demand using methods developed for differentiated goods industries.

B. Consumer Substitution Patterns

Different classes of customers are likely to react differently to similar price changes. First, the differences between sellers are likely to be more important to some customers than others. For example, alternative fuels may be more attractive substitutes for consumers of automobile propane than for crop drying. Differences in service reliability may be more important for industrial users than residential users. If this is so, these differences will cause the demand for propane to be more elastic for one group of consumers relative to another.

Second, switching costs are likely to differ across customers. It is likely that switching costs do not increase in proportion to customers' propane usage. As a result, smaller price differences among suppliers will induce higher-volume customers to switch suppliers more readily than lower-volume customers. In general, switching costs tend to be less important for higher-volume customers than for lower-volume customers. Hence, the existence of switching costs imply that demand will tend to be more elastic for consumer groups that tend to have higher-volume individual customers.

Third, some customers will tend to be better informed about changes in prices than other customers. Better informed customers will appear more price elastic than less informed customers. Customers will tend to gather more price information if they can easily act on the information (e.g., low switching costs), and if the gains to finding a price difference are large. The gains to a price difference are proportional to the quantity that the customer purchases. Therefore, higher volume customers will benefit more from searching for a lower price and will, consequently, tend to be better informed. Hence, the existence of price information imperfections imply that demand will tend to be more elastic for consumer groups that tend to have higher-volume individual customers.

Lastly, demand may be more sluggish for some consumers relative to others. A reason for this is that uninformed consumers may not remain uninformed forever. If they discover price changes slowly, say through word of mouth, they may change their current demand to reflect price changes that may have occurred months ago. Another reason is that switching costs may diminish over time. A consumer who has decided to take advantage of a cheaper alternative may switch only after she has depleted her current supply of propane. Both of these effects suggest that demand estimation should allow current demand to be affected by both current prices and prices that were in effect in the recent past and that different consumer groups may react more quickly than others.

The models I estimate below attempt to account for differences in consumer behavior by estimating different substitutability parameters for different consumer groups. For both companies the previously described data allow for similar aggregations of consumers into the following categories: residential, industrial, automobile and other.

C. Brand switching versus product demand

The economic modeling of demand for a brand includes the substitution effects from most, if not all, of the possible related products. Econometric estimation may involve many parameters: one for the price effect from each related product to each brand under investigation. The number of relevant parameters increases exponentially with the number of products under consideration. For example, a demand system with five brands requires the estimation of 25 parameters for the own- and cross-price elasticities of each product and possibly five parameters for the income elasticities. The data often do not permit the estimation of so many parameters with precision. Moreover, ignoring the effects of some possible substitutes are likely to bias the estimates for others.

The commonly used technique employed to reduce the number of parameters to be estimated is called two-staged budgeting. Two-staged budgeting can be likened to a two-staged consumer decision process. First, consumers decide whether to purchase propane and how much to purchase at different prices for propane, gasoline, electricity, heating oil, etc. Second, those choosing propane decide among propane suppliers, depending on the relative prices of propane suppliers. Two-staged budgeting assumes that these decisions are somewhat disjointed, but relate to each other in a particular way. Specifically, it assumes that the substitutability between propane suppliers is affected by alternative fuels only through the common effect that alternative fuels have on general propane demand.

For the researcher, two-staged budgeting allows for estimation of the two stages separately and then reconstruction of each propane supplier's demand elasticity. My estimates are confined to the lower stage. The merger simulations require estimates from both stages. I perform simulations assuming a variety of upper-stage demand elasticities.

D. Consumer Demand Identification

The relationship between price and quantity is a confluence of both supply and demand effects. To focus on the effects of prices on quantity demanded, one needs to "identify" changes that occur independent of non-price changes in demand. In particular, we would not want to associate changes in the quantity demanded due to, say a colder than normal winter, as being caused by a contemporaneous change in price. Since such changes in prices result from stronger than usual demand at all price levels, we infer that the relationship between price and quantity as representing producer behavior. In contrast, if we identify that price changes occurred because costs changed, we can associate any changes in quantity that occur as resulting from the price changes. Variables that allow us to identify purely demand or supply effects are called "instrumental variables."

Much of consumer demand estimation focuses on finding suitable instruments that identify changes in, say price, that were not caused by shifts in demand. Ideally, one would like measures that proxy for changes in marginal costs, such as a change in the price of a factor input.

The portion of price changes that is associated with these factor cost changes represents producer behavior and is not caused by shifts in demand. The relationship between quantity changes and this portion of the price changes that these cost changes identify represents consumer responses to price changes free of any shift in demand. In order to estimate both own-price and cross-price elasticities, instruments are needed that identify firm-specific price movements.

Variance components methods take advantage of the panel nature of data to identify demand systems. Panel data are data that track different markets (for example, locations or consumer groups) over time. These methods require that different markets share similar cost changes but not similar shifts in demand. For example, if shifts in demand are local in nature, but most of the variation in costs are at a company-wide level, then prices in two locations are related only through a shared cost element. This means that the price in one location can be used as an instrumental variable for prices in another location. For variance components methods, this assumption is actually incorporated into assumptions about the variance of the estimator.

In propane markets, shifts in demand, other than seasonal variations, are likely to be local in nature. However, most of the firm-specific variations in costs could also be local in nature. While branches serving customers in different locations may be supplied with propane from the same source, these represent common, and not firm-specific, costs. Most of the firm-specific costs of retailing the propane could be incurred within the market distributing the propane. This means that prices in two different geographic markets will only be spuriously related and will not identify cost-based price changes. Consequently, using prices in other markets as instruments are not likely to yield meaningful results.

Fortunately, these data allow for a more conservative instrumental variables approach.

Different product categories within a geographic location are likely to share similar shifts in costs, but may not share shifts in demand. When the costs of retailing propane to one consumer group increase, a firm is likely to reallocate capacity to more equalize the retailing costs across categories. Therefore, costs across product categories within a branch are likely to include a common retailing cost element. Accordingly, I use prices for other product categories as instrumental variables to identify consumer demand.

E. Empirical Modeling

The substitutability of consumer goods can be measured by estimating a system of equations that represents consumer demand. While many different functional forms for this system exist, probably the most widely accepted is the Almost Ideal Demand System (AIDS). The AIDS model comports with economic theory better than most models and still remains tractable to implement. Moreover, own and cross price-elasticities that are used in merger simulations can be recovered from the estimation. The Linear Approximate AIDS (LA/AIDS) is even more tractable and is the most common implementation of AIDS. Below, I report results for LA/AIDS estimation.

<u>The Constant Elasticity of Substitution Model</u>

Before proceeding to the LA/AIDS estimation, I first estimated demand substitutability assuming the Constant Elasticity of Substitution (CES) functional form. This model requires less stringent assumptions about the nature of substitution and the data, and does not require the data to adhere to consumer demand theory. It is possible that the restrictions imposed by consumer demand theory will be violated when the data are measured with error. The CES specification assumes that the percent change in the ratio of the output quantities due to a change in their price ratio is a constant for all price changes. Since the substitutability between the products is revealed in a single parameter estimated from the data, this functional form directly reveals substitutability information in a very simple application. Moreover, this specification does not require the researcher to make strong assumptions about substitution with other goods, such as alternative fuels. For each functional form, this specification permitted the product substitutability to differ across product categories and market shares to vary across markets independently of price effects (i.e., fixed market effects were included).

The data were fitted to the following equation

$$\ln\left(l_{cmt}^{Sup} / l_{cmt}^{ICG} \right) = \sum_c \left(\sum_{m=1}^{M} \lambda_{mc} d_m + \sigma_c \ln\left(p_{cmt}^{Sup} / p_{cmt}^{ICG} \right) \right) + \varepsilon_{mt}$$

where l represents liters, p price, d dummy variables for markets, and the subscripts c, m, and t represent product category, market, and time. The σ_c's are elasticities of substitution that can differ across product categories and the λ_{mc}'s are shift parameters for each market and product category.

Table 2
Constant Elasticity of Substitution Model Estimates
Dependent Variable is the Log of the Superior-ICG Quantity Ratio

	Residential	Industrial	Automobile
Log of Superior-ICG Price Ratio	-1.306[+] (0.690)	-3.315* (0.737)	-1.202 (0.831)
Dummies for Markets	sign.	sign.	sign.
Observations	888	1,935	1,941
R Squared	0.689	0.760	0.750

Asterisks and plus signs indicate statistical significance at the 1% and 10% level. Individual market dummy variables were included and were jointly statistically significantly different from zero at the 1% level.

Results for each of the Residential, Industrial and Automobile groups indicate that consumers do substitute between Superior and ICG when the price ratio changes (see Table 2). The results for the Other product category either implied that firms' demand curves sloped upward or were statistically insignificant. This could be because the included product groups differ between Superior and ICG. These results also suggest that residential consumers of propane may not substitute between the two companies' services as readily as consumers using propane for industrial or automotive uses. In general, I infer from these results that propane from ICG and Superior are imperfect substitutes. Unfortunately, it is difficult to proceed from these estimates directly to merger simulation. Therefore, I next estimated the LA/AIDS model.

Table 3
Constant Elasticity of Substitution Model Estimates for Different Lag Price Constructions
Dependent Variable is the Log of the Superior-ICG Quantity Ratio

	Residential		Industrial		Automobile	
Log of MA3 of Superior-ICG Price Ratio	-1.862* (0.612)		-4.044* (0.863)		-1.816 (1.289)	
Log of MA6 of Superior-ICG Price Ratio		-1.383* (0.663)		-3.447* (0.690)		-2.701* (1.036)
Dummies for Markets	sign.	sign.	sign.	sign.	sign.	sign.
Observations	822	783	1,842	1,809	1,768	1,677
R Squared	0.690	0.692	0.747	0.762	0.760	0.748

Asterisks and plus signs indicate statistical significance at the 1% and 10% level. Individual market dummy variables were included and were jointly statistically significantly different from zero at the 1% level.

Table 3 reports results when a demand is assumed to respond sluggishly. Not all consumers are likely to adjust their propane purchases the same month that the price changes. Some of the switching observed at a point in time could be the result of changes in prices that occurred over the past few months. To account for this, I construct two moving averages of current and past prices. MA3 is constructed as a weighted average of the current price and the previous two month's prices with the weights being 3, 2, and 1. MA6 is constructed as a weighted average of the current price and the previous six month's prices with the weights being 6, 5, 4, etc. The resulting estimates of the elasticity of substitution represent a longer run and should indicate a greater degree of substitution. Indeed, the estimates reported in Table 3 are larger than those in Table 2. However, except for automobile usage, it appears that prices from more than three months back do not affect current demand.

The LA/AIDS Model

The data were fitted to the following equation representing the LA/AIDS functional form

$$w_{cmt}^{Sup} = \sum_{c} \left(\sum_{m} \alpha_{cm}^{Sup} d_{m} + \gamma_{c}^{Sup} \ln p_{cmt}^{Sup} + \gamma_{c}^{ICG} \ln p_{cmt}^{ICG} + \beta_{c}^{Sup} \ln L_{mt} \right) + \varepsilon_{cmt}^{Sup}$$

where w represents the firm's share of sales and L represents the consumption of liters of propane for both firms and for all product categories. To account for a possible slow response, the moving averages of prices were calculated as a weighted average of the current price and prices over the previous two months with the weights being 3, 2, and 1. As with the CES specification, dummy variables for each market are included to account for differences across markets. The parameters of interest are the γ_cs and β_cs measuring the effect that changes in price and total propane expenditures have on firms' market shares.

As with the CES estimates, the Other product category estimates either implied upward-sloping demand curves or were statistically insignificant and, therefore, are not reported. Likewise, results for each of the residential, industrial and automobile groups indicate that consumers do substitute between Superior and ICG (see Table 4). All parameters have the expected signs, but the estimates of the relevant automobile parameters are not statistically significantly different from zero at the ten percent level. These results suggest that consumers of propane for industrial use are more demand elastic than residential or automotive consumers.

Table 4
AIDS Consumer Demand Model Estimates
Dependent Variable is Superior's Market Share

	Residential	Industrial	Automobile
Log Superior Price	-0.374*	-0.766*	-0.423
	(0.077)	(0.159)	(0.316)
Log ICG Price	0.252*	0.633*	0.497
	(0.081)	(0.176)	(0.398)
Log Budget Amount	0.065*	-0.032*	0.006
	(0.009)	(0.008)	(0.012)
Dummies for Markets	sign.	sign.	sign.
Observations	1,087	2,069	2,002
R Squared	0.752	0.787	0.719

Asterisks and plus signs indicate statistical significance at the 1% and 10% levels. Individual market dummy variables were included and were jointly statistically significantly different from zero at the 1% level.

VI. Strategic Producer Behavior

A. Strategic Pricing

Besides estimates of consumer behavior, merger simulation requires information regarding producer behavior. Specifically, it requires assumptions regarding how firms respond to each others' strategic decisions. While decisions regarding marketing effort, product positioning and market entry could be relevant, probably the most important decision has to do with pricing the product. Statistical examination of non-price decisions is not typically undertaken due to a lack of suitable data. But if firms respond to each other for one type of strategic decision, they are likely to respond similarly to others.

Assumptions regarding how firms respond to each others' pricing decisions directly relate to measuring the effects of a merger. The estimates of consumer demand behavior from the LA/AIDS model refer to the situation where one firm's price changes while the other firm's price remains constant; these elasticities are called Marshallian demand elasticities. If in fact, a price change by one firm triggers a similar price change by a competing firm, the actual amount of consumer substitution is reduced. The actual demand elasticity that the firm faces is the residual sum between the Marshallian demand and the cross-elastic effect from its competitor's optimal price response to the firm's price change,

$$\eta_{ii}^{R} = \eta_{ii} + \theta_{ji}^{R}\eta_{ij}$$

where θ^{R}_{ji} is firm j's percentage price reaction to firm i's price change $\theta^{R}_{ji} = (\partial P_j/\partial P_i)\times(P_i/P_j)$. At one extreme, firms could match each others' price changes one-for-one, i.e. $\theta^{R}_{ji} = 1$, in which case consumers gain nothing from substituting between firms. At the other extreme, firms may make their pricing decisions solely based on changes in their own costs, and not react to each other at all, i.e. $\theta^R_{ji} = 0$. The relevant question becomes, how much of a competitor's price change does a firm reflect in its own price changes?

Answering this question usually requires information about cost changes that are unique to one firm. Prices set by firms in an industry tend to rise and fall together for a variety of benign, and often confounding, reasons. An important cause of simultaneous price changes in the propane industry is likely due to fluctuations in the costs of the raw inputs that are common to both firms. This cause of price correlation does not reflect the strategic reactions to pricing decisions that apply to merger simulations because both firms may be independently reacting to a change in costs that each one faces. In contrast, the reactions of either firm to a change in costs that is unique to one firm could indicate the amount of strategic pricing behavior.

B. Evidence from price relationships to costs

The data include information that provides insights into some of these pricing decisions. Information regarding ICG's monthly gross profits for each market product category was included in these data. Revenues net of gross profits represent a consistent measure of costs incurred by ICG. These costs divided by the number of liters sold represent average costs per liter. ICG's price should be increasing in these costs. If changes in these costs are unique to ICG, then the only reason for Superior to also raise prices would be to react to the new ICG price. Thus, the relative magnitudes of ICG's and Superior's price changes due to these cost changes provide an indication of how Superior strategically prices in reference to ICG. This analysis can only provide an incomplete picture because data on Superior's costs are not available.

The data were fitted to the following relationships:

$$\ln P_{cmt}^{ICG} = \sum_c \left(\sum_m \delta_{cm} d_m + \phi_c^{ICG} \ln r_{mt} + \theta_c^{ICG} \ln c_{cmt}^{ICG} \right) + \varepsilon_{cmt}$$

and

$$\ln P_{cmt}^{Sup} = \sum_c \left(\sum_m \delta_{cm} d_m + \phi_c^{Sup} \ln r_{mt} + \theta_c^{Sup} \ln c_{cmt}^{ICG} \right) + \varepsilon_{cmt}$$

where the *r*'s are the price of wholesale propane at either Sarnia (markets in eastern Canada) or Edmonton (markets in western Canada). The θ_c's represent the effect that changes in ICG's costs, other than movements in wholesale propane, have on ICG's and Superior's prices. Table 4 reports that increases in wholesale costs tend to increase retail propane prices for both Superior and ICG. Not surprisingly, the relevant coefficients are of similar magnitude for both firms, suggesting that wholesale propane represents a common cost to both firms. Table 4 also reports that changes in ICG's costs tend to increase retail propane prices for both Superior and ICG. However, the magnitudes of the coefficients for ICG are larger than the comparable coefficients for Superior.

If these costs, net of wholesale propane costs, are unique to ICG and are not shared by Superior, then Superior is responding to ICG's price change and not to a cost change. In this case, the ratio of θ^{Sup} to θ^{ICG} indicates the magnitude of Superior's price response to an ICG price change. If, instead, this cost measure includes some costs that are common to both firms, as well as some costs unique to ICG, then some of the estimated coefficients represent simultaneous responses to common costs changes as well as possible strategic producer behavior. In this case, estimates of θ^{Sup} to θ^{ICG} are measured with more error and one should not place as much confidence on the interpretation on the ratio. These ratios are 0.65, 0.66 and 0.66 for the residential, industrial and automotive categories. These are interpreted as implying that a one percent increase in ICG's price will be matched with about a two-thirds of a percentage point price increase by Superior depending on the category.

Table 4
Cost Model Estimates
Dependent Variables are Log of ICG's and Superior's Prices

	ICG Price			Superior Price		
	Residential	Industrial	Auto	Residential	Industrial	Auto
Log ICG 'Cost'	0.114* (0.010)	0.062* (0.007)	0.044* (0.006)	0.074* (0.013)	0.041* (0.007)	0.029* (0.005)
Log Rack Price	0.102* (0.014)	0.223* (0.011)	0.190* (0.010)	0.231* (0.019)	0.243* (0.011)	0.259* (0.009)
Dummies for Markets	sign.	sign.	sign.	sign.	sign.	sign.
Observations	1,224	2,136	2,083	1,148	2,145	2,107
R Squared	0.895	0.646	0.845	0.782	0.772	0.846

Asterisks indicate statistical significance at the 1% level. Individual market dummy variables were included and were jointly statistically significantly different from zero at the 1% level.

Because ICG may not fully respond to changes in its costs within one month and Superior also may not react to changes in ICG's prices within the same month, a version of these equations that include lagged costs was also estimated. While the details are not reported, the implied pricing parameters are 0.55, 0.75, and 0.61 for the residential, industrial and automotive categories, similar to those above.

While I have measured Superior's strategic response to ICG's price, I have not measured the degree to which ICG strategically responds to Superior's price changes. Most economic models of strategic behavior posit that firms' strategic decisions are somewhat symmetric. A notable exception is a leader-follower, or dominant firm-competitive fringe relationship. In these relationships, one firm, usually the more dominant firm, sets prices according to its demand and cost conditions, oblivious to the other firms. The follower firms then set their prices taking into account the leader's price as well as their demand and cost conditions. While it is possible that Superior acts as a leader and ICG as a follower, there is no evidence to support this assertion. In the merger simulations below, I assume that both firm's incorporate the same amount of each others' price changes into their own pricing decisions.

VII. Superior-ICG Merger Simulation

Well known formulae exist for calculating own-price and cross-price elasticities from AIDS coefficients and upper-stage demand elasticity estimates. My LA/AIDS estimates represent demand substitution between ICG and Superior. Upper-stage elasticities represent the demand for propane. However, for some markets, regional and discount propane dealers exist. These firms are not represented in either demand parameters even though they are likely to exert some competitive pressure on ICG and Superior.

In order to include the regional and discount suppliers in the analysis, some assumptions must be made regarding how substitutable they are with ICG and Superior. Since these do not represent nationally branded products, they are not likely to be any more substitutable with ICG and Superior products than ICG and Superior are with each other. I include them in the analysis by assuming a three-stage budgeting process in which consumers first decide how much to spend on propane; then they next decide between nationally branded propane and regional or discount propane if either exists in their market; and finally they decide between ICG and Superior as their supplier. I assume that at the second stage decision, the substitutability between ICG and Superior and regional or discount suppliers is exactly half of what it would be in the third stage. Specifically, I halve the values of the estimated parameters from the lower level LA/AIDS model and use them as the parameter values for an LA/AIDS model at the second stage. A greater degree of substitutability between ICG and Superior versus regional and discount suppliers, would imply larger demand elasticities for ICG and Superior.

At the top level, I have to make assumptions regarding the demand elasticity for propane for different uses. Table 6 presents calculations of own-price demand elasticities for ICG and

Superior for residential, industrial and automotive uses assuming that upper-level elasticities are -1.5, -2.0 and -2.5. The calculated own-price elasticities are all between -1.9 and -3.9, indicating that if a firm were to raise price by one percent, the number of liters sold would fall by between 1.9% and 3.9%. The table indicates that the existence of regional and discount firms has little effect on the estimated demand elasticities. The left half of Table 6 assumes that regional and discount suppliers represent 25% of the retail propane market. In geographic markets in which they represent a larger market share, the associated ICG and Superior demand elasticities would be larger.

Table 6
Own Price Elasticity Estimates
Under Various Modeling Assumptions

	With Regional & Discount Dealers			Without Regional & Discount Dealers		
	Propane Demand Elasticity					
	-1.5	-2.0	-2.5	-1.5	-2.0	-2.5
ICG						
Residential	-2.40	-2.47	-2.54	-2.40	-2.49	-2.58
Industrial	-3.07	-3.21	-3.34	-2.94	-3.12	-3.30
Automotive	-3.71	-3.78	-3.86	-3.68	-3.77	-3.87
Superior						
Residential	-1.97	-2.28	-2.58	-1.93	-2.34	-2.75
Industrial	-2.72	-2.96	-3.20	-2.50	-2.81	-3.13
Automotive	-2.08	-2.38	-2.68	-1.93	-2.34	-2.74

Table 7 reports the change in price due to the merger assuming there were no changes in marginal costs. This table incorporates both the consumer demand elasticities from table 6 and the producer reaction estimates from section VI. Individual firm price increases are estimated to be between 0.5% and 20.7%, depending on the product category and the assumed propane demand elasticity. Average price increases were calculated using ICG's and Superior's two-firm market shares as weights. Average price increases are estimated to be between 1.4% and 15.1%.

Table 7
Estimates of Percent Price Increases Under Various Modeling Assumptions

	With Regional & Discount Dealers			Without Regional & Discount Dealers		
	Propane Demand Elasticity					
	-1.5	-2.0	-2.5	-1.5	-2.0	-2.5
ICG						
Residential	11.8%	5.4%	1.4%	13.1%	4.6%	0.5%
Industrial	10.2%	6.1%	3.0%	17.1%	8.4%	4.3%
Automotive	16.3%	10.3%	5.3%	20.7%	11.0%	6.2%
Superior						
Residential	7.1%	3.8%	2.1%	7.8%	3.4%	1.6%
Industrial	8.2%	5.0%	3.1%	14.0%	6.7%	3.5%
Automotive	5.7%	3.1%	1.7%	7.8%	3.4%	1.5%
Average						
Residential	8.0%	4.1%	2.1%	8.8%	3.6%	1.4%
Industrial	8.9%	5.4%	3.3%	15.1%	7.3%	3.8%
Automotive	7.7%	4.5%	2.7%	10.3%	4.8%	2.2%

The larger estimates of the price increase may overestimate the true values. This is because the parameter values on which they are based may not hold for such large price increases. Specifically, the price increase depends on the shape of the demand curve away from the range of prices that have been observed. For example, the estimated 20.7% price increase in automotive markets without other propane retailers assumes that the propane elasticity is -1.5 even after the price increase. With such a large price increase, consumers may begin considering other goods to be closer substitutes than is implied by a -1.5 propane demand elasticity.

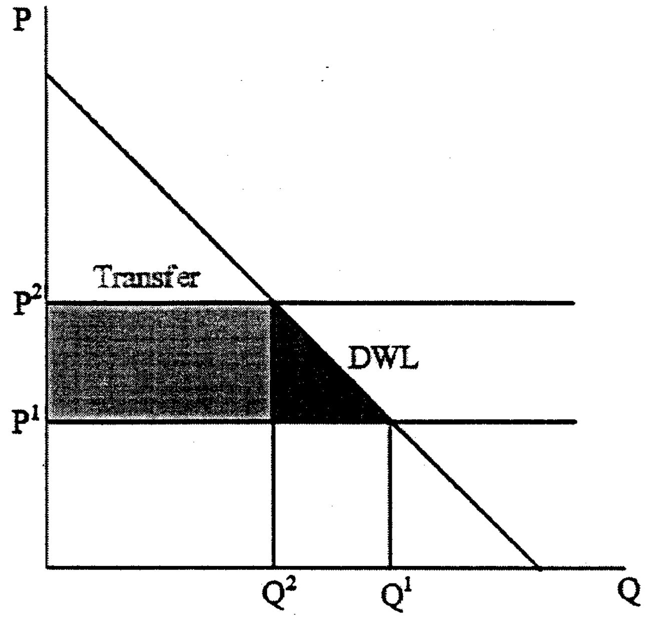
It is apparent from table 7 that the estimated price increase due to the merger depends heavily on the assumed propane demand elasticity. Average estimates of the price increase due to the merger are greater than 7%, and up to 15%, when the propane demand elasticity is assumed to be -1.5. Propane demand being even less elastic would imply even larger price increases. However, when the propane elasticity is -2.5, all the estimates of the average price increase due to the merger are less than 4%. Propane demand more elastic than -2.5 would imply still smaller price increases.

VIII. Consumer Surplus Effects of a Price Increase

Price increases lead to fewer consumer purchases and a loss of consumer surplus. This can be understood by referencing the simple demand curve in Figure 1 below. The demand curve represents consumers' willingness-to-pay for the next unit of the product. At low levels of consumption consumers typically value additional units more highly than at higher levels of consumption. This results in a downward sloping demand curve. Consumers purchase units of the product until their willingness-to-pay falls below the price that they would have to pay. Therefore, when the price rises, say from P^1 to P^2, consumers scale back their purchases until their willingness-to-pay is equal to the new price.

When this happens consumers are necessarily worse off. The difference between consumers' willingness-to-pay and the price they actually pay, represents how much better off consumers are from buying the product and is called consumer surplus. When the price increases, consumers who place a high willingness-to-pay on the product will continue to purchase the product but will have to forgo more money to do so. The increased price on each of these purchases represents a transfer of consumer surplus to producers surplus (shaded light in Figure 1). Other consumers place a willingness-to-pay for the product above the initial price, P^1, but below the ending price, P^2. These consumers will discontinue purchasing the product. Since they had previously valued the product by more than the price they were required to pay, they suffer a loss in consumer surplus. In this case, since these transactions no longer occur, the lost consumer surplus is not transferred to producers but is lost to society and is called the deadweight loss (shaded dark in Figure 1).

Figure 1
Deadweight Loss and Transfer of Consumer Surplus due to Price Increasing from P^1 to P^2



The size of the transfer and the deadweight loss due to a price increase will depend on three factors: the size of the price increase, the steepness of the demand curve and the shape of the demand curve. Table 8 reports the transfer and deadweight loss as a fraction of the initial sales for various percentage price increases, for three hypothetical demand elasticities and for a linear demand curve. The demand elasticity is assumed to hold only at the initial price and quantity. For the values in the table, the transfer is larger in magnitude than the deadweight loss. For a given price increase, a flatter demand curve (larger elasticity) implies a smaller transfer but a larger deadweight loss. Both the deadweight loss and the transfer are larger when the price increase is larger. While the deadweight loss increases exponentially with the size of the price increase, the transfer increases slightly less than linearly.

Table 8
Deadweight Losses and Consumer Surplus Transfers as Percentages of Initial Sales under Various Assumptions

	Elasticity = -1.5		Elasticity = -2.0		Elasticity = -2.5	
Price Increase	Deadweight Loss	Transfer	Deadweight Loss	Transfer	Deadweight Loss	Transfer
20%	3.0%	14.0%	4.0%	12.0%	5.0%	10.0%
19%	2.7%	13.6%	3.6%	11.8%	4.5%	10.0%
18%	2.4%	13.1%	3.2%	11.5%	4.1%	9.9%
17%	2.2%	12.7%	2.9%	11.2%	3.6%	9.8%
16%	1.9%	12.2%	2.6%	10.9%	3.2%	9.6%
15%	1.7%	11.6%	2.3%	10.5%	2.8%	9.4%
14%	1.5%	11.1%	2.0%	10.1%	2.5%	9.1%
13%	1.3%	10.5%	1.7%	9.6%	2.1%	8.8%
12%	1.1%	9.8%	1.4%	9.1%	1.8%	8.4%
11%	0.9%	9.2%	1.2%	8.6%	1.5%	8.0%
10%	0.8%	8.5%	1.0%	8.0%	1.3%	7.5%
9%	0.6%	7.8%	0.8%	7.4%	1.0%	7.0%
8%	0.5%	7.0%	0.6%	6.7%	0.8%	6.4%
7%	0.4%	6.3%	0.5%	6.0%	0.6%	5.8%
6%	0.3%	5.5%	0.4%	5.3%	0.5%	5.1%
5%	0.1%	4.6%	0.3%	4.5%	0.3%	4.4%
4%	0.1%	3.8%	0.2%	3.7%	0.2%	3.6%
3%	0.0%	2.9%	0.1%	2.8%	0.1%	2.8%
2%	0.0%	1.9%	0.0%	1.9%	0.1%	1.9%
1%	0.0%	1.0%	0.0%	1.0%	0.0%	1.0%
0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table assumes linear demand with the given point elasticity at the current price and output levels.

Table 9 calculates the dollar amounts of the transfer and the deadweight losses due to increased prices assuming that the current total sales for ICG and Superior in overlapping markets is $750 million. The relevant total sales amount for this table the sum of all customer propane expenditures, liters times retail price. For example, if the propane demand elasticity was

-2.0 and all prices rose by 8% due to the merger, consumers would lose $50.4 million (6.7% of $750 million) in transfers to producers and $4.8 million (0.6% of $750 million) in deadweight losses every year. Deadweight losses and transfers change slightly with different elasticities, but change considerably for different price increases.

Table 9
Deadweight Losses and Consumer Surplus Transfers in Millions of Dollars under Various Assumptions

	Elasticity = -1.5		Elasticity = -2.0		Elasticity = -2.5	
Price Increase	Deadweight Loss	Transfer	Deadweight Loss	Transfer	Deadweight Loss	Transfer
20%	$22.5	$105.0	$30.0	$90.0	$37.5	$75.0
19%	$20.3	$101.9	$27.1	$88.4	$33.8	$74.8
18%	$18.2	$98.6	$24.3	$86.4	$30.4	$74.3
17%	$16.3	$95.0	$21.7	$84.2	$27.1	$73.3
16%	$14.4	$91.2	$19.2	$81.6	$24.0	$72.0
15%	$12.7	$87.2	$16.9	$78.8	$21.1	$70.3
14%	$11.0	$83.0	$14.7	$75.6	$18.4	$68.3
13%	$9.5	$78.5	$12.7	$72.2	$15.8	$65.8
12%	$8.1	$73.8	$10.8	$68.4	$13.5	$63.0
11%	$6.8	$68.9	$9.1	$64.4	$11.3	$59.8
10%	$5.6	$63.8	$7.5	$60.0	$9.4	$56.3
9%	$4.6	$58.4	$6.1	$55.4	$7.6	$52.3
8%	$3.6	$52.8	$4.8	$50.4	$6.0	$48.0
7%	$2.8	$47.0	$3.7	$45.2	$4.6	$43.3
6%	$2.0	$41.0	$2.7	$39.6	$3.4	$38.3
5%	$1.4	$34.7	$1.9	$33.8	$2.3	$32.8
4%	$0.9	$28.2	$1.2	$27.6	$1.5	$27.0
3%	$0.5	$21.5	$0.7	$21.2	$0.8	$20.8
2%	$0.2	$14.6	$0.3	$14.4	$0.4	$14.3
1%	$0.1	$7.4	$0.1	$7.3	$0.1	$7.3
0%	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

Table assumes linear demand with the given point elasticity at the current price and output levels and that the total current sales from overlapping markets is $750 million per year.

VIII. Conclusions

In this affidavit, I have attempted to do six things. First, I have outlined the general methodology used to simulate a horizontal merger and noted what parameters it requires. Second, I discussed the consumer demand characteristics relevant to estimating brand-switching behavior for the propane market. Third, I presented estimates of the substitutability between propane supplied by ICG and Superior for different customer groups. Fourth, I presented estimates of the degree of pricing coordination between ICG and Superior. Fifth, I applied these estimates to the merger simulation methodology in order to estimate the likely price increase due to the merger in the absence of efficiencies, entry or supply-side substitution. Finally, I outlined a method for calculating the loss to consumers for various price increases.

This analysis yields a number of conclusions that are relevant to the proposed merger between Superior and ICG. First, merger simulation methodologies can be applied to this merger. Second, demand behavior is likely to differ across customer classes. Third, these conclusions allow me to infer that customers do substitute between Superior and ICG when relative prices change. Fourth, Superior appears to match part of ICG price increases. Fifth, ignoring possible price reductions from merger efficiencies, entry or supply-side substitution, the incorporation of these estimates into a merger simulation implies prices will increase due to the merger. The size of the price increase depends primarily on the demand for propane. Specifically, if propane demand is relatively inelastic, the merger is likely to raise average prices by 8% or more. However, if propane demand is relatively elastic, the merger is likely to raise average prices by less than 4%. Finally, a 8% price increase is likely to yield a deadweight loss of $4.8 million and consumer surplus loss of over $55.2 million per year. The net present values of these amounts over a ten year horizon discounted at 6% per year are $35.3 million in deadweight losses and a consumer surplus loss of $406.3 million.