

Live Lamb and Lamb Products Confidentiality Study

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1. Executive Summary

LMR confidentiality guidelines were established based on the premise of AMS “printing” a weighted average price along with the volume of transactions. We assessed the viability of alternative price reporting calculations that would: 1) maintain the integrity of the “printed” price as a result of price discovery between supply and demand; 2) ensure minimal infringement of private company information; and 3) not facilitate the act of market collusion. We used the period of one week for this study as the base period, which is consistent with most current AMS reporting for lamb.

Because of the lack of transaction volume in this market, we took great care to maintain the confidential integrity of the data. We also made an effort to provide meaningful information related to all alternatives. In most cases we masked the identity of an individual data series, and in most cases we used a proxy for the LMR’s 3/70/20 confidentiality threshold. We were careful to note that any alternative price calculation deemed viable in this report will need to be further vetted by AMS. Our analysis of alternatives did not include a comprehensive review into any particular alternative price calculation.

We spent considerably less effort analyzing lamb product cuts. Our premise is that our findings at the level of live trade is generally applicable to the lamb product cuts report. For lamb product cuts, the need for an alternative reporting metric is hit-and-miss across different cuts. This makes offering a general recommendation difficult. As would be expected, lamb product firms tend to be in-and-out of the market regularly to replenish, or to move, inventories. For some cuts one firm may have such a large market share there is no viable alternative price reporting metric to consider.

We looked into the case of how long price information remains in the market. We determined that period to be no more than three weeks, with the exception of seasonal tendencies. However, caution must be taken in consideration of reporting historical prices without consideration of confidentiality. A key proprietary business detail is the margin, and firm-level margins tend to remain constant over time. Because the lamb and lamb products industries are fairly consolidated, we have a concern that firm-level margin information could be exposed with the release of historical information.

A concise summary of our findings for live lamb is as follows:

Relaxing 3/70/20 thresholds		
Relax “3”	infeasible	
Relax “70”	infeasible	
Relax “20”	infeasible	
Apply 3/70/20 to plants instead of firms		infeasible
Consolidate weight categories		
Lighter weight categories	infeasible	

Heavier weight categories	feasible, but subject to being infeasible
Consolidate transactions across weeks	infeasible
Use the comprehensive price	feasible, with slight caveat
Include cooperative lambs into formula	infeasible
Include cooperative lambs into comprehensive	feasible, adds volume
Price off the net cutout	generally infeasible
Supplement LMR with voluntary data	potentially feasible, AMS to look at auction slaughter lamb data
Move to a voluntary system	most likely infeasible
Price Index	generally feasible, with caveat of using subjective judgement
Rounding	infeasible
Olympic averaging	infeasible
Simple average	infeasible
Removing the tails	generally infeasible
Standardized pricing	feasible, with caveat "black box" approach

Summary: live lamb

Ultimately, we believe the AMS comprehensive price to be a good price series for industry to use. The standardized pricing approach is worth consideration by USDA AMS and industry for implementation, should the comprehensive price not be sufficient to meet industry need. This approach relies upon price relationships from the two most recently completed market weeks as well as the proportion of transactions containing attributes of interest (FOB, formula, etc.) for the reported week. Accordingly, this process is conceptually transparent and reasonably appealing given existing reporting challenges faced by AMS and frustrations expressed by the lamb industry. If ultimately implemented, we would recommend USDA AMS periodically re-examine this process as any substantial change in transaction types could be important to further consider. Furthermore, we recommend USDA AMS not publically report actual relationships used in the price calculation process. While additional transparency in concept is appealing, reporting actual coefficients would reveal important information that may present confidentiality concerns.

Summary: lamb products

Because of the inclusion of imported lamb products, we generally found more firms contributing information. In general, the findings for live lamb hold for lamb products. For the lamb product cut prices associated with more than one firm reporting and now unreportable, there are three potential price reporting alternatives. The impact of any one, or combination, of these alternatives will lead to a marginal improvement in reporting of 5 or 6 price series. First, consideration should be given to merging fresh and frozen product with a rule for eliminating frozen product outlier data points. Second, AMS could look at a longer rolling-average period. However, we do not believe this alternative will consistently solve the confidentiality issue. The second option, which we view as viable, is applying the standardized pricing model when a specific cut no longer consistently conforms to 3/70/20 threshold and for which there is more than one firm reporting.

2. Project Overview and Study Objectives

Livestock and meat are being marketed in dramatically different ways today than in the recent past. Negotiated trade has been rapidly replaced by formula pricing, forward markets, and longer term marketing agreements. Changing domestic and global meat customer and consumer demands are driving the meat industry to be more responsive to consumer interests. This is leading to more vertical coordination and integration, and, relative to when the Livestock Mandatory Reporting Act (LMR) was enacted in April 2001, generally different terms of trade, e.g., contracts, is used by meat packers who report information to USDA-AMS under LMR.

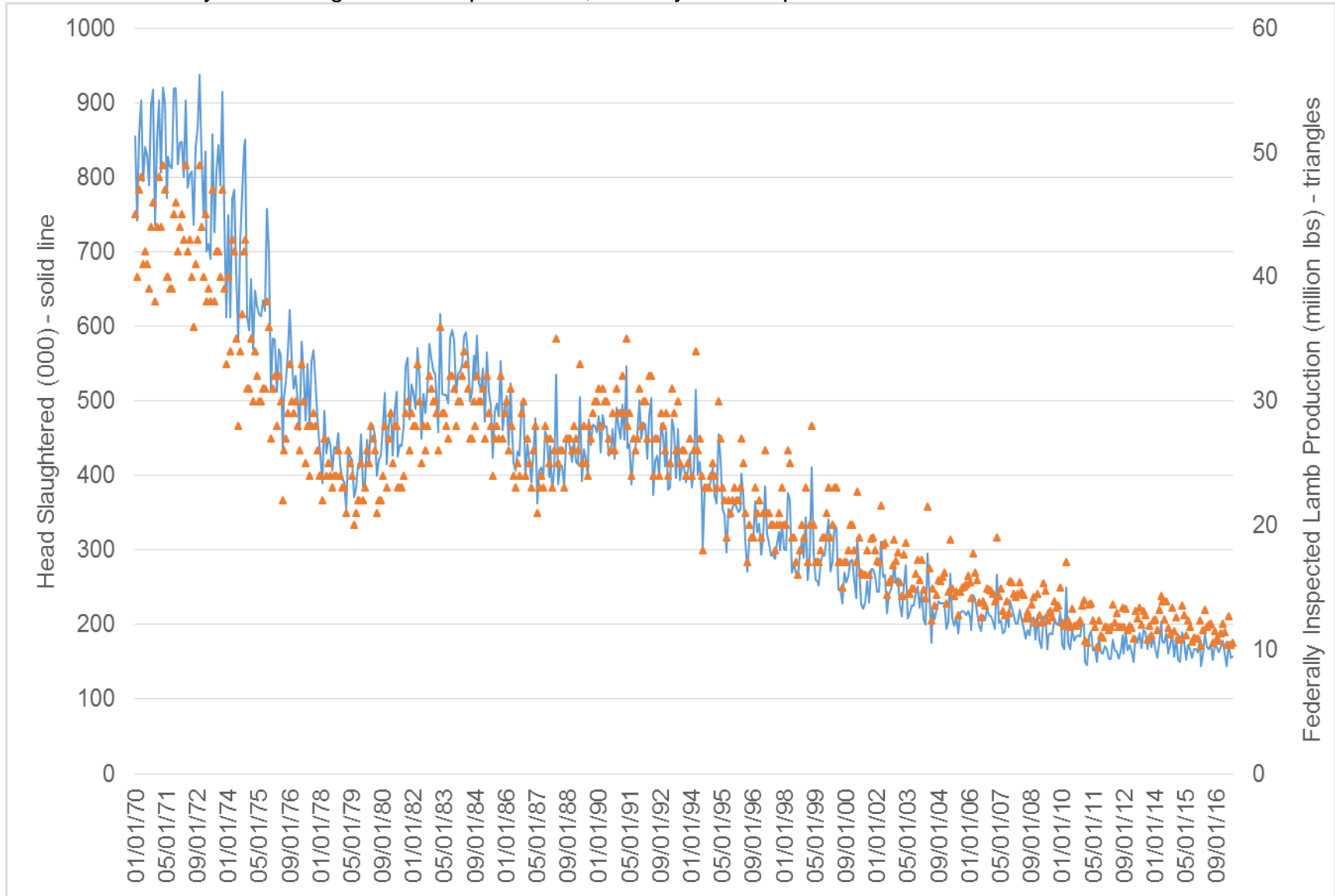
This issue has long been a concern, but it is becoming a greater concern as markets become more vertically integrated, coordinated, differentiated, and in many instances thinly traded. The use of LMR information has expanded beyond price discovery and determination to include establishing insurance contracts, futures contract settlement, indemnity loss payment determination, market research, and for policy analysis. Capability for USDA-AMS together with industry to quickly assess new market developments in the livestock and meat sectors and to determine how to modify reporting accordingly, will be an important dimension of the effectiveness of LMR in the future.

The U.S. sheep and lamb industry has undergone considerable change over the past one-half century, and over the prior 15 years this change continues. In particular, the lamb meat market became a global marketplace beginning in the 1970's and continues to today. Over a fifteen year period alone the percentage of imports in relation to domestic meat production has risen from 56% in 2000 to 142% in 2015. U.S. imports of lamb carcasses and lamb meat has reduced today's domestic production to 20% of production levels fifty years ago (exhibit 2.1). Domestic production today is one-half of production to when the Livestock Mandatory Reporting Act (LMR) was enacted in April 2001. This decline in domestic production at the farm-level has the up value-chain effect of a declining need for feeders and initial processors.

Using live and carcass transaction level data over the 2012 through March 2017 period and lamb products transaction level data over the 2016 through March 2017 period, we examined various alternatives to the currently reported weighted average price. Specifically, the objectives of this study were:

- Examine LMR transaction data for alternative confidentiality consideration of reporting entities while maintaining information integrity and consideration of the needs of producers and industry.
- Explore alternative ways to aggregate reported data to enable AMS to publish market information while preserving the confidentiality of the market participants.
- Examine the period of time that data remains relevant to establishing the current market price.

Exhibit 2.1. Weekly head slaughtered and production, January 1970 to present.



Source: Livestock Marketing Information Center and Agricultural Marketing Service.

3. Consideration of Alternatives to using the Weighted Average Price

This section of the report describes alternative aggregation schemes to achieve the 30/70/20 confidentiality guidelines used by AMS in deciding information to “print” a weighted average price.

Because of the few numbers of firms reporting during a given week, we sought a method to convey market shares without disclosing confidential information. There is no exact replacement for a 3/70/20 threshold or for alternative threshold considerations. We apply the Herfindahl Index to the LMR transaction data to approximate the confidentiality threshold. The Herfindahl Index is computed as:

$$H = \sum_i^n (S_i^2)$$

Where s_i equals the market share of the i^{th} firm in the market of n firms. While the Herfindahl Index does not have a time dimension, i.e., measure over a 60-day period, we suggest a Herfindahl Index value of at least 0.60 is a decent approximation of the 3/70/20 threshold. Herfindahl Index values above 0.60 indicate an increasing level of difficulty in meeting any relaxed confidentiality threshold.

IMPORTANT

It is IMPORTANT to note that the Herfindahl Index reported here is relevant only to data reported through LMR and NOT the entire market. Thus, we refer to a LMR Herfindahl Index or the LMR H-index.

The 30/70/20 guidelines must be understood. The 3/70/20 confidentiality guideline requires the following three conditions (Source: <https://www.ams.usda.gov/sites/default/files/media/ConfidentialityGuidelines.pdf>):

1. At least three reporting entities need to provide data at least 50 percent of the time over the most recent 60-day time period.
2. NO single reporting entity may provide more than 70 percent of the data for a report over the most recent 60-day time period.
3. NO single reporting entity may be the sole reporting entity for an individual report more than 20 percent of the time over the most recent 60-day time period.

Following AMS guidelines, an entity is equal to a firm. There are two important reasons why preserving confidentiality is a priority. First, the foundation of a free enterprise economy allows firms to maintain a degree of privacy to protect their firm-level knowledge. Second, the Sherman Antitrust Act severely penalizes firms and persons that engage in collusive activities. If a government agency were to report information that potentially infringes on proprietary business, then the government would be a

facilitator of an industry unfairly sharing information. If the agency reported transaction data for a small number of firms, then each firm could “back out” their own information to arrive at the competitor’s information. The 3 threshold protects against any two entities consistently reporting. Even for three or more firms, there is the concern of collusion if one or two of the firms represent a significant percentage of the market share, during a given time period. The 70 and 20 thresholds are in place to protect against such situations where one or two entities dominate over many smaller entities. If the thresholds of 70 and 20 are relaxed too much, e.g., 80 and 10, then the 3 threshold would need to increase to ensure the information is not used in a collusive manner.

3.1 Relaxing the 3/70/20 thresholds

We examined the impacts of relaxing each of the 3/70/20 thresholds now used with in LMR. To preserve the confidentiality of the actual data we report approximation computations to publicly show reasoning for concern, or lack of impact, over relaxing either of the 3, 70, or 20 thresholds.

Increasing the “3” threshold

- Readers will see by Exhibit 3.1.1 that relaxing the 3 threshold will have little impact because many weeks 3 or fewer firms are reporting [note: one may average across weeks to get the average number of firms reporting during a 60-day window].
- Keep in mind the volume of formula trade dominates over the volume of negotiated trade by a ratio of between 2:1 and 3:1.

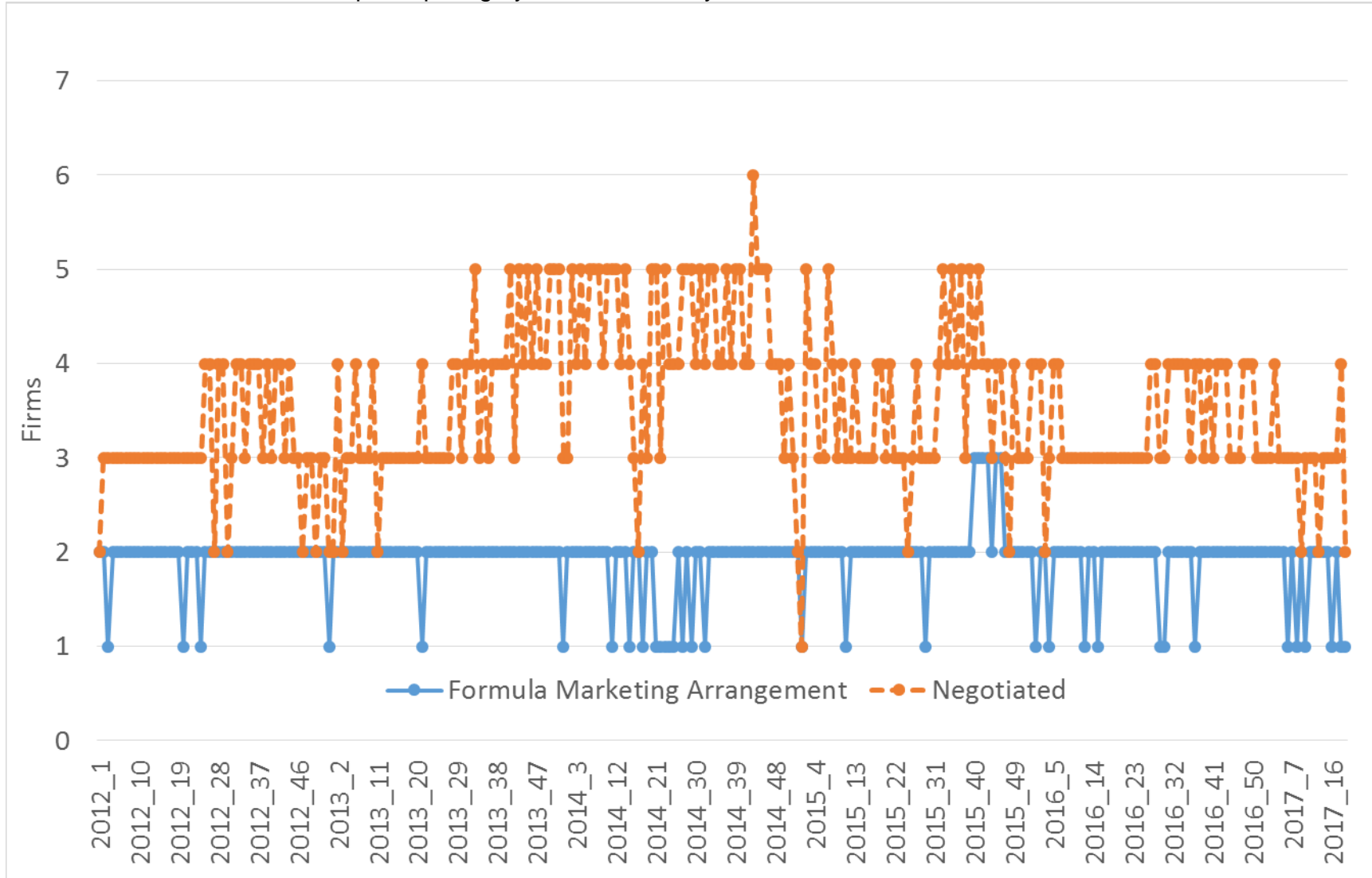
Relaxing the “70” threshold

- Readers will see by Exhibit 3.1.2 that the percentage of weeks when one entity is above the 70 threshold is considerably high.
- Relaxing this threshold will have little impact on the number of reportable transactions.

Relaxing the “20” threshold

- Because of the similarity in how the 20 and 70 thresholds are reviewed, readers can again examine Exhibit 3.1.2 to envision why relaxing the 70 threshold will have little impact on the ability of AMS to report more information.

Exhibit 3.1.1. Number of firms participating by market, January 2012 - March 2017



Source: Agricultural Marketing Service.

Note: This figure represents the number of firms and not volume of trade by the firms.

Exhibit 3.1.2. Percent of observations with a single entity having over a 70% market share in a given week, January 2012 – March 2017.



Source: Agricultural Marketing Service.
Note: F = Formula & N = Negotiated

3.2 Apply the 3/70/20 threshold to plants instead of firms

Readers will see through information in Exhibit 3.2.1, and comparison to Exhibit 3.1.1, there is minimal change in the number of entities reporting transactions.

- Due to confidentiality we report no price or headcount information here.
- Our review found that firms with multiple plants use similar procurement methods.
- Based on our review of the data this change would impede on business freedoms and potentially facilitate collusive behavior.

3.3 Consolidating weight categories

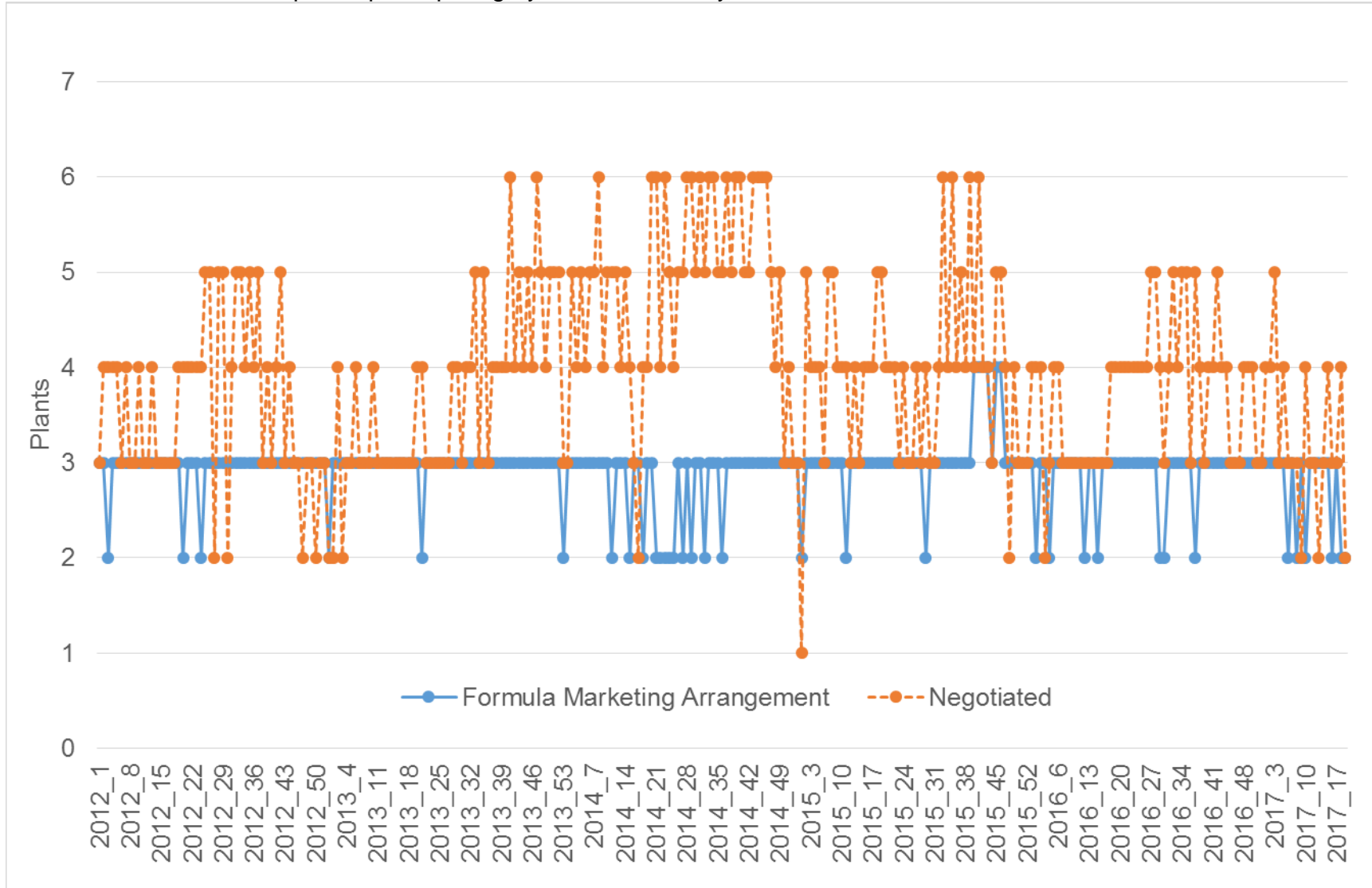
In visiting with industry stakeholders, their preference is to NOT combine weight categories unless absolutely necessary to meet the confidentiality threshold. We examined two example scenarios for the lowest three weight categories. The baseline inflects current categories. The percentage of weeks with no submitting transactions or single entity submitting transaction is reported. The LMR Herfidahl index (H-index) is also reported in each of the three sampled weight categories where the H-index is above 0.60. There is evidence that combining weight categories allow for access to more regularly available data, however, the measure of meeting the confidentiality threshold remains a strong concern.

Exhibit 3.3.1. Percentage of no transactions submitted or single entity reporting during a given week, for lighter weight categories.

Weight Category	Category i	Category ii	Category iii
Baseline	97.18%	98.18%	75.56%
H-Index: >0.60 for each baseline category			
Combining weight categories	73.93%		
H-Index: > 0.60			

- For the lighter weight categories, there is a very low probability of finding an alternative method for maintaining confidentiality.
 - Discontinuing reporting lighter weight categories should be considered.
- For the heavier weight categories, combining weight categories seems unnecessary given the feasibility of other aggregation alternatives reported in this report.

Exhibit 3.2.1. Number of plants participating by market, January 2012 - March 2017.



Source: Agricultural Marketing Service.

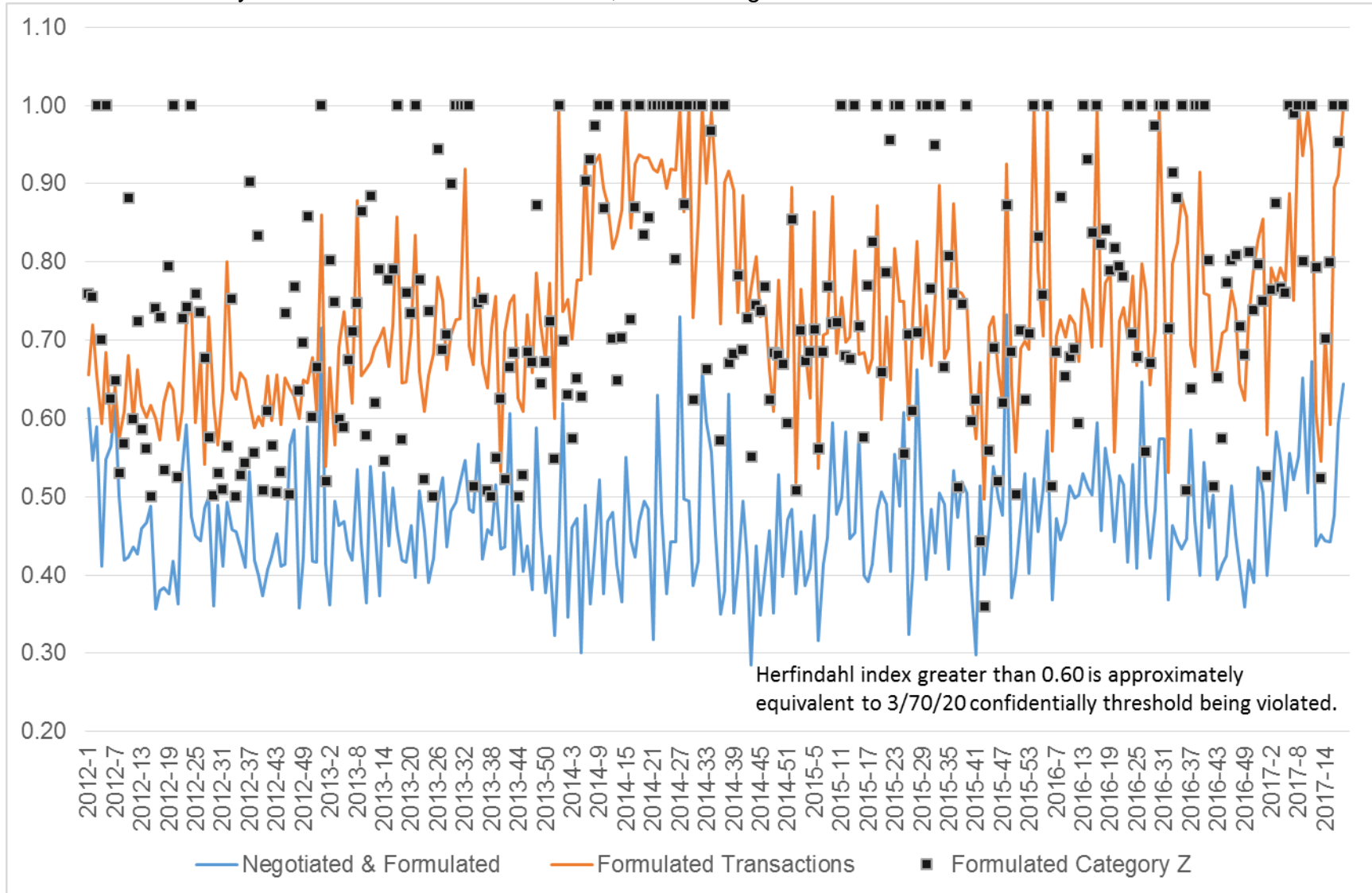
Note: This figure represents the number of firms and not volume of trade by the firms.

3.4 Consolidating transactions across weeks

We considered alternative aggregating strategies across time. Using knowledge summarized in section 5 that “the market” encompasses two weeks, we examined aggregating data across two weeks. First, the baseline is established by computing the weekly LMR H-index for negotiated formulated transactions. The AMS moving to a comprehensive reported price was the only sustainable way to continue reporting a price.

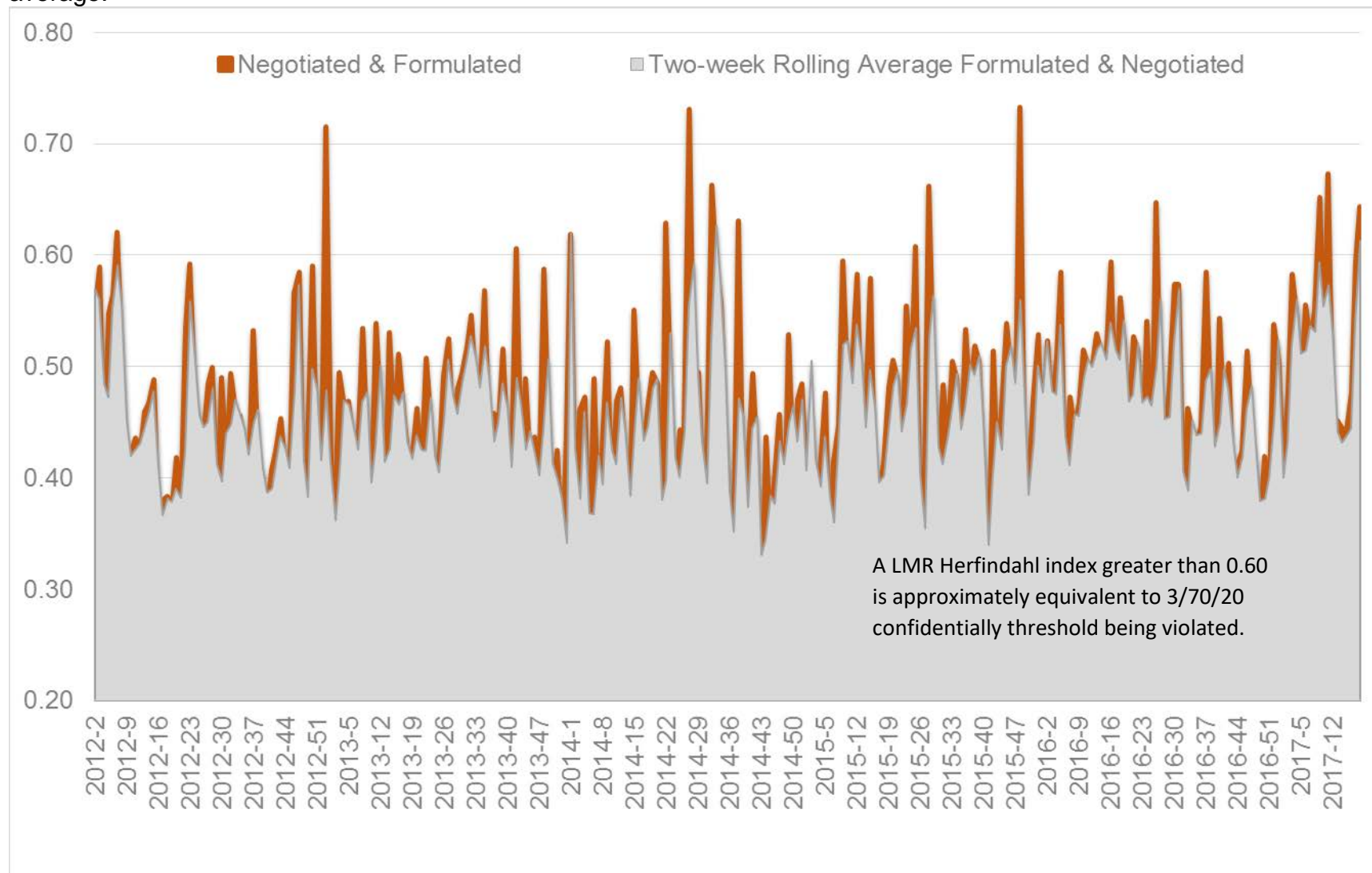
Any significant change in LMR H-index by aggregating across weeks would be observed in the comprehension data, leading to a deeper study of more specific data Exhibit 3.4.2 issued to show the LMR H-index for a single week and two-week moving average. Obviously, the two week moving average LMR H-index is only minimally lower than the single week. Aggregating transactions across a two-week period is not sufficient to avoid collusive concerns.

Exhibit 3.4.1. Weekly live lamb LMR Herfindahl Index, 2012 through March 2017



Source: Agricultural Marketing Service.

Exhibit 3.4.2. Weekly live lamb LMR Herfindahl Index, 2012 through March 2017, for actual week and two week rolling average.



Source: Agricultural Marketing Service.

4. Alternative Confidentiality Considerations

This section follows closely on section 3, but delves more into alternative scenarios of market price reporting that go beyond AMS current use of the weighted average price.

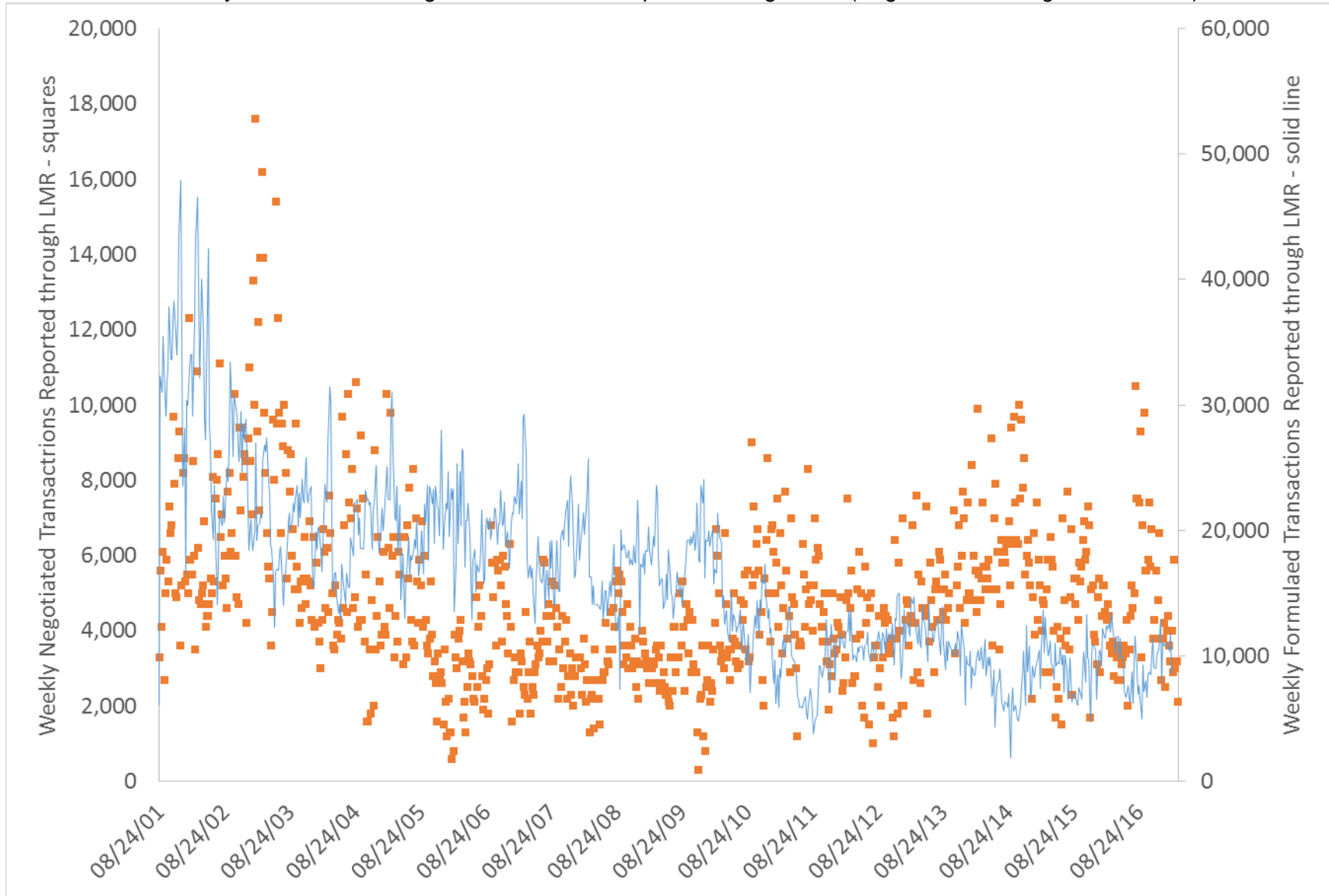
4.1. Comprehensive price report

An obvious option to consider is AMS's recently created comprehensive report. We provide only facts here, based on historical information. Exhibits 4.1.1 and 4.1.2 show secondary data trends, for negotiated and formulated transactions, over the life of LMR. Exhibits 4.1.3 and 4.1.4 are scatter plots showing how well different price series track against each other. Clusters closer to the black line show the two price series track better with each other. Overall, combining negotiated and formulated transactions into a comprehensive price tracks the formula price well (see Exhibit 4.1.4).

We went one step further to examine outliers shown in Exhibit 4.1.4. A rule was created that if the comprehensive price is outside of a range +/- \$5 of the formulated, then only the formula price transactions are used to compute the reported price on the given day. The rule was enacted 138 (17.5%) of the 788 weeks. While this significantly improved the clustering of prices, going forward AMS would need to avoid announcing dates when only the formula transactions are utilized. This would ensure firm-level confidentiality.

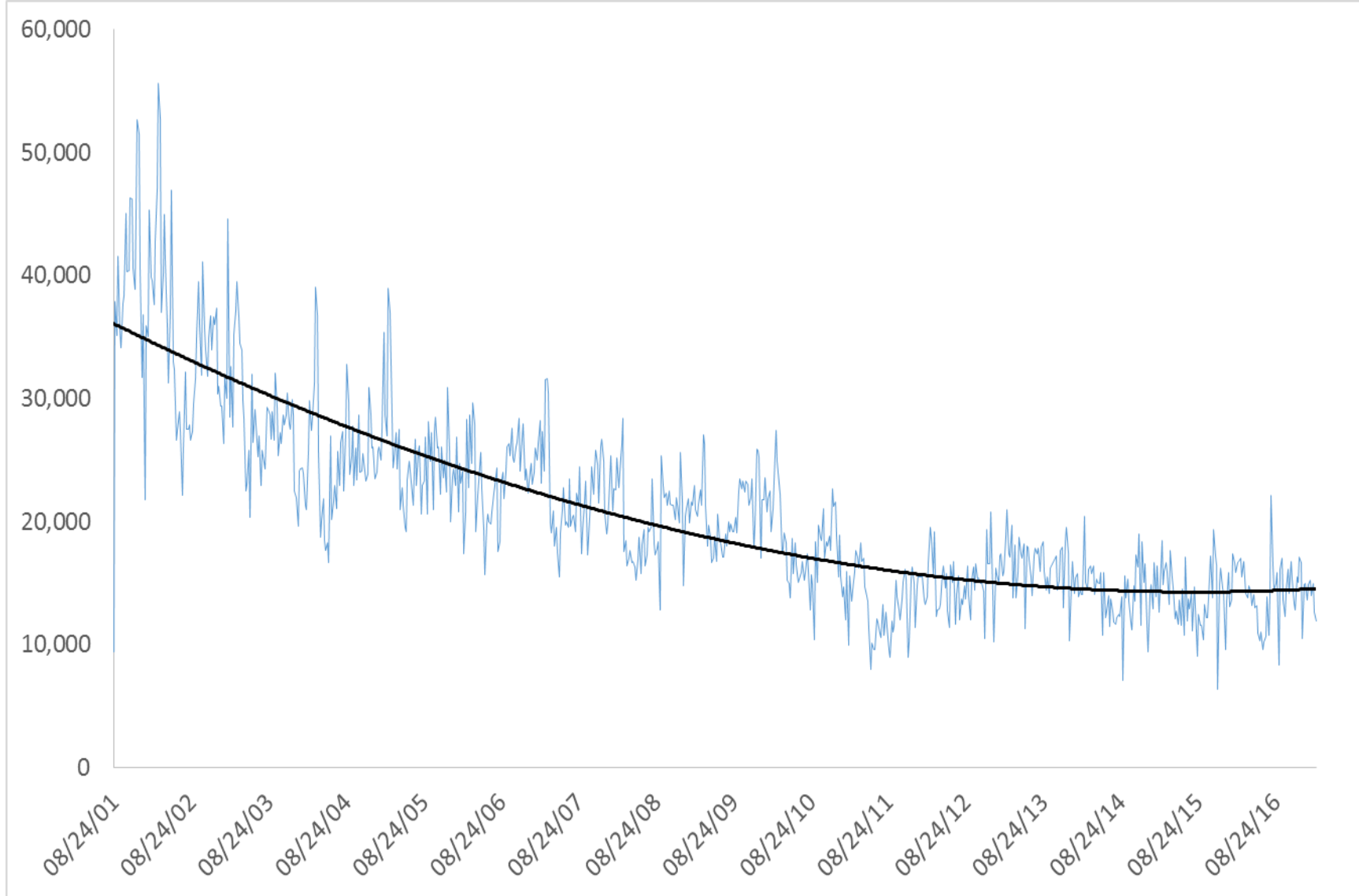
The comprehensive price now reported by AMS is a feasible option for the time being, as long as firms continue to report a sufficient number of transactions within both purchase types of negotiated trade and of formula trade. Note, there are two firms reporting formula transactions (see Exhibit 3.1.1), which is lower than the "3" threshold of 3/70/20.

Exhibit 4.1.1. Weekly formulated and negotiated lamb head reported through LMR (August 2001 through March 2017)



Source: Livestock Marketing Information Center and Agricultural Marketing Service.

Exhibit 4.1.2. Weekly combined formulated & negotiated lamb head reported through LMR (August 2001 through March 2017)



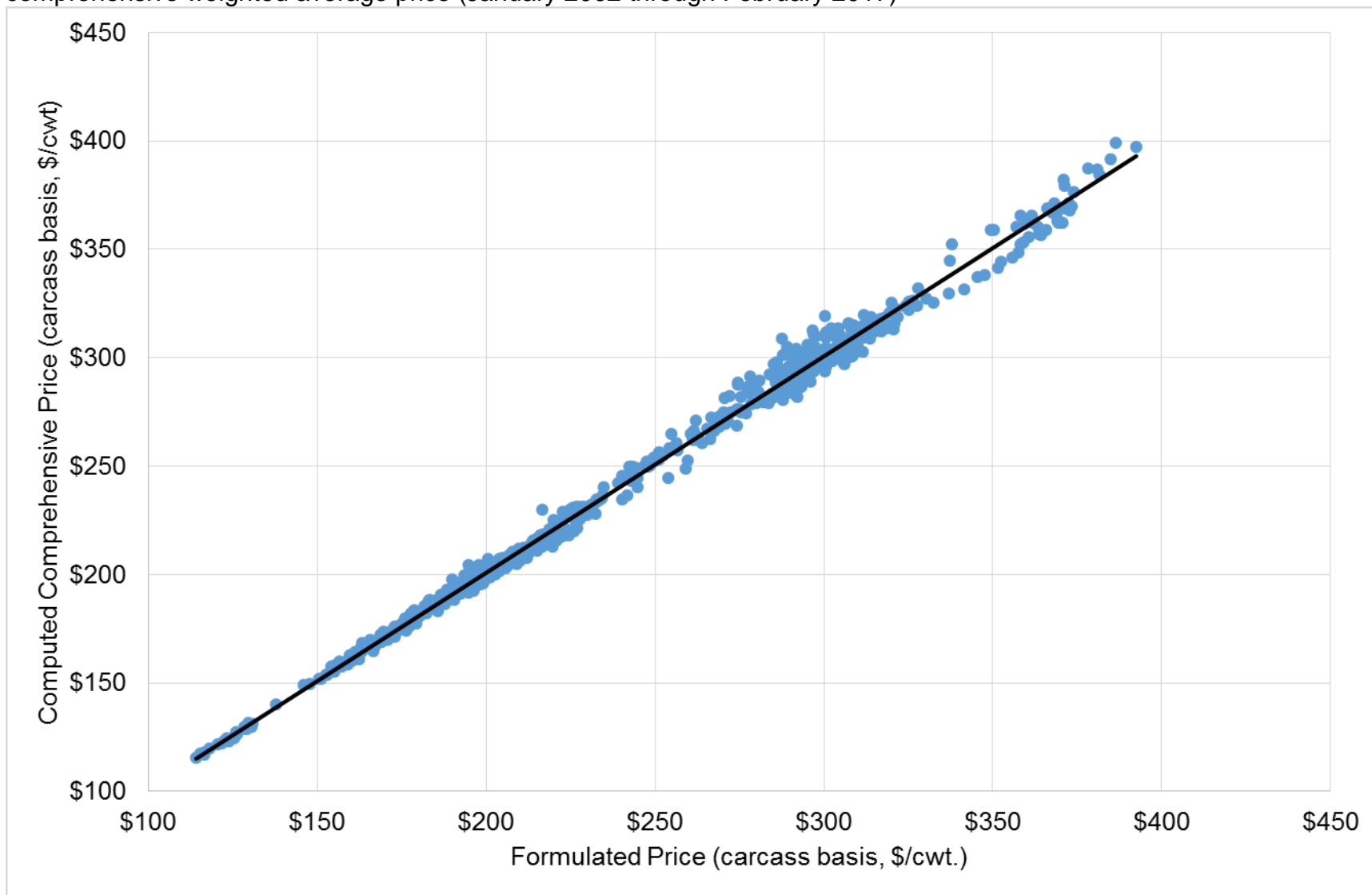
Source: Livestock Marketing Information Center and Agricultural Marketing Service.

Exhibit 4.1.3. Relationship between the weekly carcass basis reported formulated weighted average price and reported negotiated weighted average price (January 2002 through February 2017)



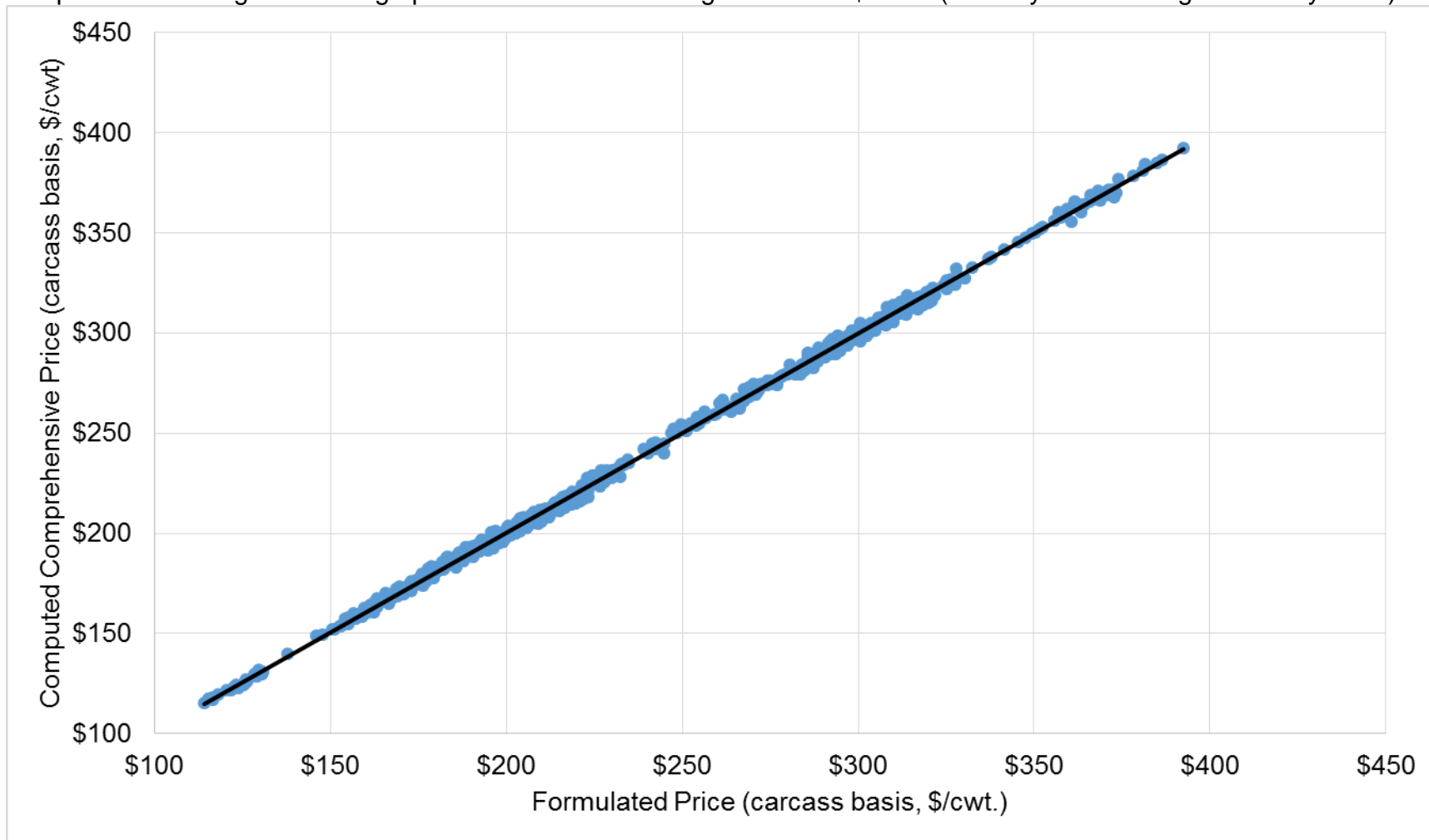
Source: Livestock Marketing Information Center and Agricultural Marketing Service.

Exhibit 4.1.4. Relationship between the weekly carcass basis reported formulated weighted average price and computed comprehensive weighted average price (January 2002 through February 2017)



Source: Livestock Marketing Information Center and Agricultural Marketing Service.

Exhibit 4.1.5. Relationship between the weekly carcass basis reported formulated weighted average price and computed comprehensive weighted average price & rule of an outlier greater than \$5/cwt. (January 2002 through February 2017)



Source: Livestock Marketing Information Center and Agricultural Marketing Service.

4.2 Inclusion of cooperative lambs

We examined 13 weeks of cooperative member owner lamb transactions for the impact on formula price reporting. The addition of this data does not impact the number of firms reporting. However, the LMR H-index declines sharply. Because we did not have weight categories, we were unable to reach conclusion related to specific formula weight categories. Because the addition of cooperative lamb transactions does not improve the 3/70/20 “3” threshold, the addition of cooperative lambs alone is not sufficient to overcome concerns that LMR could facilitate collusion.

Exhibit 4.2. Formula trade confidentiality measures before and after inclusion of cooperative member owned transactions.

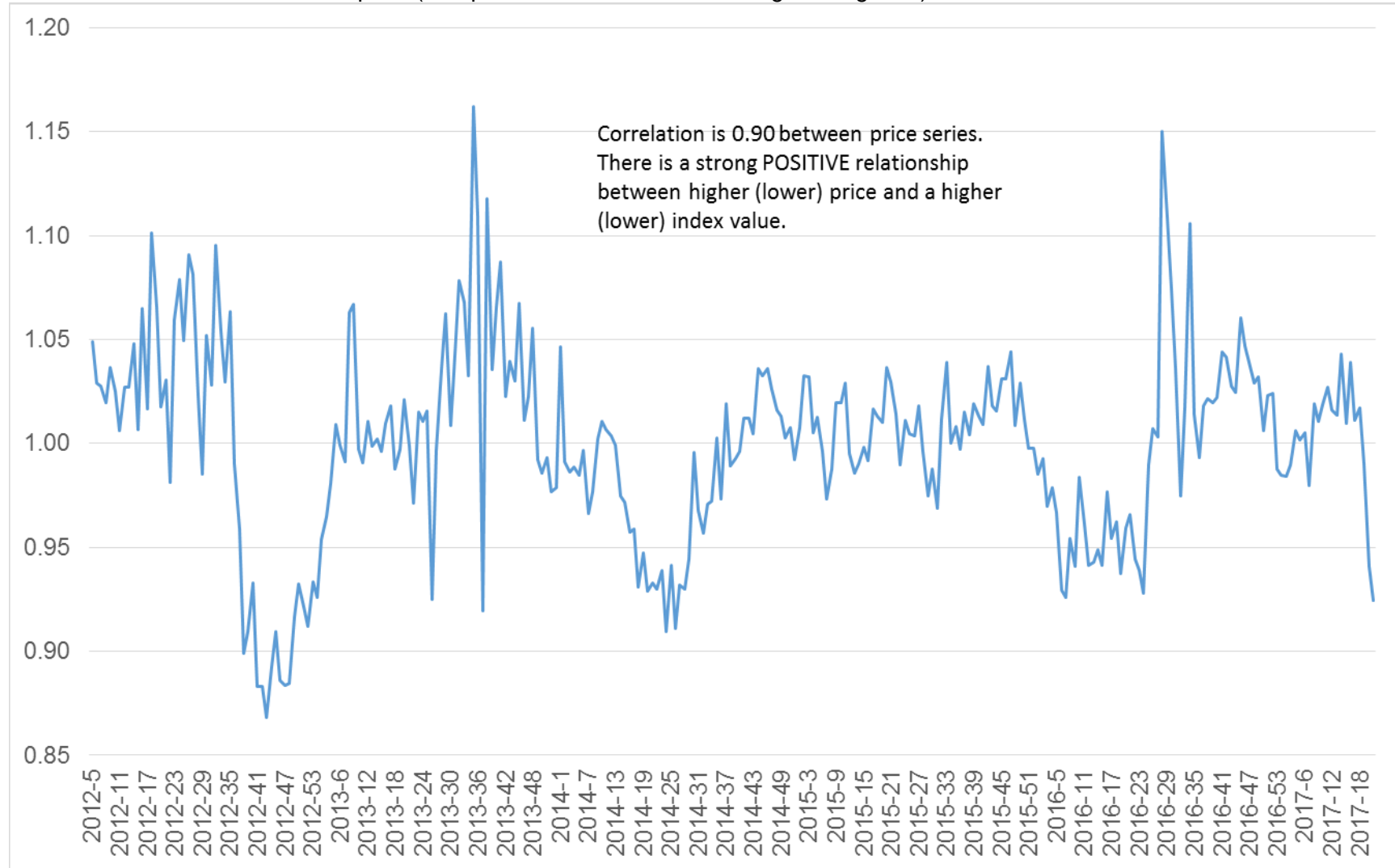
	Before		After	
	<u># of Firms</u>	<u>LMR H-Index</u>	<u># of Firms</u>	<u>LMR H-Index</u>
Period 1	2	0.665	2	0.525
	2	0.709	2	0.501
.	2	0.714	2	0.502
.	2	0.764	2	0.529
.	2	0.738	2	0.500
.	2	0.646	2	0.517
.	2	0.623	2	0.503
.	2	0.728	2	0.500
.	2	0.793	2	0.501
.	2	0.828	2	0.508
.	2	0.854	2	0.541
.	2	0.579	2	0.510
.	2	0.792	2	0.503
.	2	0.772	2	0.502
.	2	0.793	2	0.515
Period 13	2	0.776	2	0.759

Source: Agricultural Marketing Service.

4.3 Pricing off the net cutout

Because lamb meat cuts have more reportable transactions and a better chance of being reported, we examined the feasibility of using AMS voluntarily computed Net Cutout Value as an approximate value to a formula lamb weight category. We do not specify the weight category here to preserve confidentiality. Exhibit 4.3.1 is used to show the ratio of these prices. While the movement in price is quite high at 0.90, there are periods when the cutout and formulated carcass prices are measurably different. Values outside +/- 0.05 of the perfect relationship of 1.0 are a concern. If special considerations were put in place – such as in a window contract – the net cutout could serve as a mechanism to track lamb price. We do not now, however, see this as the best viable alternative.

Exhibit 4.3.1. Ratio of the cash price (unreportable and confidential weight categories) to the AMS net cutout value



Source: Agricultural Marketing Service.

4.4 Augment LMR with voluntary information

- We considered the option of supplementing LMR information with voluntary reported information. This option might cause confusion as to how much overlap exists between LMR and voluntary information. AMS provides supplemental information for the Live Cattle trade (see <https://www.ams.usda.gov/mnreports/lstdirectfsc.pdf> and the appendix), but the voluntary cattle data is not combined with LMR data.
- AMS could examine the impact on the comprehensive price by aggregating auction slaughter lamb transactions with LMR live lamb transactions. This could add volume to LMR reports. We see slaughter lamb transactions as negotiated trade, so aggregating the data will not add to the formula trade reports and the negotiated trade is too thinly traded to regularly report by weight category. AMS personnel may want to investigate this option in more detail using more robust auction transaction data.
- We visited with industry stakeholders about moving exclusively to a voluntary reporting program. Based on those discussions this is not a viable option for sustaining "printed" prices with sufficient volume to provide market price validity.

4.5 Price index

The price index shows the extent to which a price has changed over a period of time as compared with the price(s) in a certain year taken as the base. For example, if a price index has a base year of 2000, current prices are being compared to prices in that time period. Price indexes are used extensively to estimate changes in prices over time and are also used to measure differences in costs among different geographic locations. The collection of prices must be planned so that differences between the prices of any two dates will reflect changes in price and price alone.

There are several methodologies for computing an index. The simplest index price at time t is of the form:

$$Index\ Price_t = \frac{\frac{1}{n_t} \sum_i P_{it} \cdot n_{it}}{\frac{1}{n_0} \sum_i P_{i0} \cdot n_{i0}} = \frac{\sum P_t}{\sum P_0}$$

Where,

n_{it} is the market share of the i th firm in the current period t , subscript 0 represents the base period, and $n_t = \sum n_{it}$ and $n_0 = \sum n_{i0}$;

P_{it} represents the transaction prices in the current period; and

P_{i0} represents the transaction prices in the base period.

The challenge with persons using the simple index as a replacement for the "printed" price is that a base price period must be provided, which will disclose information related to P_0 and n_0 . This allows for any entity to quite easily use a current index to back

into the current price (P_0), i.e., reverse engineer the information to facilitate the presumption of collusion and infringe on private transaction information.

We consider a less common index computation (Lowe Index) of the form:

$$Index Price_t = \frac{\frac{1}{n} \sum_i P_{it} \cdot n_{is}}{\frac{1}{n} \sum_i P_{i0} \cdot n_{is}}$$

Where,

n_{is} is the market share of the i th firm in period s and $n = \sum n_{it}$;
 P_{it} represents the transaction price in the current period; and
 P_{i0} represents the transaction price in the base period 0.

The advantage with the Lowe index is that the transaction volume weight (e.g., weight and head) share (n_{is}) assigned to a firm price is tied to an arbitrary period of time. The chosen volume weights could be suppressed from public viewing.

The advantage of this particular index is that AMS can provide the base period price (P_0) as a reference point, suppress the firm share weights used, and utilize the current price without the ease of reverse engineering the current price (P_t). Also, AMS will be able to provide the current number of transactions because the current period transactions are not used in computing the current period price.

The downside is that AMS will need to select a period from which to derive the firm transaction head and lamb weights to compute market share weights. This is a subjective decision that would need to remain in place over time.

We cannot publicly recommend a time period for the firm share weights, as this would lead to loss of suppressed information. Instead, we offer an example using secondary data from the Livestock Marketing Information Center and AMS.

Assumptions and computational process, for this example, include:

- 1) Looking at carcass basis prices for the formulated 75-85 lb range for the May 2013 through January 20, 2017 period (i.e., off the LS302).
- 2) Use the period May 2013 through July 2013 as the base pricing period.
- 3) Assume there are four firms in this market during the base period. Select an alternative set of dates, say the first 10 weeks of 2015, determining the four firms have a market share of formulated trade in this weight category of: 6%, 23%, 56%, and 15%.

- a. Note, the share weights would be suppressed from the public. Only AMS personnel and the third-party contractor will know these weights.
 - b. The share weights always remain the same except for when firms do not report share weights, as they will need to be adjusted where firms do not participate in the market in a given week.
 - c. If any firm reports no transactions share weights, the weighting matrix will adjust accordingly.
 - i. If only one firm reports, then the index will need to be suppressed due to confidentiality. This is a concern for lighter weight categories.
- 4) Using the information from 2) and 3) one computes the base period price is \$221/cwt.
- a. Note, this will differ from the actual weighted average price computed off the 302 because the share weights will differ.
- 5) Moving forward to the January 20, 2017 period, the reported 75-85 formulated carcass price is computed as \$291/cwt.
- a. Note, this will differ from the actual price because the index uses the weights of 3) in computing the weighted average price.
- 6) The index is computed as $\$291/\$221 \times 100 = 132$. This is 132% of the base period price (see step 4).
- a. A user of this data would take the 132.0 reported by AMS to know that the price of 75-85 lb. lambs today is, on average, 132% of the base price period. So, the price today is 132% of \$221, or \$291.

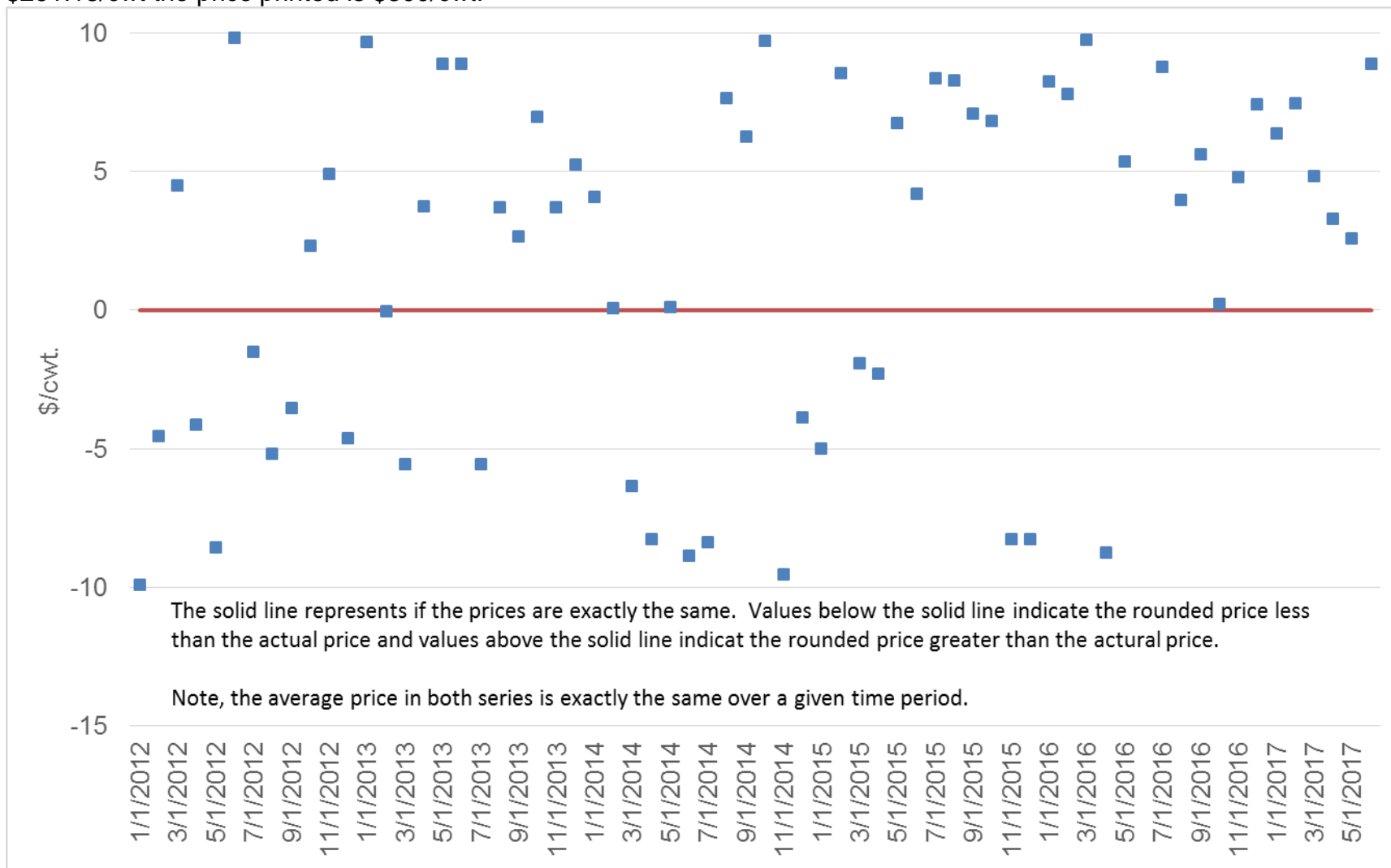
This price index is a feasible option though an option that will take considerable industry education.

4.6 Rounding

We examined the impact of rounding on the impact of market prices and on the ability to keep information confidential. Because the trade volume is light within the lamb trade and the industry is small, there is some risk that a firm could back out the true price of the day. Given this consideration, we chosen an interval of \$20/cwt. to round. We chose \$20/cwt, as this is approximately 7% of the average actual price in the data, which significantly reduces the chances of an entity backing out the actual price regardless of trade volume.

While rounding results in the same average price over a time span, the week-to-week variation in price is concerning. Since lamb markets will not sell the same volume of lambs each week, a lamb buyer or seller may observe a price above or below the true market value depending on the week. This approach distorts the market price in price discovery and could be controversial when used for a revenue insurance product.

Exhibit 4.6.1. Difference between formulated carcass price rounded to the nearest \$20/cwt increment and actual price (@ 7% of the average price), i.e., if the actual price is \$288.63 /cwt the price printed is \$280/cwt, or if the actual price is \$291.13/cwt the price printed is \$300/cwt.



Source: Agricultural Marketing Service.

4.7 Averaging: alternatives to the weighted average

Olympic averaging

Olympic averaging refers to the process of eliminating the high and low prices (i.e., entire transaction) over a time period. In the case of LMR lamb the period is a week.

We examined the coefficient of variation (weekly standard deviation in price divided by the weekly average price) for a random formulated carcass weight category, and the graph of this data is shown in Exhibit 4.7.1. The variability of the price series suggests reporting an Olympic average could be a viable option. Removing the hi-lo values did not impact the mean value at a sufficient level to give concern to market distractions. However, upon review of the number of weekly transactions for specific weight categories there are insufficient weekly transactions to sustain any level of anonymity with the Olympic average option, i.e., easy for individual firms to identify missing transactions. While this concern is not necessarily true for heavier weight categories, the Olympic average alternative is not a long-term fix.

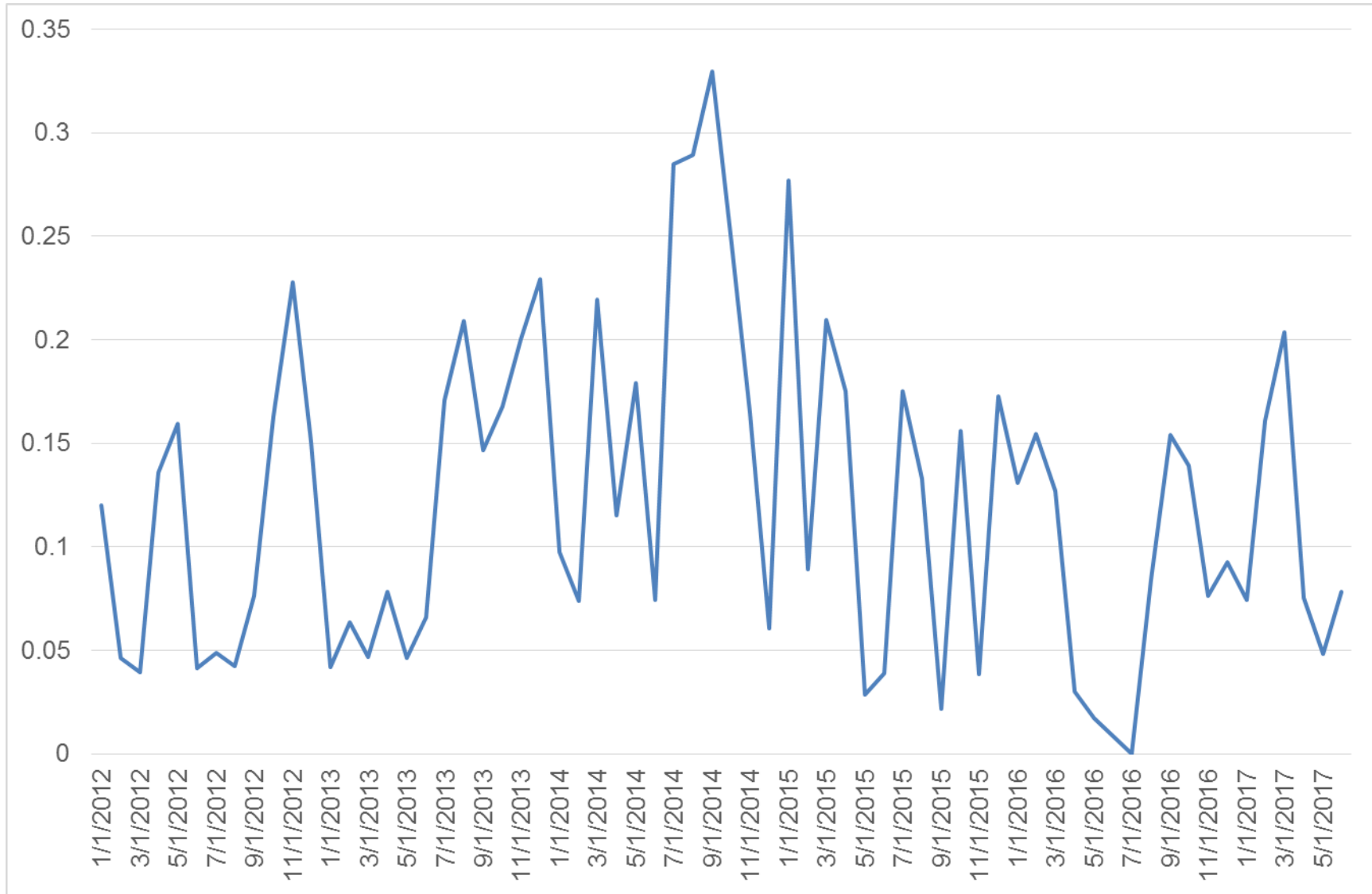
Simple Average

We looked at printing the simple average price versus the weighted average price. This is not a viable option because the simple average and weighted average differ significantly. Also, there is no week-to-week consistency in the difference. While the difference is not as pronounced for the heavier weight categories, the difference remains significant.

Trimming the Tails Average

We looked at lopping off the bottom and top 1%, 5%, and 10% of the transactions during a week. On some days, lopping off this many transactions significantly reduces the number of transactions from which to compute a weighted average price. Regardless, this price reporting alternative was sufficiently different from the weighted average price. We see this alternative as deriving a price that does not reflect the true market price.

Exhibit. 4.7.1. Coefficient of variation for a randomly chosen price series in the formulated carcass category.



Source: Agricultural Marketing Service.

4.8 Standardized pricing model

Given the well-documented challenges AMS currently faces in regularly reporting prices, a new alternative approach was considered that utilizes information from all transactions AMS receives. Specifically, a standardized price-computed approach was considered for viability using the first 17 weeks of 2017 as an examination period. The three-step, sequential approach proceeds as follows:

1. Identify the full set of transactions for the most recently completed two weeks, but not current week (e.g. at 8 am on Monday of each week). Using these actual transactions, a regression model estimates the relationship between head count, processing plant, formula, FOB, and weight category on transaction price.¹
 - a. Step 1 provides a model correlation vector describing how attributes of each raw transaction reported to AMS impact the reported prices in the examined two week period.
2. Use the full set of transactions for the current week (e.g. at 4 pm on Friday of each week) to identify the mean head count as well as the proportion of transactions that occur for each processing plant, are formula, are FOB, and fall in each of six weight categories.
 - a. Step 2 summarizes the proportion of raw transactions reported to AMS in the current week that comprise each attribute considered in Step 1.
3. Multiply the model correlation vector from Step 1 by the current week's transaction summary in Step 2 to derive the "New Industry Weekly Reported Price."
 - a. Given the first 17 weeks of 2017 on average contained 65 transactions (ranging from 39 to 80) being received by AMS, this results in Step 1 using on average 130 transactions and step 2 using on average 65 transactions.

This three-step process was completed sequentially for the first 17 weeks of 2017. In each new week, the process was updated to utilize one new week of information and drop the oldest week of information. As an example, for the initial week's assessment step 1 would contain information for the last two weeks of 2016 (December 17th – 30th) while step 2 (perhaps conducted late on January 6th) would contain information for December 31st - January 6th. Then when implementing for the second week's assessment step 1 would contain information for December 24th – January 6th while step 2 (perhaps conducted late on January 13th) would contain information for January 7th – 13th.

¹ Here head count is a continuous variable while all other variables are discrete (0/1) variables that serve as intercept shifters from the base case of transactions from one specific plant, non-formula, non-FOB, in the under 45 lb category.

The primary benefits of this approach include an ability to report information every week in a manner that utilizes the full set of diverse transactions reported to AMS without concern over revealing confidentiality of individual transactions. One downside of this approach is that no information is provided separating reported values by FOB, formula, or weight category characteristics.

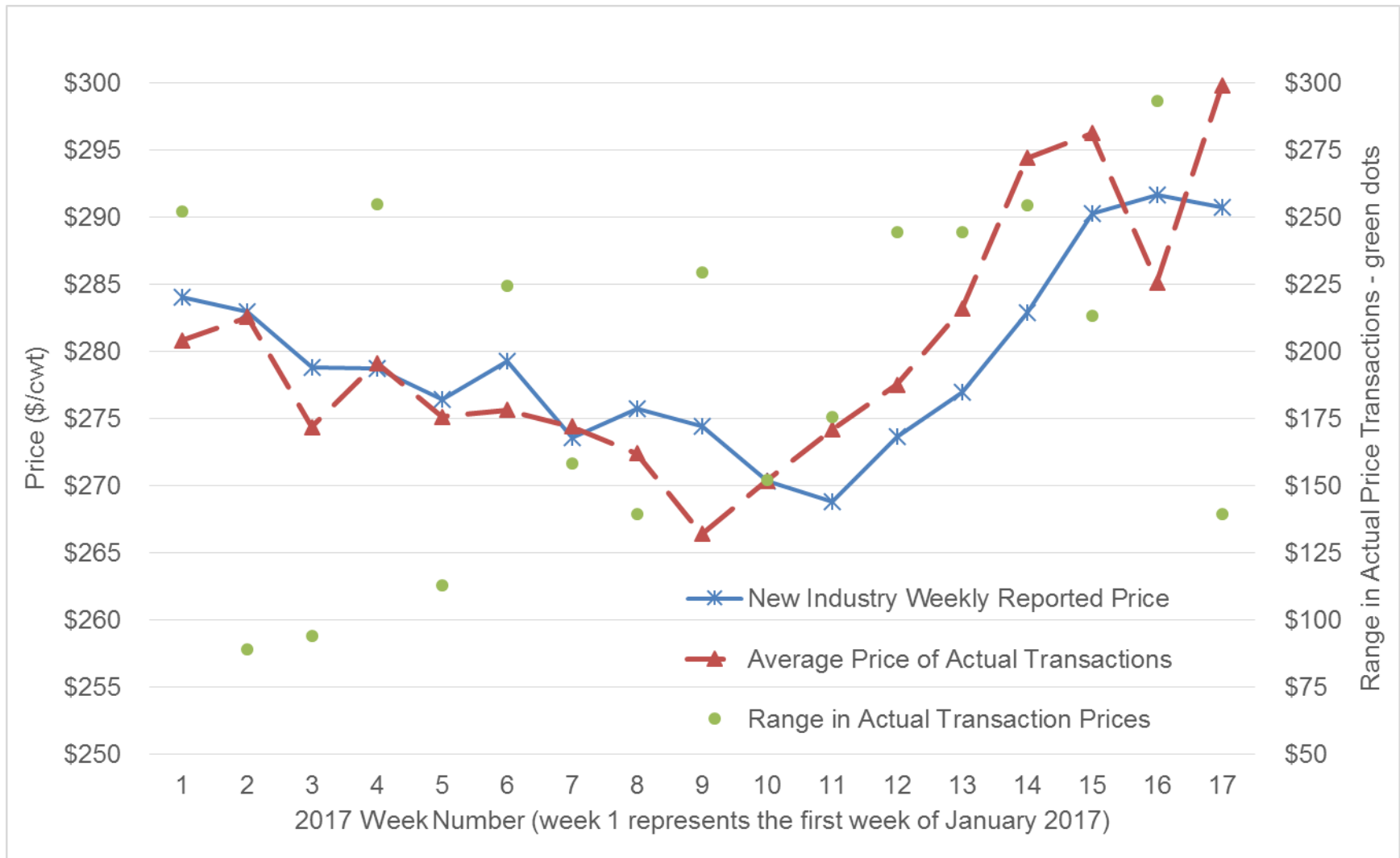
Exhibit 4.8.1 shows how the *New Industry Weekly Reported Price* would have performed early in 2017 had it been implemented. To provide context, the simple average price of actual transactions for each week is also plotted. On average over these 17 weeks, the mean actual price was \$0.73 higher than the *New Industry Weekly Reported Price* which corresponds to a 0.20% difference. The most extreme differences in mean actual price and the *New Industry Weekly Reported Price* were -\$8.00 (-3.0% in week 9) and +\$11.47 (+3.9% in week 14). While this suggests the *New Industry Weekly Reported Price* concept does a reasonable job of depicting representative industry trade, underlying variation in actual transactions reported to AMS warrants appreciation. To help show this in a confidential manner, the range in actual prices received by AMS each week is also shown in Exhibit 4.8.1. This also helps indicate how the *New Industry Weekly Reported Price* provides values that always fall between extremes in actual prices received by AMS without revealing information specific to these extreme transactions.

In addition to implementing this three-stage process as described, we considered a host of sensitivity analyses. These alternative approaches did not improve the process and included:

- Instead of Step 1 using the most recent two weeks, we considered using the most recent week only, using the most recent four weeks, and using the most recent five years of data. Using the two week period is consistent with our point on market information persisting for two weeks (see Section 5).
- We considered alternative specifications, including omission of an intercept term, dropping plant effects, collapsing weight categories into four groupings, and incorporating weight information continuously rather than discretely. This led to model correlation vectors that were less robust.
- Finally, we considered using only subsets of the transactions reported to AMS. Specifically, we considered omitting transactions with prices under a certain threshold price as well as running models separately by formula characteristics. Challenges immediately arise with shrinking an already low number of transactions.

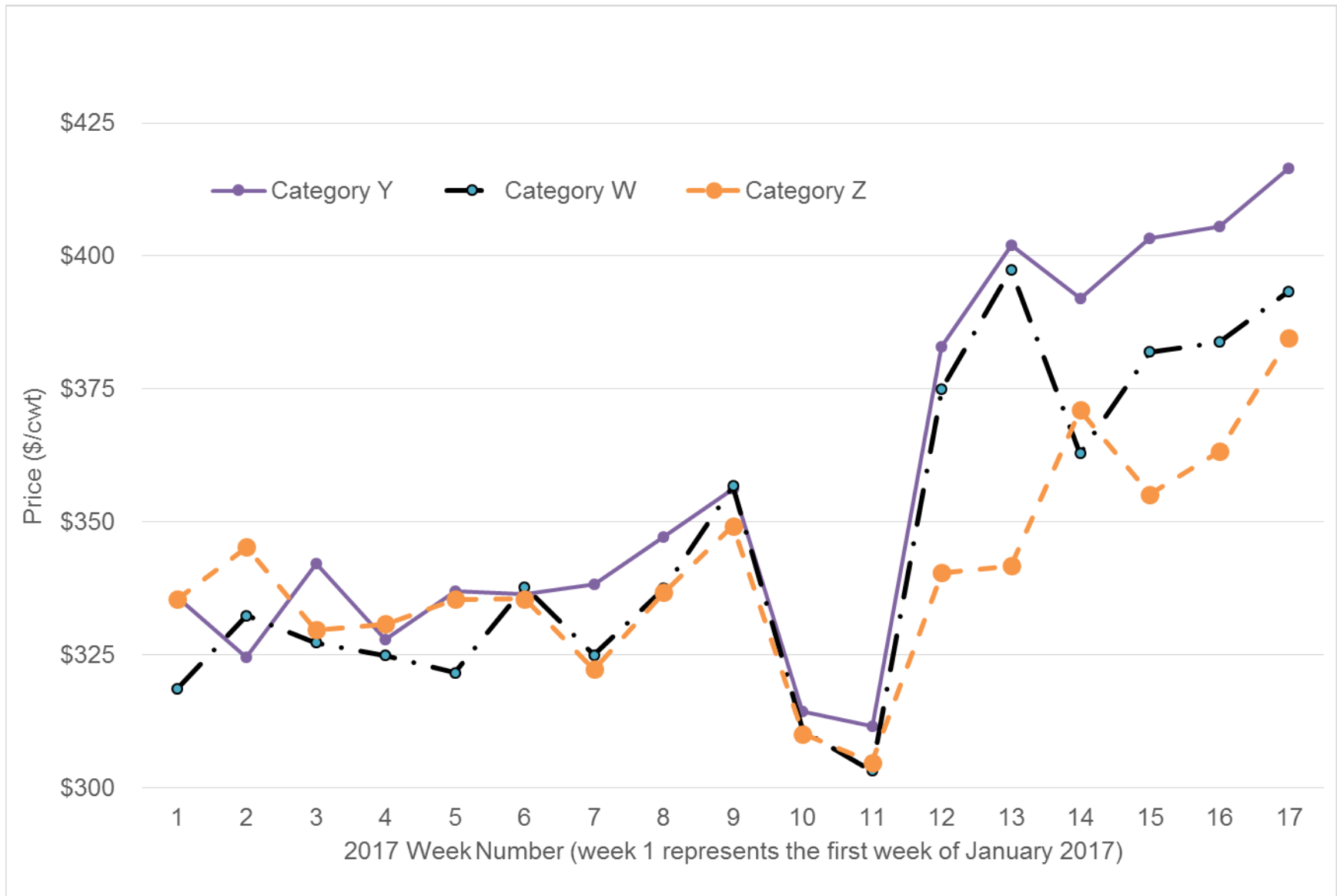
Given the variation in actual prices summarized by range information in Exhibit 4.8.1, to go one stage further it is worth considering how adjusting this three-step process could provide reportable information for weight categories. Exhibit 4.8.2 shows the *New Industry Weekly Reported Price* that results and could be reported. Values for lighter weight categories were not included as relationships between the lightest three categories are not stable for the examined period.

Exhibit 4.8.1. Standardized weekly reported price concept demonstration



Note: The dots (represented by the right-hand axis) indicate the price range. For example, the dot shown for week 2 is a value around \$85/cwt, representing the difference between the observed low and high price for the week to be \$85/cwt.

Exhibit 4.8.2. Standardized weekly reported price concept, for three chosen weight categories



5. When Is Data No Longer Confidential?

Some may wonder when information, or data, is irrelevant to the current market situation. Market prices are determined by the intersection of market supply and demand curves (see exhibit 5.1).

The market supply curve is derived from the summation of individual firm marginal cost curves. For lambs, this is the summation of individual feed yard cost curves. The factors of supply are the size of the live lamb herd, costs of inputs, and imports of lambs or carcasses. In a biological process like lamb production, lamb supply is primarily determined 6 to 8 months in advance by the number of lambs born. This is why the supply curve is drawn steeply in exhibit 5.1, i.e., once a producer has the lambs on the ground it's difficult to increase the supply of lamb much.

Market demand is determined by the summation of all end-user needs and wants, which derives the demand for live lamb by processors. End-user products vary in price and form, and the lamb value chain coordinates the flow of quantities versus payments from end-users. This creates a retail-to-processor margin as shown in exhibit 5.2. The retail price is set based on the price necessary to clear the market based on supplies established from the lamb crop 6 to 8 months ago. The retail demand price is then used to set the processor and farmer prices.

Before moving forward, let's reflect: Globally, sheep producers lambing today are a strong signal of lamb meat available 6 to 8 months from now. Currently, the end-user must find a price point to clear the market of this quantity of meat. Demand is realized through this iterative process, leaving the processor to work off a margin between the price paid for a lamb and the composite value of all the parts of the lamb sold to end-users (i.e., meat, offal, pelts, etc.). Processors then take costs out of this gross margin to arrive at a level of profitability. An individual processor's margin can tell much about operating costs, fabrication costs, employment costs, and pricing strategies of the business. Their "margin" is considered proprietary information. Reporting past prices because the prices are no longer relevant to the current market runs the risk of exposing firm-level margins, which tend to be stable over time.

Exhibit 5.1. Farm-level supply and demand.

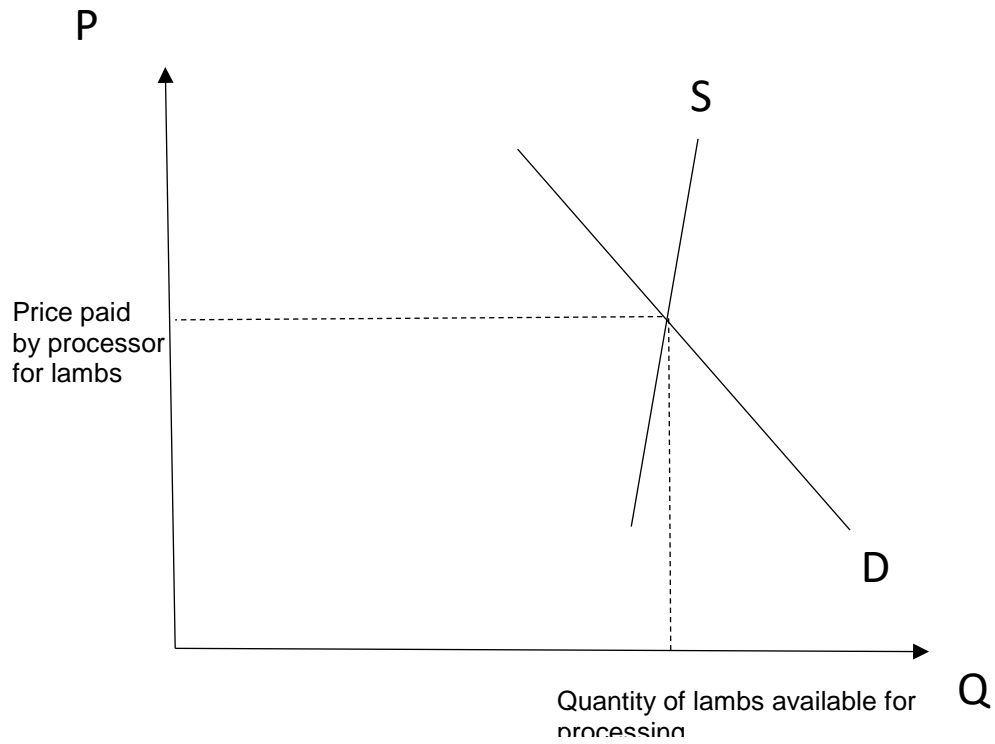
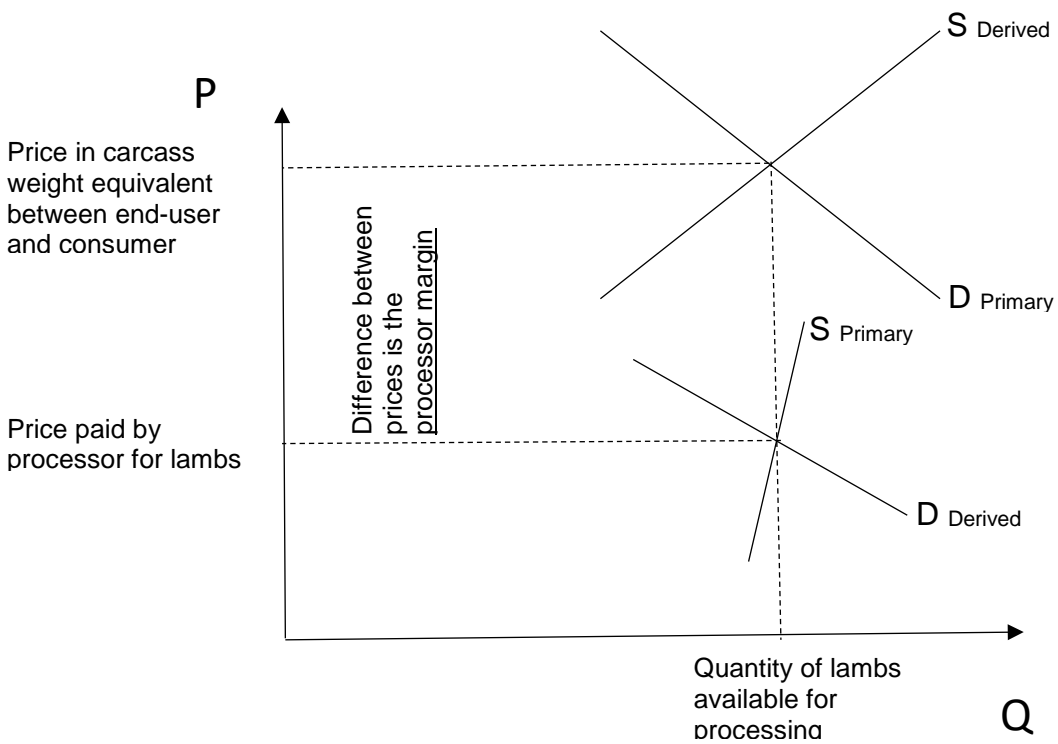


Exhibit 5.2 Farm-to-retail margin.



Market price persistence

Market prices fluctuate day-to-day or week-to-week based on supply and demand fluctuations. For livestock market reporting of live lamb, the market has been set as one week, i.e., weekly reports such as the 302, 352, or 500 (note: 500 is a 5-day rolling average) For an example, see here https://www.ams.usda.gov/mnreports/lm_lm352.txt and the appendix for the LM352, National Weekly Slaughter Sheep Review. How long does the current market remain relevant to prices in the future?

To examine this question, we used LMIC price data. To test the relationship of lamb carcass price across weeks we regressed 822 weeks of current week formula lamb carcass prices on the last four weeks of reported prices (see exhibit 5.3). One week ago the price is virtually the same. Two weeks ago approximately every \$0.29 of price this week is in common with a price two weeks ago. Three and four weeks ago are virtually irrelevant to today's market. Thus we conclude that transactions more than three weeks old are of little relevance to the current market price.

Exhibit 5.3 Regression Results of Market Price Relative to Time Dimension, Using Secondary Data

<i>Regression Statistics</i>				
R Square				0.997
Standard Error				3.476
Observations				822

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.94	0.47	2.00	0.05
Formula price lagged 1 week	1.01	0.03	29.52	0.00
Formula price lagged 2 weeks	0.29	0.05	6.02	0.00
Formula price lagged 3 weeks	-0.08	0.05	-1.57	0.12
Formula price lagged 4 weeks	-0.23	0.03	-6.65	0.00

We completed a similar time-series study for one set of firm-level transactions for a specific weight category. The results of this analysis were revealed the exact same results of the current market price showing up in the price over the next two week period. These results are not reported here to preserve confidentiality.

We recognize the seasonality of prices is present, but we did not specifically model seasonality in the modeling.

6. Lamb Products

For lamb product cuts, we looked at transaction data over the 2016 through March 2017 period. Over 50 cuts were included in the data. Using the premise that the findings of the live trade are generally applicable to the product trade, we spent considerably less time analyzing these transactions.

As shown in exhibit 6.1, the issue of confidentiality is not as much a concern with the lamb product cuts price series. Not surprising is that frozen product cuts have fewer firms in the market than firms in the market for fresh product. We believe more harm than good can be accomplished by adjusting how lamb product prices are adjusted.

Exhibit 6.1. Percentage of approximately 55 cuts having fewer than 2, 3, or 4 firms reporting over the period January 2016 through March 2017. Includes both fresh and frozen trade.

Less than ___ firms reporting consistently	2 firms	3 firms	4 firms
	14% of cuts	23% of cuts	32% of cuts

Note: These percentages should be taken as maximums because we did not take the time to cross-reference cuts with blended IMPS codes.

Combining fresh and frozen cuts

We examined the prices between fresh and frozen product trade. When data were available prices of fresh and frozen, for the same IMPS code, were either close to each other or the frozen product was significantly discounted. AMS could consider combining fresh and frozen transaction data with a rule of dropping transactions from the computation for any frozen cut value 10% below the weighted average cut price for that reporting period.

Extending the rolling average period beyond 5 days

Because of the vastness of the lamb product cut data, we did not specifically evaluate how long a current price remains relevant beyond the 5-day rolling average. A cursory review of the many price series suggests AMS may want to investigate with industry increasing the number of days from a 5-day to a 7-day or 10-day rolling average. Due to the volume weight of specific transactions and the high value of the cuts, it is difficult to quantify the firm-level financial implications of establishing a new price series. The caveat here is that this aggregation alternative would minimally increase the number of currently unreportable prices.

Standardized pricing model

Without conducting significant analysis we believe that cut prices associated with more than one firm reporting and now unreportable could be reported using a standardized pricing model. Our review of the data for the various cuts now unreportable lead us to this conclusion. By our calculations this would allow 5 additional fresh cuts to be reported for fresh product.

7. Appendix

https://www.ams.usda.gov/mnreports/lm_lm352.txt

LM_LM352 **Please see note below regarding the Comprehensive section**
St. Joseph, MO Fri Aug 18, 2017 USDA Market News

National Weekly Slaughter Sheep Review for w/e Friday, August 18, 2017

Compared to last week, negotiated purchases of slaughter lambs were 7.00 to 8.00 lower.

Negotiated Purchases:

This Week: 7600 Last Week: 5000 Last Year: 7500

Domestic Slaughter Lambs

Choice and Prime:

Live Purchases:	Weight Range	Price Range	Wtd Avg Price
Wooled and Shorn	120-170 lbs	145.00-199.25	167.98

Formula Purchases:

Formula purchase information for previously slaughtered lambs (carcass basis)

Weighted Average Weight: 84.14 lbs
Weighted Average Net Price: 324.01
Weighted Average Dressing Percent: 50.60

**Effective today, cooperative member lambs are included in this
Comprehensive
Information section**

Comprehensive Information:

Includes all negotiated, formula, & cooperative member lamb data submitted
this week
(carcass basis)

Weighted Average Weight: 77.72 lbs
Weighted Average Net Price: 325.69
Weighted Average Dressing Percent: 51.20

This report covers transactions reported this week. Comments and market
conditions include information gathered from voluntary sources. All prices,
weights, and head counts are gathered through the Livestock Mandatory
Reporting
system.

Voluntary Reporting Example: Live Cattle LS-831 complements LMR cattle fed cattle reports

SALES VOLUME:

Thursday, 8/17/17

Reported: 15,000
 Estimated: 58,000

PRICES PAID:

	STEER/HEIFER — Select and Choice		
	LIVE F.O.B (CASH)	DRESSED Delivered (CASH)	DRESSED Delivered (Grid Basis)
TX/OK/NM	110.00	None	None
KANSAS	110.00	None	None
NEBRASKA	110.00-110.50	175.00-177.00	None
COLORADO	110.50	None	None
IA/MN	110.00	175.00	None