An Analysis of Retail Fluid Milk Pricing in the Eastern United States

Yuliya V. Bolotova
Department of Agricultural Sciences
College of Agriculture, Forestry and Life Sciences
Clemson University
Clemson, SC 29634
yuliyab@clemson.edu

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Abstract

In 2008 and 2009 dairy farmers in the U.S. Southeast and Northeast regions filed class action antitrust lawsuits, in which they alleged that Dean Foods, the largest fluid milk processor in the country, and Dairy Farmers of America, the largest dairy cooperative in the country, engaged in anticompetitive conduct, which restricted competition in the fluid milk market in these regions. This research analyzes the performance of fluid milk channel during the period affected by the alleged anticompetitive conduct and the period of antitrust actions in eight cities located in the affected regions. The empirical analysis reveals differences in the behavior of retail fluid whole milk prices, farm milk prices (Class I milk prices) and farm-to-retail margins during the two analyzed periods. There is empirical evidence indicating that increases in farm milk prices (Class I milk prices) are much higher in magnitude than increases in retail fluid whole milk prices, and farm-to-retail margins are lower in the antitrust action period. Furthermore, the vertical price transmission process (cost pass-through) and retail fluid milk pricing practices are different in the two analyzed periods in seven out of eight cities.

Key words: antitrust, fluid milk, cartels, cost pass-through, regulated pricing.

1. Introduction

The behavior of fluid milk prices at the retail level and the relationship between retail prices and farm prices have been a focus of academic research and policy discussions (GAO Reports 1998a,b, 2001; 2004). During the last few decades, the U.S. dairy industry experienced significant structural changes. Increasing consolidation and concentration were observed at all stages of the dairy industry, including farm level, milk processing, distribution and retailing (Blayney and Manchester 2000; Shields 2010; Gould 2010). These structural changes affected the conduct of firms and the performance of the industry. Some of the industry performance issues analyzed in academic research are related to the patterns of response of retail fluid milk prices to changes in farm milk prices. The reported empirical results often present evidence of increasing farm-to-retail margin and decreasing farm share of the retail price.

The process of increasing consolidation and concentration that affected fluid milk channel in the U.S. included a series of mergers and acquisitions involving dairy cooperatives and fluid milk processors. Dairy Farmers of America (DFA), the largest dairy cooperative in the country, was formed in 1998 as a result of the merger of four large regional dairy cooperatives. Dairy cooperatives have historically been involved in handling and marketing (including processing) milk of their members and representing dairy farmers in negotiations with milk processors (Manchester and Blayney 1997; Shields 2009; Ling 2012). In 2001, Suiza Foods Corporation, then the largest milk processor, acquired Dean Foods Company to form a new company named Dean Foods Company, which has become the largest fluid milk processor in the country.

In 2008 and 2009 dairy farmers (plaintiffs) in the U.S. Southeast and Northeast regions filed class action antitrust lawsuits, in which they alleged that Dean Foods and Dairy Farmers of America (among other defendants) engaged in anticompetitive conduct, which restricted competition in the fluid milk market in these regions and violated Section 1 and Section 2 of the Sherman Antitrust Act (1890) (Shields 2010; Greene and Rhee 2011; Abrams, Commins and Foix 2014). In particular, this conduct affected the purchase, sale, marketing and processing of Grade A milk in Federal Milk Marketing Orders 5 and 7 (“Southeast”) and 1 (“Northeast”), and decreased milk prices paid to dairy farmers. The Grade A milk used in fluid milk processing (Class I milk or “beverage” milk), which is sold to or purchased by fluid milk processing (bottling) plants, is the product affected by the alleged anticompetitive conduct.

The lawsuits alleged a conspiracy among the defendants to monopolize and monopsonize fluid milk market in the affected geographic areas. The alleged anticompetitive business practices included refusals to compete (agreements not to compete); using exclusive full supply contracts; allocating markets; suppressing and stabilizing milk prices paid to dairy farmers. After several years of litigations, the lawsuits have been settled. Dean Foods and Dairy Farmers of America agreed to pay substantial monetary penalties and to change some elements of their business practices. Both Dean Foods and Dairy Farmers of America did not admit any wrongdoing.

The objective of this research is to evaluate the performance of fluid milk channel during the period affected by the alleged anticompetitive conduct and the period of antitrust actions. In particular, the empirical analysis presented in the paper evaluates the behavior of retail fluid whole milk prices and the relationship between retail fluid whole milk prices and farm milk prices (i.e. vertical price transmission mechanism) in selected cities located in the Southeast and Northeast regions during the two periods of interest. The Southeast region is represented by Atlanta, GA; Miami, FL; Louisville, KY; and New Orleans, LA. The Northeast region is represented by Syracuse, NY; Philadelphia, PA; Hartford, CT; and Boston, MA.

The paper is organized as follows. Section 2 discusses data and presents the results of a descriptive statistical analysis providing a preliminary empirical evidence on the behavior of retail fluid whole milk prices, farm milk prices (Class I milk prices) and associated margins in the two analyzed periods. Section 3 discussed a theoretical framework of vertical price transmission, which is used to develop an econometric model presented in Section 4. Section 5 discusses the results of econometric analysis, and it is followed by the conclusion.

2. Data and Descriptive Statistical Analysis

Data

Retail fluid whole milk prices are obtained from monthly surveys conducted by the USDA Agricultural Marketing Service (include whole milk and reduced fat milk). The surveys report prices charged by the first largest food store chain, the second largest food store chain, and the largest convenience store chain in selected U.S. cities. The average price over the three outlets is reported as well. The average retail fluid whole milk price measured in $ per gallon is used in the analysis presented in the paper. These survey-based retail fluid whole milk prices are also available in the USDA Milk Marketing Order Statistics Public Database.

Farm milk price used in the analysis is Class I milk price, which is also available in the USDA Milk Marketing Order Statistics Public Database. The Database contains Class I milk price and the announced cooperative Class I milk price for particular geographic locations (cities). Class I milk prices are announced on a monthly basis before the beginning of the month in which these prices apply.

Class I milk price is the minimum price that milk processors have to pay for Grade A milk used in manufacturing fluid (beverage) milk products within the system of Federal and State Milk Marketing Orders. Dairy cooperatives are allowed to negotiate over-order premiums (are also referred to as over-order payments) that are added to the government-announced Class I milk prices. The over-order premiums typically reflect milk quality characteristics and cooperatives' charges for performing milk assembling services. The announced cooperative Class I milk price, which is the sum of the government-announced Class I milk price and the cooperative-announced over-order premium, is used in the analysis presented in the paper. Class I milk prices are announced in $ per hundredweight (cwt). To be comparable to retail prices, Class I milk prices are converted from $ per cwt into $ per gallon. This Class I milk price is to be referred to as "farm price" throughout the paper[1].

Descriptive Statistical Analysis

This section includes a descriptive statistical analysis of the behavior of retail fluid whole milk prices, farm milk prices and farm-to-retail margins (margins to be referred to in the paper) for 8 cities. The margin is calculated using two approaches. First, the margin is calculated as the difference between retail price and farm price, which is measured in $ per gallon. Second, the margin is expressed as a percentage of retail price. The analyzed retail prices, farm prices and margins are depicted in Figures 1-8.

In the case of each analyzed city, the averages and the coefficients of variation are calculated for retail price ($ per gallon), farm price ($ per gallon) and margin ($ per gallon and % of retail price) for two periods of interest. The first period is referred to as the pre-antitrust action period, and the second period is referred to as the antitrust action period.

[1] The announced cooperative Class I milk price is not available for Syracuse, therefore the government-announced Class I milk price is used as farm price for this city.

In the case of the Southeast region, the pre-antitrust action period is January 2001 to July 2008, and the antitrust action period is August 2008 to December 2012. January 2001 (the beginning of the pre-antitrust action period) is the date when the alleged anticompetitive conduct was believed to begin affecting fluid milk market in the Southeast region[2]. August 2008 (the beginning of the antitrust action period) is the month when the complaint was filed in the U.S. District Court for the Eastern District of Tennessee[3]. December 2012 is chosen as the end date of the antitrust action period due to the data availability issue.

In the case of the Northeast region, the pre-antitrust action period is January 2002 to September 2009, and the antitrust action period is October 2009 to December 2012. January 2002 (the beginning of the pre-antitrust action period) is the date when the alleged anticompetitive conduct was believed to begin affecting fluid milk market in the Northeast region[4]. October 2009 (the beginning of the antitrust action period) is the month when the complaint was filed in the U.S. District Court for the District of Vermont[5]. December 2012 is chosen as the end date of the antitrust action period due to the data availability issue.

The results of descriptive statistical analysis for the Southeast and Northeast regions are summarized in Tables 1 and 2, respectively. The results reveal a number of empirical patterns that are common to the majority of the analyzed cities in both Southeast and Northeast regions.

Southeast Region

In the pre-antitrust action period, the average farm milk price ranges from $1.56 per gallon (Louisville) to $1.85 per gallon (Miami), and the average retail fluid whole milk price ranges from $2.88 per gallon (Louisville) to $3.78 per gallon (New Orleans). During the same period, the average margin measured in $ per gallon is in the range of $1.31 per gallon (Louisville) to $2.11 per gallon (New Orleans), and the average margin measured as a % of retail price is in the range of 46% (Louisville and Miami) to 56% (New Orleans).

[2] *Sweetwater Valley Farm, Inc., et al v. Dean Foods Company et al* (corrected consolidated amended complaint; August 04, 2008) and Dean Foods Company settlement notice (U.S. District Court for the Eastern District of Tennessee; February 14, 2012).

[3] The lawsuit parties reached settlement agreements in 2011 and 2013.

[4] *Allen et al v. Dairy Farmers of America, Inc. et al* (revised consolidated amended class action complaint and jury demand; April 13, 2011) and DFA/DMS settlement notice (U.S. District Court for the District of Vermont).

[5] The lawsuit parties reached settlement agreements in 2011 and 2015.

Both the average farm price and average retail price have increased in the antitrust action period, as compared to the pre-antitrust action period, in all analyzed cities. The rate of the farm price increase is much higher than the rate of the retail price increase in Atlanta, Miami and Louisville. For example, while the average farm prices increase by approximately 20% in Atlanta and Miami, the average retail prices increase by 2.3% and 7.6%, respectively. Similarly, in Louisville, the average farm price increases by 17.6%, and the average retail price increases only by 6.6%. The pattern of price changes in New Orleans is somewhat different, both the average farm price and average retail price increase at approximately similar rates, 16.8% and 14.5%, respectively.

In the antitrust action period, the average margin measured in $ per gallon decreased in Atlanta, Miami and Louisville (15%, 8% and 6.6%, respectively) and increased in New Orleans (12.7%), and the average margin measured as a % of retail price decreased in all cities. The largest magnitude margin decreases are observed in Atlanta, Miami and Louisville (18.1%, 14.7% and 13.6%, respectively). The lowest magnitude margin decrease is in New Orleans (1.8%).

As for the patterns of price volatility (measured using the coefficient of variation), in the majority of the analyzed cases (cities and periods), the farm price volatility is much higher than the retail price volatility. The exception is the price behavior in Atlanta in the antitrust action period; the coefficient of variation is the same for both the retail price and farm price. In the case of Miami, Louisville and New Orleans, the volatility of farm price and the volatility of retail price have decreased, and the volatility of margin (measured as a % of retail price) has increased in the antitrust action period, as compared to the pre-antitrust action period. In Atlanta, the volatility of farm price has decreased, the volatility of retail price has increased, and the volatility of margin (measured as a % of retail price) has increased.

Northeast Region

In the pre-antitrust action period, the average farm milk price ranges from $1.41 per gallon (Syracuse) to $1.65 per gallon (Philadelphia), and the average retail fluid whole milk price ranges from $2.89 per gallon (Syracuse) to $3.38 per gallon (Hartford). During the same period, the average margin measured in $ per gallon is in the range of $1.47 per gallon (Syracuse) to $1.78 per gallon (Hartford), and the average margin measured as a % of retail price is in the range of 50.3% (Philadelphia) to 52.8% (Hartford).

Both the average farm price and average retail price have increased in the antitrust action period, as compared to the pre-antitrust action period, in all analyzed cities. The rate of the farm price increase is much higher than the rate of the retail price increase in Boston, Hartford and Syracuse. For example, while the average farm prices increase by approximately 17% in Boston and Hartford, the average retail prices increase by 10.5% and 8.4%, respectively. Similarly, in Syracuse, the average farm price increases by 18.6%, and the average retail price increases by almost 7%. The pattern of price changes is somewhat different in Philadelphia, where both the average farm price and the average retail price increase by approximately 20%[6].

In the antitrust action period, the average margin measured in $ per gallon increases in Boston, and Philadelphia (4.5% and almost 20%, respectively). This margin practically does not change in Hartford (an increase of 1%), and it decreases in Syracuse (4.2%). The average margin measured as a % of retail price decreased in all cities. The largest magnitude margin decreases are observed in Syracuse, Hartford and Boston (11%, 7.2% and 5.7%, respectively). The lowest magnitude margin decrease is in Philadelphia (approximately 1%).

As for the patterns of price volatility (measured using the coefficient of variation), in all analyzed cases (cities and periods), the farm price volatility is higher than the retail price volatility. In the case of all cities, the volatility of farm price and the volatility of retail price have decreased in the antitrust action period, as compared to the pre-antitrust action period. The volatility of margin (measured as a % of retail price) has increased in the antitrust action period in Boston and Syracuse, and the volatility of this margin has decreased in Philadelphia and Hartford.

Southeast and Northeast Compared

The patterns of changes (in particular, the percentage increases) in the average farm prices are similar in all analyzed cities. This is mostly explained by the fact that milk prices at the farm level are set within the system of Federal and State Milk Marketing Orders. Consequently, farm prices (Class I milk price in this analysis) tend to move in a similar manner across different geographic locations.

[6] The explanation for a somewhat distinct pattern of milk price behavior in Pennsylvania is a presence of the state milk price control regulation, which affects both wholesale and retail prices of fluid milk products. New York State also has a milk price control regulation (New York State Milk Price Gouging Law), which affects retail fluid milk pricing. The presence of state-level milk price control regulations in Pennsylvania and New York State affects the pattern of behavior of retail fluid milk prices and margins in these two states (Novakovic and Washburn 2008; Bolotova and Novakovic 2012).

As indicated by empirical evidence, the rates of the retail price increase tend to be somewhat similar in the analyzed cities, although the patterns of retail price changes vary more than the patterns of farm price changes. A noticeable difference between the two regions is in the magnitude of the observed decreases in the average margins (measured as a % of retail price) during the antitrust action period. The margin decreases are noticeably higher in magnitude in the Southeast region, as compared to the Northeast region. The average margins in the antitrust action period are 41.7%, 39%, 39.7% and 54.9% in Atlanta, Miami, Louisville and New Orleans, respectively. In the same period, the average margins are 45.8%, 49.7%, 49% and 48.3% in Syracuse, Philadelphia, Hartford and Boston, respectively.

3. Theoretical Framework

An economic model of vertical price transmission is used as a theoretical framework to develop an econometric model presented in the next section. This theoretical framework was used in previous research focusing on farm-to-retail price transmission and retail pricing practices in the U.S. fluid milk industry (Lass et al 2001; Lass 2005; Carman and Sexton 2005; Cotterill 2005; Capps and Sherwell 2007; Bolotova and Novakovic 2012).

A vertical price transmission mechanism characterizes the process of changes in output prices, which follow changes in input prices. Equation (1) is a simple vertical price transmission model applied to the fluid milk channel. In this model, retail fluid milk price (RP) is output price, and farm milk price (FP) is input price. RP is specified as a linear function of FP. The flow of the causation effect from farm price to retail price is ensured in the U.S. dairy industry. Class I milk prices (farm price in this analysis) are publicly announced on a monthly basis, approximately 10 days before the month in which these prices apply.

(1) $RP = a + b \times FP$

a is a nonnegative constant, and *b* is a farm price transmission coefficient (is also referred to as cost pass-through). The magnitude of *a* and *b* provides evidence on the nature of the farm-to-retail price transmission process and pricing method used by retailers (in the setting of this research)[7]. The magnitude of $b=1$ (a complete cost pass-through) and $a>0$ are consistent with a perfectly competitive pricing, and would reflect a fixed *absolute* markup pricing method used by retailers. Two special cases, $b<1$ (an incomplete cost pass-through) and $b>1$ (more than a complete cost

[7] In the setting of this research, retail fluid milk price and farm-to-retail margin reflect the performance of both the fluid milk processing stage and retail stage of the fluid milk channel.

pass-through), may indicate a presence of imperfectly competitive pricing (seller market power of retailers).

The magnitude of *b=0.5* and *a>0* are consistent with a profit-maximizing behavior of a monopolist operating in a market with linear demand and constant marginal cost. A profit-maximizing oligopoly, in a similar market environment, would yield the magnitude of *b* in the range from 0.5 (monopoly) to 1 (perfect competition). The output price stabilization method would be consistent with output pricing predicted by the underlying economic models of profit-maximizing behavior[8].

The magnitude of *b>1* and *a=0* are consistent with a profit-maximizing behavior of a monopoly and oligopoly operating in a market environment with non-linear demand and constant marginal cost. The oligopoly cost pass-through would be greater than one, but smaller than the monopoly cost pass-through (assuming the same industry and demand and supply conditions). The fixed *percentage* markup pricing (margin stabilization pricing method) would be consistent with output pricing explained by the underlying economic models of profit-maximizing behavior. The magnitude of *b>1* and *a>0* reflect a combination of two pricing methods: a fixed percentage markup pricing and a fixed absolute markup pricing.

4. Econometric Model

Equation (2) represents a general version of a distributed lag model to be used to develop an econometric model. The current month retail price (RP_t) is specified as a function of the current month farm price (FP_t) and a number of lagged (previous months) farm prices (FP_{t-1}; $FP_{t-2;}$ etc.); ε_t is the error term.

(2) $RP_t = \alpha + \beta_0 \times FP_t + \beta_1 \times FP_{t-1} + \beta_2 \times FP_{t-2} + \beta_3 \times FP_{t-3} + \ldots + \varepsilon_t$

In light of the theoretical framework, the estimated coefficients (α and β's) can be used to characterize the nature of farm-to-retail milk price transmission process and the type of fluid milk pricing methods used by retailers. α is the fixed absolute markup, and β's are vertical price transmission coefficients (cost pass-through). For example, β_0 reflects the effect of a change in the current month farm price on the current month retail price (can be thought of as a current month cost pass-through). The sum of all estimated β's reflects the cumulative effect of changes in the

[8] The economic models of profit-maximization by firms with the seller market power are discussed in standard microeconomics text-books, for example see Besanko and Braeutigam (2002). Discussions of the nature of pricing practices are presented in George and King (1971), Carman and Sexton (2005) and Bolotova and Novakovic (2012).

current and previous month farm prices on the current month retail price (can be thought of as a cumulative cost pass-through).

The number of lagged farm prices included in the econometric models for individual cities varies. A series of regression diagnostics was performed to make a decision on the lag structure for farm price in the case of each individual econometric model (city)[9].

Equation (3) represents an econometric model estimated in this research for the majority of the analyzed cities (one lagged farm price). A binary variable (A_t), representing the antitrust action period, as well as the interaction effects of this binary variable with the current month farm price (AFP_t) and the previous month farm price (AFP_{t-1}), are introduced in equation (2) to capture a possible change in the relationship between the retail fluid whole milk price and farm milk price in the antitrust action period, as compared to the pre-antitrust action period.

(3) $RP_t = \alpha_0 + \beta_0 \times FP_t + \beta_1 \times FP_{t-1} + \alpha_1 \times A_t + \gamma_0 \times AFP_t + \gamma_1 \times AFP_{t-1} + \varepsilon_t$.

A_t is equal to 1, if a retail price observation belongs to the antitrust action period; and it is equal to 0, if a retail price observation belongs to the pre-antitrust action period. In this particular specification of the econometric model, the estimated coefficients are interpreted as follows. α_0 is a fixed absolute markup for the pre-antitrust action period, $(\alpha_0 + \alpha_1)$ is a fixed absolute markup for the antitrust action period, and α_1 is the difference in the fixed absolute markup between the two periods. β_0 is the current month cost pass-through for the pre-antitrust action period, $(\beta_0 + \gamma_0)$ is the current month cost pass-through for the antitrust action period, and γ_0 is the difference in the current month cost pass-through between the two analyzed periods. $(\beta_0 + \beta_1)$ is the cumulative cost pass-through for the pre-antitrust action period, $(\beta_0 + \beta_1 + \gamma_0 + \gamma_1)$ is the cumulative cost pass-through for the antitrust action period, and $(\gamma_0 + \gamma_1)$ is the difference in the cumulative cost pass-through between the two analyzed periods. The magnitude of the estimated parameters is to be interpreted in light of the discussion presented in the previous section.

[9] In the case of each city, a number of econometric models with alternative lag structures for the farm price were estimated. Akaike Information Criterion and Schwarz Criterion for these models were compared to select the appropriate model for each city.

5. Estimation Results

The OLS estimation procedure was used to estimate econometric models. The OLS estimation results are reported in Table 3 (Southeast region) and Table 4 (Northeast region). As indicated by R2, the estimated econometric models have a high degree of the explanatory power. The majority of the estimated coefficients are statistically significant, and they have a meaningful economic magnitude.

Southeast Region

The estimated econometric models have a high degree of the explanatory power. The variation in the explanatory variables explains a substantial portion of the variation in the retail fluid whole milk price. The explanatory power of the estimated econometric models ranges from 62% (Louisville) to 88% (Miami). The pattern of the estimated coefficients (including constants) in the pre-antitrust action period indicates that the nature of retail fluid whole milk pricing reflects a combination of a fixed absolute markup pricing and a fixed percentage markup pricing. The constant, which represents a fixed absolute markup, is $1.02 per gallon in Miami, $1.30 per gallon in Louisville, $1.31 per gallon in Atlanta and $1.84 per gallon in New Orleans.

The cost pass-through (CPT) is equal or greater than 1 in the case of all analyzed cities[10]. The CPT is 1.01 in Louisville, and it is not statistically different from 1[11]. This CPT magnitude indicates a complete cost pass-through, which may reflect a perfectly competitive pricing. For example, a $0.10 per gallon increase (decrease) in farm price causes retail price to increase (decrease) by $0.10 per gallon. The CPTs are 1.24 in Atlanta, 1.29 in Miami and 1.17 in New Orleans. These CPTs are statistically greater than 1[12]. CPT is more than complete in these three cities, and this particular CPT magnitude reflects a fixed percentage markup pricing (oligopoly or monopoly, non-linear demand). For example, an increase (a decrease) in farm price by $0.10 per gallon would cause retail price to increase (to decrease) by $0.124 per gallon in Atlanta, by $0.129 per gallon in Miami and by $0.117 per gallon in New Orleans.

[10] The cumulative CPT is discussed. Additional T-tests are performed using cumulative CPT.

[11] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT>1 (monopoly/oligopoly, non-linear demand). The T-statistic rejection region is [1.28; +∞) at the 10% significance level. The reported T-ratio for Louisville is 0.14.

[12] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT>1 (monopoly/oligopoly, non-linear demand). The T-statistic rejection region is [1.28; +∞) at the 10% significance level. The reported T-ratios are 4.11 for Atlanta, 5.71 for Miami and 1.64 for New Orleans.

There was a change in the CPT magnitude and retail fluid milk pricing method in the antitrust action period in Louisville, Miami and New Orleans. The fixed absolute markup has increased between the pre-antitrust action period and antitrust action period, and this increase is statistically significant in these three cities. The fixed absolute markups are $1.72 per gallon in Miami, $2.16 per gallon in Louisville and $2.65 per gallon in New Orleans. The CPT has decreased between the two analyzed periods in these three cities (the CPT decreases are statistically significant). As a result, CPT changed from being a complete/more than a complete to being incomplete. The CPTs are 0.50 in Louisville, 0.87 in Miami and 0.87 in New Orleans in the antitrust action period.

The outcomes of additional T-tests indicate that CPT in Louisville is not statistically different from 0.5 (monopoly pricing, linear demand)[13]; CPTs in Miami and New Orleans are statistically greater than 0.5 (monopoly pricing, linear demand), and they are statistically smaller than 1 (perfectly competitive pricing)[14]. This empirical evidence on CPT magnitude may reflect oligopoly pricing (linear demand). For example, CPT in Miami and New Orleans indicates that a $0.10 per gallon increase (decrease) in farm price leads to a $0.087 per gallon increase (decrease) in retail price. Incomplete CPT may reflect a presence of some form of output (fluid whole milk) price stabilization method used by retailers.

The retail fluid milk pricing method has changed in a different manner in Atlanta, as compared to the three other cities. The fixed absolute markup decreased in the antitrust action period, but CPT remained more than a complete (1.31)[15], reflecting the presence of a fixed percentage markup pricing. While an increase in the CPT magnitude is observed between the two analyzed periods in Atlanta, this increase is not statistically significant.

[13] Ho: CPT=0.5 (monopoly, linear demand), Ha: $\beta>0.5$ (oligopoly, linear demand). The T-statistic rejection region is [1.28; $+\infty$) at the 10% significance level. T-ratio for Louisville is -0.03.

[14] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT<1 (oligopoly, linear demand); the T-statistic rejection region is ($-\infty$; -1.28] at the 10% significance level. T-ratios are -1.33 for Miami and -1.28 for New Orleans. Ho: CPT=0.5 (monopoly, linear demand), Ha: CPT>0.5 (oligopoly, linear demand); the T-statistic rejection region is [1.28; $+\infty$) at the 10% significance level. T-ratios are 3.68 for Miami and 3.41 for New Orleans.

[15] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT>1 (monopoly/oligopoly, non-linear demand). The T-statistic rejection region is [1.28; $+\infty$) at the 10% significance level. The reported T-ratio for Atlanta is 2.06.

In summary, the nature of cost pass-through, which characterizes the farm-to-retail price transmission mechanism, is different between the two analyzed periods in Louisville, Miami and New Orleans. There is empirical evidence indicating the change from a complete (Louisville) and more than a complete (Miami and New Orleans) CPT in the pre-antitrust action period to an incomplete CPT in the antitrust action period in these three cities. In the case of Atlanta, the CPT nature (more than complete) has not changed between the two analyzed periods. The changes in CPT were accompanied by the changes in the fixed absolute markups. In Louisville, Miami and New Orleans, the cities where CPT has decreased in the antitrust action period, the fixed absolute markup has increased. In Atlanta, while the CPT has increased, the fixed absolute markup has decreased.

Northeast Region

The estimated econometric models have a high degree of the explanatory power. The variation in the explanatory variables explains a substantial portion of the variation in the retail fluid whole milk price. The explanatory power of the estimated econometric models ranges from 75% (Hartford) to 92% (Philadelphia). The pattern of the estimated coefficients (including constants) in the pre-antitrust action period indicates that the nature of retail fluid whole milk pricing methods reflects a combination of a fixed absolute markup pricing and a fixed percentage markup pricing. The constant, which represents a fixed absolute markup is $1.23 per gallon in Syracuse, $1.34 per gallon in Philadelphia, $1.71 per gallon in Hartford and $1.77 per gallon in Boston.

The CPT is approximately equal to or greater than 1 in the case of all analyzed cities[16]. The CPTs are not statistically different from 1 in Hartford and Boston[17]. This empirical evidence alone reflects a complete CPT, which is consistent with a perfectly competitive pricing. The CPTs are equal to 1.17 in Syracuse and 1.19 in Philadelphia, and they are statistically greater than 1[18]. This empirical evidence reflects more than a complete CPT, which is consistent with a fixed percentage markup pricing (oligopoly or monopoly, non-linear demand).

[16] The cumulative CPT is discussed (in the case of Syracuse and Philadelphia it is the current month CPT). Additional T-tests are performed using cumulative CPT (current month CPT for Syracuse and Philadelphia).

[17] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT>1 (monopoly/oligopoly, non-linear demand). The T-statistic rejection region is [1.28; +∞) at the 10% significance level. The reported T-ratios are 0.54 for Hartford and -0.96 for Boston.

[18] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT>1 (monopoly/oligopoly, non-linear demand). The T-statistic rejection region is [1.28; +∞) at the 10% significance level. The reported T-ratios are 2.38 for Syracuse and 3.58 for Philadelphia.

There was a change in the CPT magnitude and the retail fluid milk pricing method in the antitrust action period in all analyzed cities. In particular, the fixed absolute markup has increased and the CPT has decreased (all these changes are statistically significant). In the antitrust action period, the fixed absolute markups are $1.77 per gallon in Syracuse, $1.90 per gallon in Philadelphia, $2.48 per gallon in Hartford and $3.18 per gallon in Boston. The CPT changed from being complete in Hartford and Boston and more than complete in Syracuse in the pre-antitrust action period to being incomplete in the antitrust action period in these three cities. The CPTs are 0.78 in Syracuse, 0.64 in Hartford and 0.24 in Boston. The CPT in Philadelphia is 1.03.

The outcomes of additional T-tests indicate that during the antitrust action period CPT in Syracuse and Hartford is statistically greater than 0.5 (monopoly pricing, linear demand), and it is statistically smaller than 1 (perfectly competitive pricing)[19]. This empirical evidence on CPT magnitude may reflect oligopoly pricing (linear demand). The CPT in Philadelphia is not statistically different from one, the magnitude consistent with a perfectly competitive pricing.

In summary, the nature of cost pass through is different between the two analyzed periods in all cities. The CPT changed from being complete in the pre-antitrust action period to being incomplete in the antitrust action period in Hartford and Boston. The CPT changed from being more than complete to being complete in Philadelphia. The CPT changed from being more than complete to being incomplete in Syracuse. The fixed absolute markup has increased in all cities. The overall pattern revealed by the econometric analysis of the Northeastern cities may suggest that the cities with higher fixed absolute markup in the antitrust action period have lower CPT magnitude.

[19] Ho: CPT=1 (perfectly competitive pricing), Ha: CPT<1 (oligopoly, linear demand); the T-statistic rejection region is $(-\infty; -1.28]$ at the 10% significance level. The reported T-ratios are -2.10 for Syracuse and -3.25 for Hartford. Ho: CPT=0.5 (monopoly, linear demand), Ha: CPT>0.5 (oligopoly, linear demand); the T-statistic rejection region is $[1.28; +\infty)$ at the 10% significance level. The reported T-ratios are 2.71 for Syracuse and 1.33 for Hartford.

6. Conclusion

The empirical analysis presented in the paper indicates that there are differences in the behavior of retail fluid whole milk prices, farm milk prices (Class I milk prices) and associated margins during two periods: the pre-antitrust action period and antitrust action period. Furthermore, there is empirical evidence indicating that vertical price transmission process (cost pass-through) and retail fluid milk pricing practices are different in the two analyzed periods in seven out of eight cities.

In the case of all analyzed cities, but Atlanta, the fixed absolute markup is higher and the cost pass-through is lower in the antitrust action period, as compared to the pre-antitrust action period. The CPT decreased, and it changed from being complete (Louisville, Hartford and Boston) or more than complete (Miami, New Orleans, Syracuse and Philadelphia) in the pre-antitrust action period to being incomplete in the antitrust action period (all mentioned cities but Philadelphia where CPT became complete). Atlanta is the only city among the analyzed cities, where CPT remained more than complete in the antitrust action period, and the fixed absolute markup decreased. The cities, which have higher fixed absolute markups in the antitrust action period, have lower CPT.

If the results of econometric analysis are compared to the results of descriptive statistical analysis, the following patterns are revealed. Atlanta, where a rather small change is observed in the retail fluid milk pricing practice, is characterized by the lowest increase in retail price (2.3%) and the highest decrease in margin (18.1%) in the antitrust action period, as compared to the pre-antitrust action period. The cities where retailers have adjusted their fluid milk pricing practices (all other analyzed cities) are characterized by higher increases in retail fluid whole milk prices and lower decreases in farm-to-retail margins.

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Table 1 U.S. Southeast: Retail Fluid Whole Milk Prices, Class I Milk Prices and Margins.

City/Variable	Units	Pre-antitrust action period 01/2001-07/2008 Average (CV)	Antitrust action period 08/2008-12/2012 Average (CV)	The change in the average (CV) between two periods (%)
Atlanta, GA				
Class I milk price	$/gallon	1.65 (0.19)	1.98 (0.14)	20.1 (-23.1)
Retail price	$/gallon	3.35 (0.12)	3.42 (0.14)	2.31 (20.2)
Margin	$/gallon	1.70 (0.10)	1.44 (0.24)	-15.0 (153.7)
Margin	% of retail price	50.92 (0.08)	41.70 (0.16)	-18.1 (92.4)
Miami, FL				
Class I milk price	$/gallon	1.85 (0.17)	2.23 (0.13)	20.6 (-19.0)
Retail price	$/gallon	3.39 (0.12)	3.65 (0.09)	7.6 (-28.4)
Margin	$/gallon	1.54 (0.10)	1.42 (0.15)	-8.0 (48.1)
Margin	% of retail price	45.68 (0.08)	38.97 (0.14)	-14.7 (76.6)
Louisville, KY				
Class I milk price	$/gallon	1.56 (0.20)	1.84 (0.16)	17.6 (-21.5)
Retail price	$/gallon	2.88 (0.12)	3.06 (0.11)	6.6 (-12.1)
Margin	$/gallon	1.31 (0.14)	1.23 (0.29)	-6.6 (108.2)
Margin	% of retail price	45.96 (0.13)	39.72 (0.23)	-13.6 (75.6)
New Orleans, LA				
Class I milk price	$/gallon	1.67 (0.19)	1.95 (0.13)	16.8 (-28.6)
Retail price	$/gallon	3.78 (0.11)	4.33 (0.08)	14.5 (-31.7)
Margin	$/gallon	2.11 (0.13)	2.38 (0.12)	12.7 (-2.3)
Margin	% of retail price	55.92 (0.09)	54.90 (0.09)	-1.8 (3.6)

Table 2 U.S. Northeast: Retail Fluid Whole Milk Prices, Class I Milk Prices and Margins.

City/Variable	Units	Pre-antitrust action period 01/2002-09/2009 Average (CV)	Antitrust action period 10/2009-12/2012 Average (CV)	The change in the average (CV) between two periods (%)
Syracuse, NY				
Class I milk price	$/gallon	1.41 (0.21)	1.68 (0.13)	18.6 (-38.2)
Retail price	$/gallon	2.89 (0.13)	3.09 (0.08)	6.9 (-41.5)
Margin	$/gallon	1.47 (0.09)	1.41 (0.12)	-4.2 (25.4)
Margin	% of retail price	51.44 (0.09)	45.80 (0.11)	-11.0 (19.1)
Philadelphia, PA				
Class I milk price	$/gallon	1.65 (0.19)	1.99 (0.11)	20.5 (-42.3)
Retail price	$/gallon	3.30 (0.12)	3.95 (0.06)	19.7 (-46.7)
Margin	$/gallon	1.65 (0.09)	1.96 (0.06)	18.9 (-35.4)
Margin	% of retail price	50.29 (0.08)	49.72 (0.06)	-1.1 (-27.0)
Hartford, CT				
Class I milk price	$/gallon	1.60 (0.19)	1.87 (0.12)	16.7 (-36.5)
Retail price	$/gallon	3.38 (0.11)	3.67 (0.06)	8.4 (-46.9)
Margin	$/gallon	1.78 (0.11)	1.79 (0.10)	1.0 (-13.5)
Margin	% of retail price	52.81 (0.10)	49.04 (0.09)	-7.2 (-4.4)
Boston, MA				
Class I milk price	$/gallon	1.61 (0.19)	1.88 (0.12)	16.6 (-36.4)
Retail price	$/gallon	3.29 (0.10)	3.63 (0.03)	10.5 (-70.3)
Margin	$/gallon	1.68 (0.11)	1.75 (0.11)	4.5 (4.0)
Margin	% of retail price	51.23 (0.11)	48.29 (0.12)	-5.7 (6.9)

Table 3 U.S. Southeast Region: OLS Estimation Results.
Dependent variable is retail fluid whole milk price ($/gallon).

Coefficient/ Independent variable	Atlanta, GA	Louisville, KY	Miami, FL	New Orleans, LA
	Estimated Coefficient (T-Ratio)			
α_0	1.31* (13.57)	1.30* (8.96)	1.02* (11.04)	1.84* (9.34)
$\beta_0 \times FP_t$	0.65* (5.05)	0.60* (5.05)	0.68* (5.00)	0.27[b] (1.39)
$\beta_1 \times FP_{t-1}$	0.59* (4.93)	0.41* (2.71)	0.61* (4.16)	0.40* (2.16)
$\beta_2 \times FP_{t-2}$				0.50* (3.64)
$\alpha_1 \times A_t$	-0.48[a] (-1.45)	0.86* (2.99)	0.70* (2.85)	0.81* (2.84)
$\gamma_0 \times AFP_t$	-0.67* (-2.02)	-1.37* (-4.22)	-1.01* (-4.47)	-0.51[a] (-1.56)
$\gamma_1 \times AFP_{t-1}$	0.74* (2.09)	0.86* (2.16)	0.59* (2.29)	-0.23 (-0.61)
$\gamma_2 \times AFP_{t-2}$				0.44* (1.66)
R2	0.75	0.62	0.88	0.74
DW-Statistic[#]	0.41	0.64	0.61	0.25
Pre-antitrust action period				
CPT[##]	1.24	1.01	1.29	1.17
CPT[##] change	0.07 (0.45)	-0.51* (-3.09)	-0.42* (-3.80)	-0.30* (-2.09)
Antitrust action period				
CPT[##]	1.31	0.50	0.87	0.87
Fixed absolute markup	0.83* (2.55)	2.16* (8.60)	1.72* (7.48)	2.65* (12.68)

[#]All T-ratios are calculated using the autocorrelation-robust standard errors based on the Newey-West approach.
[##]Cumulative CPT.
*Ho: $\beta=0$ and Ha: $\beta\neq0$: the estimated coefficient is statistically significant at the 10% significance level (two-tailed T-test). T-statistic rejection regions are $(-\infty; -1.64]$ and $[1.64; +\infty)$.
[a] Ho: $\beta=0$ and Ha: $\beta<0$: the estimated coefficient is statistically significant at the 10% significance level (one-tailed T-test). T-statistic rejection region is $(-\infty; -1.28]$.
[b] Ho: $\beta=0$ and Ha: $\beta>0$: the estimated coefficient is statistically significant at the 10% significance level (one-tailed T-test). T-statistic rejection region is $[1.28; +\infty)$

Table 4 U.S. Northeast Region: OLS Estimation Results.
Dependent variable is retail fluid whole milk price ($/gallon).

Coefficient/ Independent variable	Syracuse, NY	Philadelphia, PA	Hartford, CT	Boston, MA
	Estimated Coefficient (T-Ratio)			
α_0	1.23* (11.93)	1.34* (14.46)	1.71* (12.29)	1.77* (16.80)
$\beta_0 \times FP_t$	1.17* (16.32)	1.19* (22.87)	0.36* (1.82)	0.39* (2.23)
$\beta_1 \times FP_{t-1}$			0.68* (3.41)	0.55* (3.16)
$\alpha_1 \times A_t$	0.54* (2.61)	0.56* (2.70)	0.77* (2.93)	1.41* (5.80)
$\gamma_0 \times AFP_t$	-0.39* (-3.08)	-0.16[a] (-1.51)	-0.50[a] (-1.35)	-0.44[a] (-1.63)
$\gamma_1 \times AFP_{t-1}$			0.10 (0.28)	-0.26 (-0.92)
R2	0.85	0.92	0.75	0.79
DW-Statistic[#]	0.45	0.83	0.47	0.36
Pre-antitrust action period				
CPT[##]	1.17	1.19	1.04	0.94
CPT[##] change	-0.39* (-3.08)	-0.16[a] (-1.51)	-0.40* (-2.92)	-0.70* (-5.40)
Antitrust action period				
CPT[##]	0.78	1.03	0.64	0.24
Fixed absolute markup	1.77* (9.80)	1.90* (10.40)	2.48* (11.14)	3.18* (14.79)

[#]All T-ratios are calculated using the autocorrelation-robust standard errors based on the Newey-West approach.
[##]Cumulative CPT (except for Syracuse and Philadelphia).
* Ho: $\beta=0$ and Ha: $\beta\neq0$: the estimated coefficient is statistically significant at the 10% significance level (two-tailed T-test). T-statistic rejection regions are $(-\infty; -1.64]$ and $[1.64; +\infty)$.
[a] Ho: $\beta=0$ and Ha: $\beta<0$: the estimated coefficient is statistically significant at the 10% significance level (one-tailed T-test). T-statistic rejection region is $(-\infty; -1.28]$.
[b] Ho: $\beta=0$ and Ha: $\beta>0$: the estimated coefficient is statistically significant at the 10% significance level (one-tailed T-test). T-statistic rejection region is $[1.28; +\infty)$

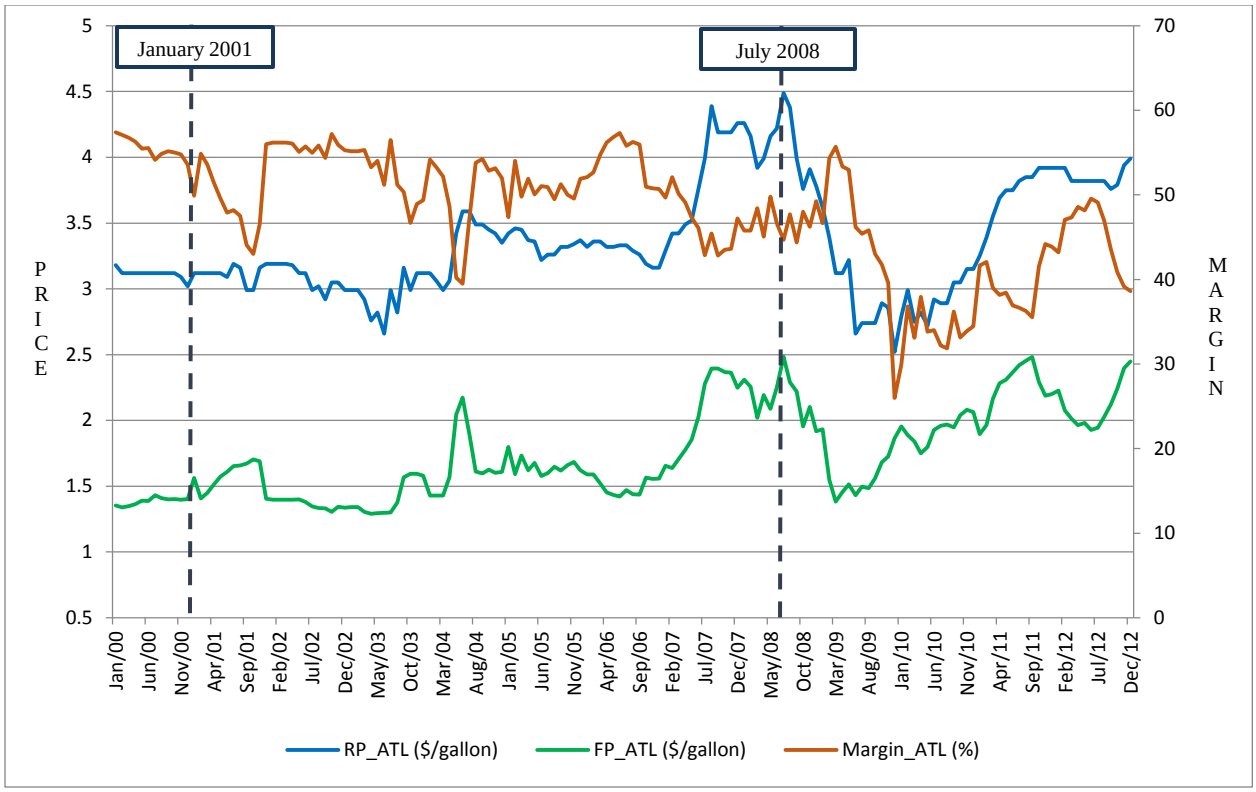

Figure 1 Atlanta, GA: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012). *01/2001-07/2008 is pre-antitrust action period, and 08/2008-12/2012 is antitrust action period.*

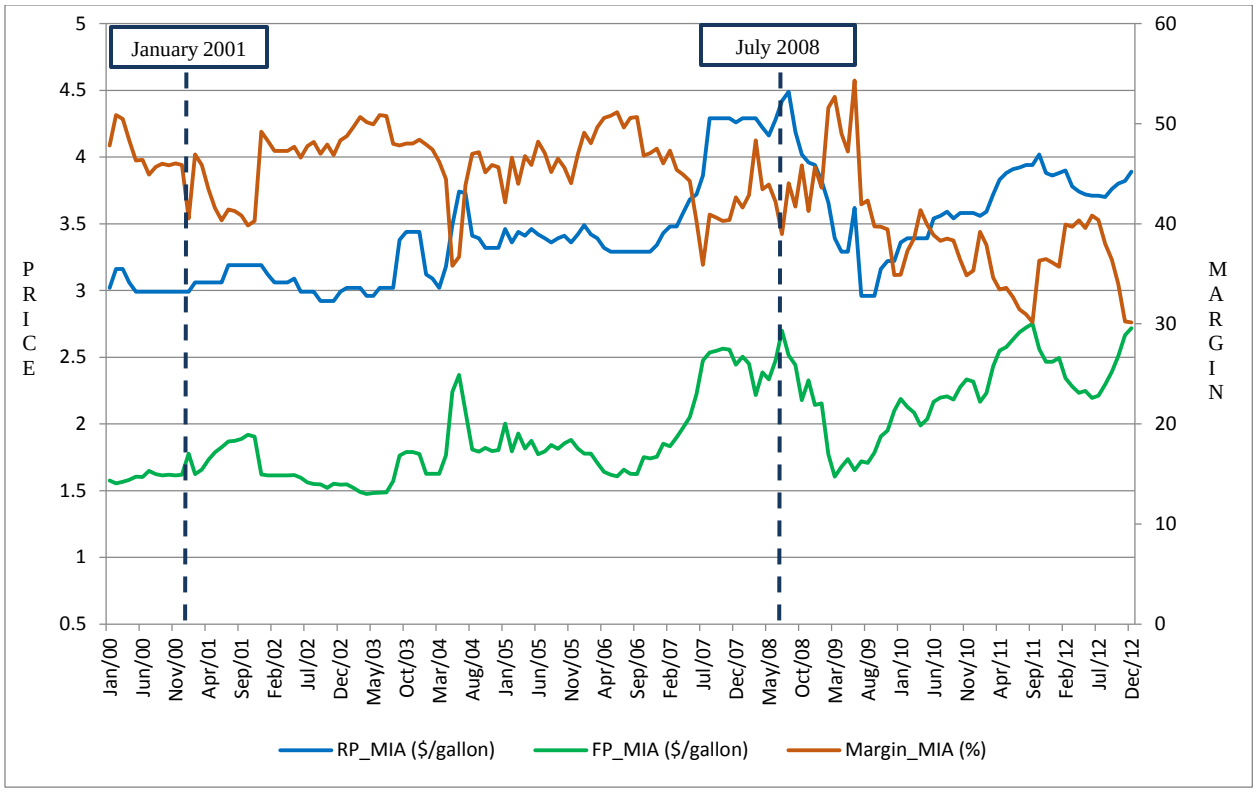

Figure 2 Miami, FL: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012). *01/2001-07/2008 is pre-antitrust action period, and 08/2008-12/2012 is antitrust action period.*

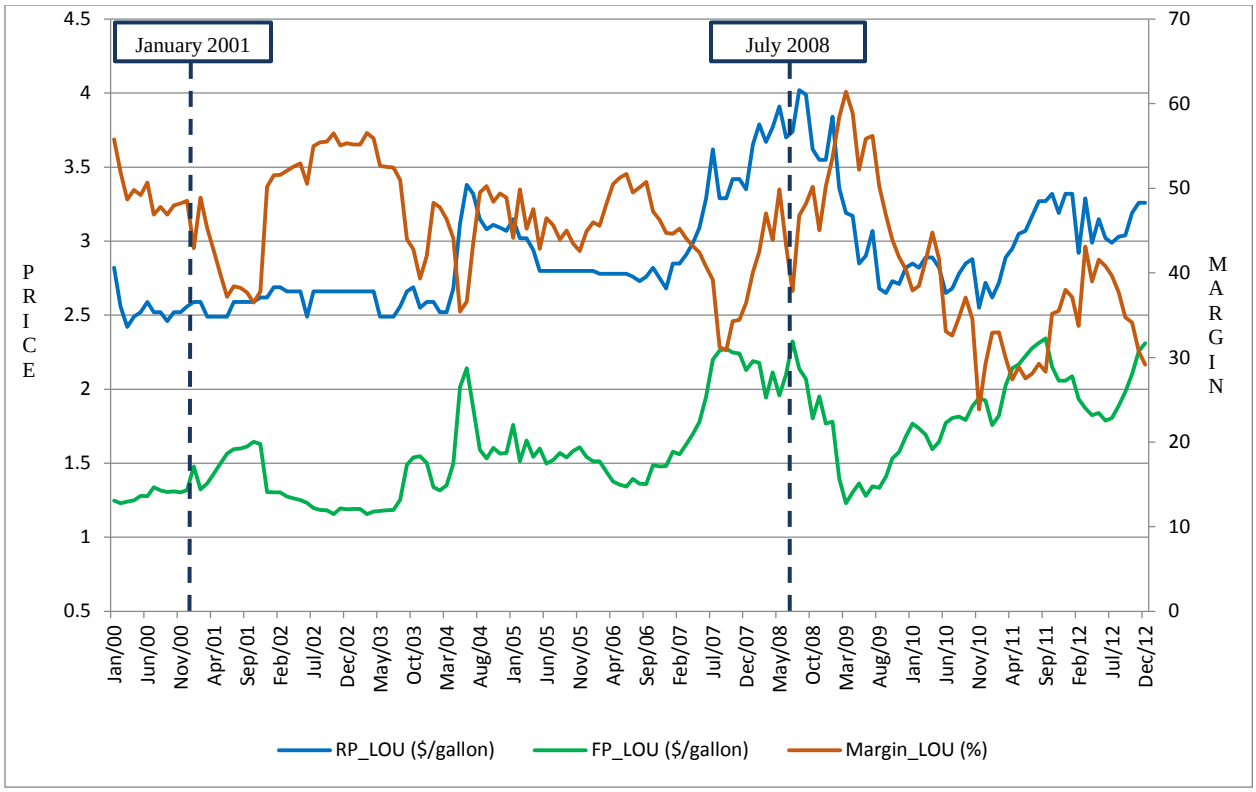

Figure 3
Louisville, KY: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012).
01/2001-07/2008 is pre-antitrust action period, and 08/2008-12/2012 is antitrust action period.

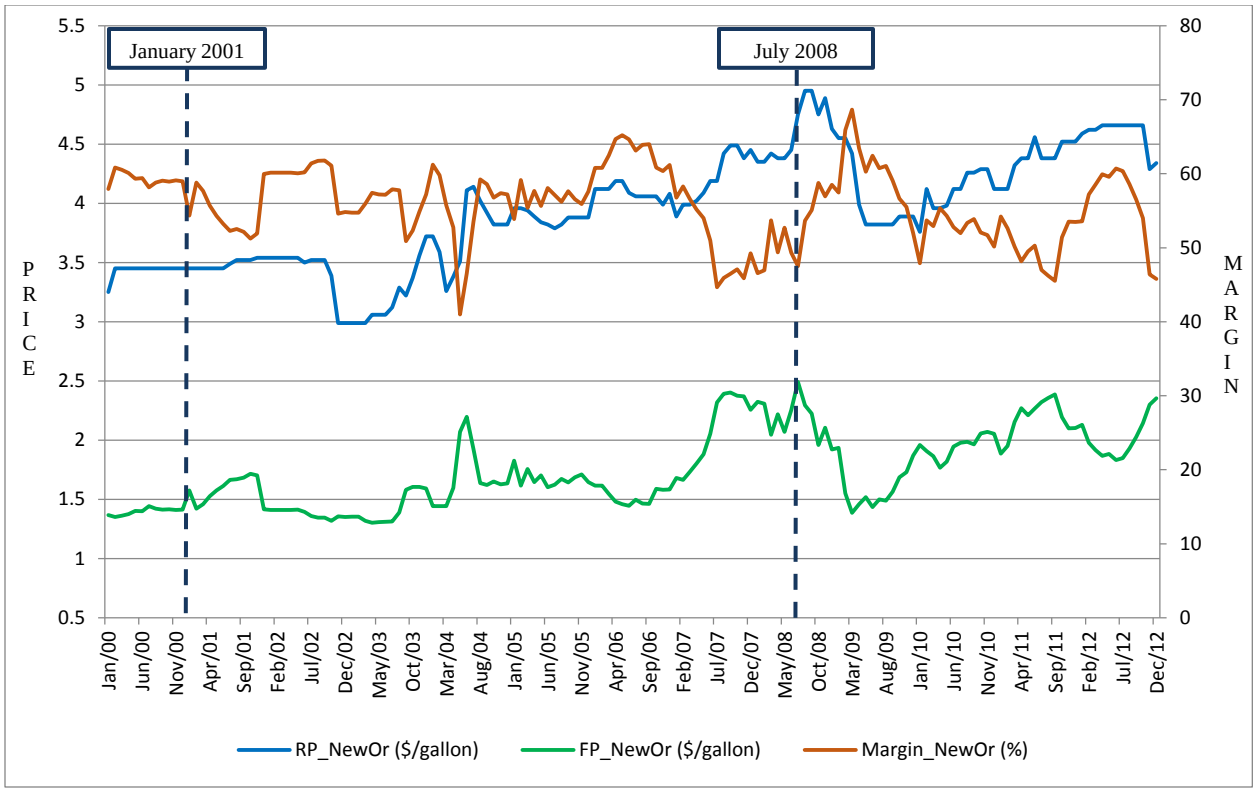

Figure 4
New Orleans, LA: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012).
01/2001-07/2008 is pre-antitrust action period, and 08/2008-12/2012 is antitrust action period.

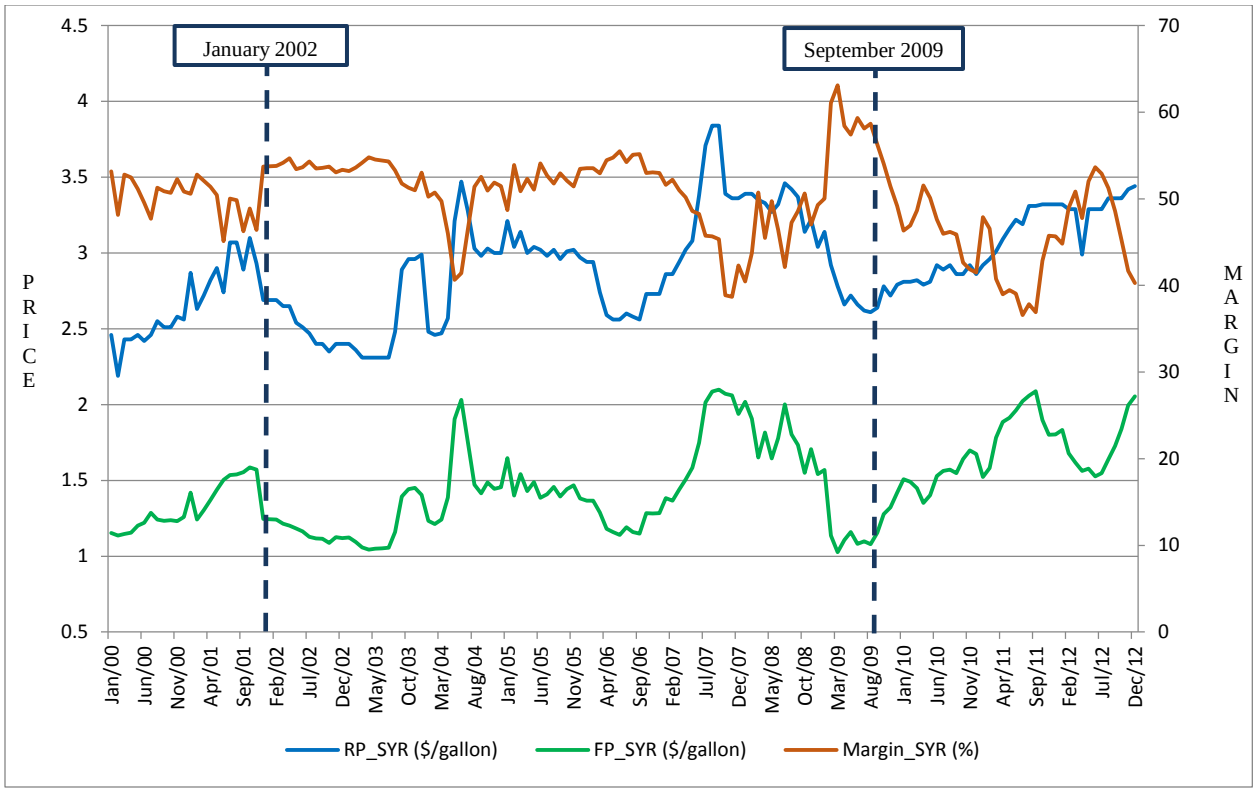

Figure 5 Syracuse, NY: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012). *01/2002-09/2009 is pre-antitrust action period, and 10/2009-12/2012 is antitrust action period.*

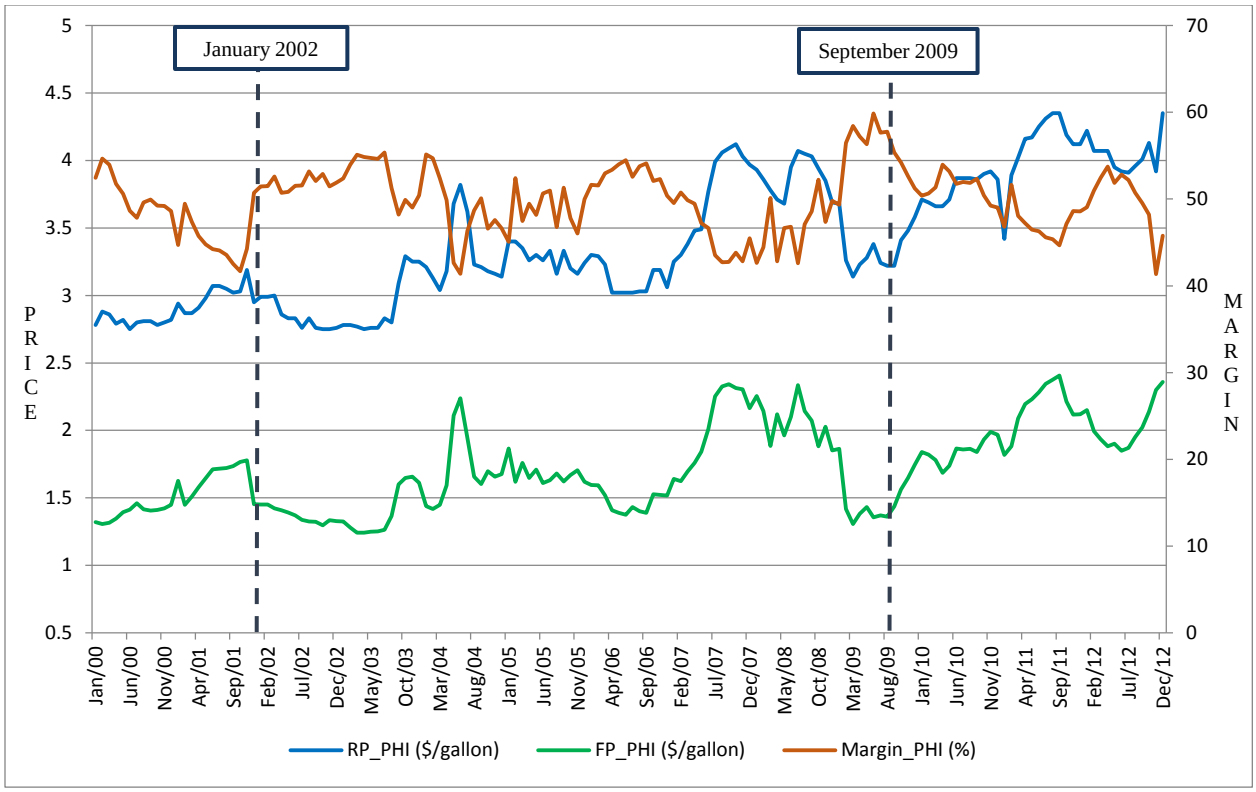

Figure 6
Philadelphia, PA: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012).
01/2002-09/2009 is pre-antitrust action period, and 10/2009-12/2012 is antitrust action period.

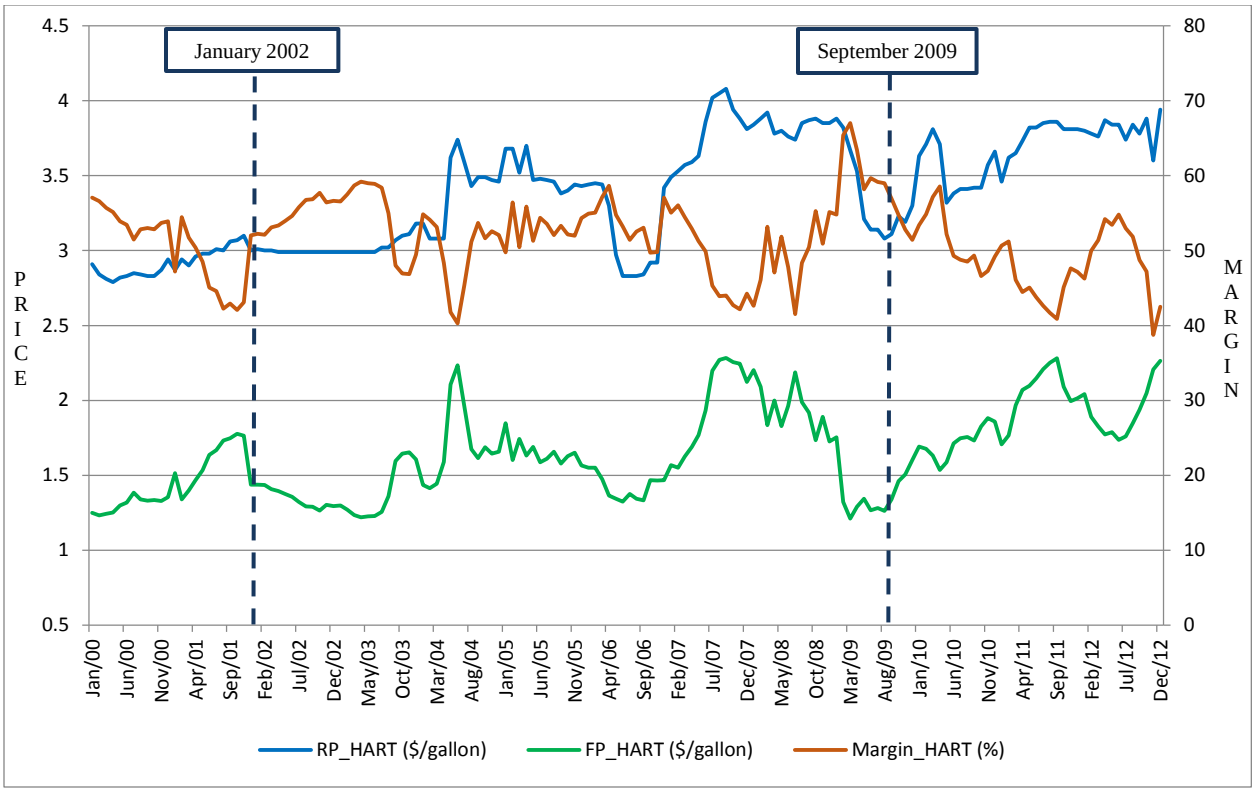

Figure 7
Hartford, CT: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012).
01/2002-09/2009 is pre-antitrust action period, and 10/2009-12/2012 is antitrust action period.

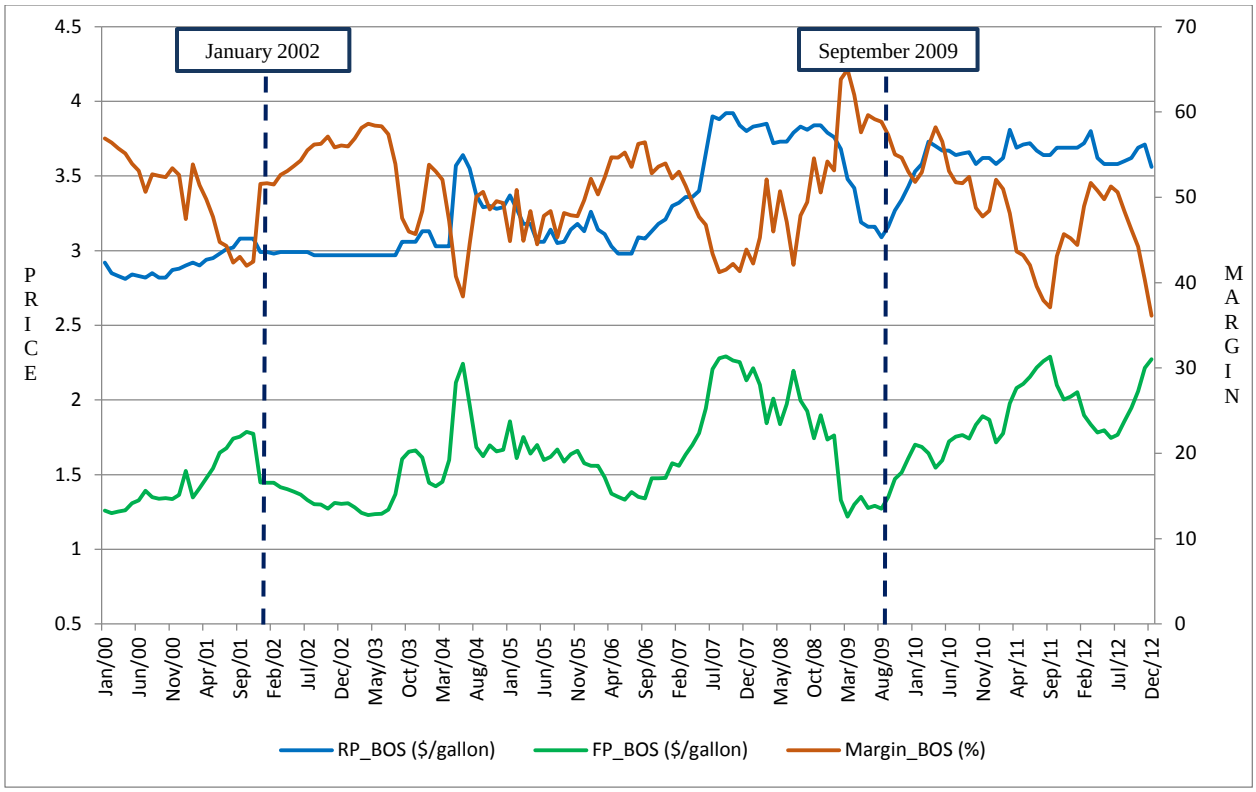

Figure 8
Boston, MA: Retail fluid whole milk price, Class I milk price and margin (2000 - 2012).
01/2002-09/2009 is pre-antitrust action period, and 10/2009-12/2012 is antitrust action period.