Development of Methodology for Calculating Estimated Net Price Information for Negotiated Barrows and Gilts

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Forward

This project report represents the sole professional opinions of the researchers. Agricultural Marketing Service staff provided access to data and information upon request. Opinions presented in this report are solely those of the authors and do not reflect or represent views or opinions of any Agricultural Marketing Service, U.S. Department of Agriculture or pork industry representatives.

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Executive Summary

This study's main objective was to assess the ability of the AMS to accurately compute (predict) net prices received for hogs at the time the negotiated base prices are reported. Several approaches were used to assess the ability of the USDA AMS to predict the base prices at the time the negotiated base prices are established.

Overall, this study concludes that no sufficiently accurate method to predict net prices at the time base prices are negotiated can be created. This conclusion is based on thorough analysis of daily reported base prices and net prices from the past 10 years and detailed analysis of all individual transactions data on negotiated base and net prices from the past 30 months. The errors in translating base prices into expected net prices would be too large to make this computation and reporting of it have value for the hog industry. Going forward the AMS and hog industry should consider several actions:

- This study does not recommend that the AMS report computed net prices, derived from negotiated base prices, at the time negotiated base prices are established. The errors in this projection would be too large to make this information have any added value to the hog industry.

    o The inability to predict net prices at the time base prices are established is not a problem associated with packer submission of information, AMS data collection, mandatory price reporting, or AMS reporting. Instead, it's related to the nature of the hog market. Too much unpredictable variation in hog quality is present across transactions, and over time, to enable reliably computing net prices at the time the base prices are established.

    o Currently, MPR legislation does not require a unique transaction identifier to match purchase transactions with slaughter transactions. While adding a unique identifier to the MPR requirement is appealing, we are unsure if the industry value will outweigh the cost to the processors.

- We suggest that AMS examine segmenting negotiated purchase data weighted average base price into thirds based on the number of animals represented by a particular report. The concept involves ordering transactions (or lots) from low price to high price. Divide the number of hogs into three equal portions. Each hog in each third has a price assigned to it. The weighted average price is then computed for each third. We recommend assessing how this new reported set of three weighted average prices would perform and what information it would add to current base price reporting.

- We suggest that AMS consider tracking individual plant price effect for all (barrows and gilts, carcass and live, and sow) negotiated prices reported, i.e., AMS could follow a similar methodology used here to measures the change in price due to dropping a plant. AMS could develop a rule for switching plants from negotiated to other market arrangements, for when a plant is considered to have a non-market related impact on the weighted average price. Impacts of alternative rules should be explored if this approach were taken to assess impacts on reported prices.

- Thinning negotiated base prices are apparent and we believe it to be true that day-to-day price variability appears to at times not be fully reflective of changing market fundamentals, and those using these reported prices as bases in marketing agreements might want to explore other alternatives if recent trends continue.

  - We recommend that the industry participants using the national weighted average consider using a historical combined multi-day (say 20 day) share volume weighting to calculate the national average from the regional prices rather than using the most recent single day's volumes in the two regions.. This will mitigate day-to-day price fluctuations in relative regional volumes that are due to non-market factors.

  - Individual producers may be more able to predict their net prices more effectively than the AMS can predict a net price for the entire market or than the AMS can predict even for individual transactions. Transactions are not distinguished by a unique seller identifier, so the AMS cannot correlate purchase transactions with slaughter transactions. Individual hog producers, however, do know this information for their own transactions.

- Tremendous variation exists among net purchase prices in the hog industry. This suggests strong price incentives are present for producing hogs that meet packer preferences for carcass weight and quality. Producers could benefit from continued information that shows them how much value they forfeit when they market hogs that do not take advantage of, or that do not fit well into, a particular packer's value matrix.

Chapter 1: Introduction

Producers arrange marketing contracts to ensure that they can access a marketing outlet, align market formulas to match the quality of animals that they produce, or provide financial stability by tying their operations to marketing contracts. Such marketing contracts typically entail establishing a base price to which quality performance premiums would be added or to which quality underperformance discounts would be subtracted. In the hog market, the most popular price used as a base in contracts is the prior day negotiated producer sold price. The contract base price may be a regional or national price. The USDA Agricultural Marketing Service (AMS) reports local and national negotiated hog prices under Mandatory Price Reporting (MPR) legislation.[1] Producers marketing with contracts want assurance that the prior day producer sold negotiated base price is the best representative price for AMS to report. Hog producers are concerned that the prior day producer sold negotiated purchase price does not include hog quality-related premiums and discounts that are reflected in an AMS-reported net price, which is reported when the hogs are slaughtered. Prior to slaughter, i.e., when the base price is set, these quality attributes are unknown. Following the definition of negotiated in the mandatory price reporting legislation, hogs purchased through negotiated means represent hogs to be scheduled for slaughter anytime during the immediate 14 calendar days following the purchase transaction.[2]

Each processor, and sometimes individual plants owned by a processor, may have an independent quality standard (buying program) when purchasing hogs. The day-to-day swings in the reported prior day negotiated purchase price could be evidence that different processors make purchases in the cash market at different times. Therefore, the perception is that adjusting the negotiated base price to a net price yields a more accurate reflection of changing market conditions over time. An adjusted base price, i.e., known base price adjusted for expected quality attributes of a lot, could be more meaningful than the currently reported base price because the adjusted base would encompass different processor base quality standards and premium and discount schedules. An adjusted base would reflect what producers are actually being paid for hogs net of quality premiums or discounts.

For example, suppose one processor is known to tie its net price to an expected back fat level. However, most processors tie the net price to an expected percentage lean level. Because the premiums and discounts are significantly different between back fat level and percentage lean

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[1] Livestock Mandatory Reporting Act: http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&navID=LSMNMainRN2L2&rightNav1=LSMNMainRN2L2&topNav=&leftNav=MarketNewsAndTransportationData&page=MPRinfo&resultType=&acct=lsmn

[2] Scheduled for delivery is different from delivered by as many as 4 days. Thus, some hogs purchased in the negotiated trade may not be slaughtered until 18 days later.

level, the base price offered between packers could differ significantly. These different pricing structures could significantly impact the AMS base price reported if the packer using back fat level represents a large proportion of negotiated purchases on an irregular basis. This would introduce base price variation that is not associated with changing market conditions but instead due to who is participating in the negotiated market. These concerns are particularly important because the hog negotiated cash market has dwindled to less than 5 percent of overall hogs being marketed.

During the past decade, the number of barrows and gilts sold through the negotiated cash hog market has steadily declined. According to mandatory price reporting data, prior day negotiated national purchases may represent as little as 1.5 percent of overall barrow and gilt purchases during some days. Small numbers of transactions allow for the possibility of small differences in procurement programs, between hog processors, to influence the weighted average negotiated price reported on any particular day. This is potentially problematic as it suggests that the particular plant buying hogs on a particular day could change the market reported negotiated price in a way not otherwise supported by general market supply and demand fundamentals.

Because of these concerns, the National Pork Producers Council established a resolution in March 2013:

> "The resolution requested NPPC to work with appropriate parties to assist USDA Market News in development of a process to calculate, then publish, an estimated net price for daily negotiated bids and consider a potential methodology for including hogs bought on a live basis in the negotiated net price for prior day and daily purchased swine reports. Pork producers watch current-day purchase reports for guidance about the level of hog prices on a particular day. Purchase data include only base prices for hogs, since the animals have yet to be harvested. Carcass measurements, however, determine premiums and discounts, and ultimately, the net prices received by packers. USDA has over 10 years of data on mandatory price reporting, and could easily determine the relationship between net and base prices reported by packers."

<u>The purpose of this project was to respond to pork industry concerns, to assess whether the necessary data are available, and to determine whether a methodology can be applied to enable AMS to publish a meaningful computed net price at the time the negotiated price is reported (up to 14+ days prior to slaughter).</u>[3]

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[3] Because for definition of negotiated trade hogs only need to be scheduled during the prior 14 calendar days, slaughter can take place beyond the 14 day window.

# Chapter 2: Hog Production and Processing Background

The U.S. pork supply chain continues to evolve. Supply chain evolution presents challenges and opportunities. New paradigms are formed, and traditions are set aside. Integration and coordination of the pork supply chain continues as suppliers and processors strive to meet consumer demand consistent high quality pork products. Hog producers respond to market signals by adopting pork genetics, production systems, and marketing arrangements that maximize profits.[4] Likewise, hog processors adopt processing technologies, innovate into value-added products, and develop buying programs that facilitate profitable operations. This chapter provides a broad overview of the evolving pork supply chain during the past 20 years. This information is important for addressing the objectives of this study because it provides information on the market environment in which the pork industry operates.

Total hog production increased by 20 percent from the mid-1990s to 2013 (Exhibit 2.1). In 2013, federally inspected industry hog slaughter was 111 million head, of which 97 percent was barrows and gilts and the rest were cull sows, stags, and boars. While the number of federally inspected hogs slaughtered has been flat in recent years, federally inspected pounds of pork production continues to increase (Exhibit 2.2). The increase in pounds of pork production has been influenced by an increase in carcass weight over time (Exhibit 2.2). During the past 20 years, the yield of carcass weight to live weight has increased from 73 percent to 75 percent of the live hog.

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[4] While profit maximization is a financial goal of a business, economists find other reasons why farmers use or choose not to use marketing arrangements and production contracts, for examples see the various works of Nigel Key.

Exhibit 2.1. Barrow and Gilt, Sow, and Stag/Board Annual Slaughter, 1994 to 2013[5]
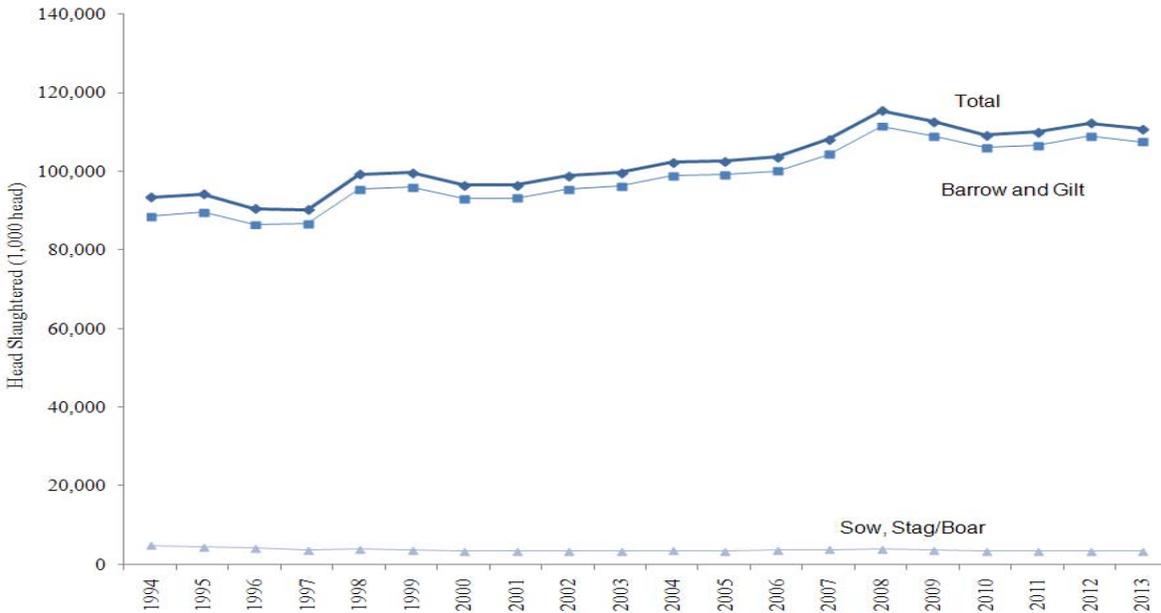
Exhibit 2.2. Federally Inspected Pork Production and Carcass Weights, 1994 to 2013[6]

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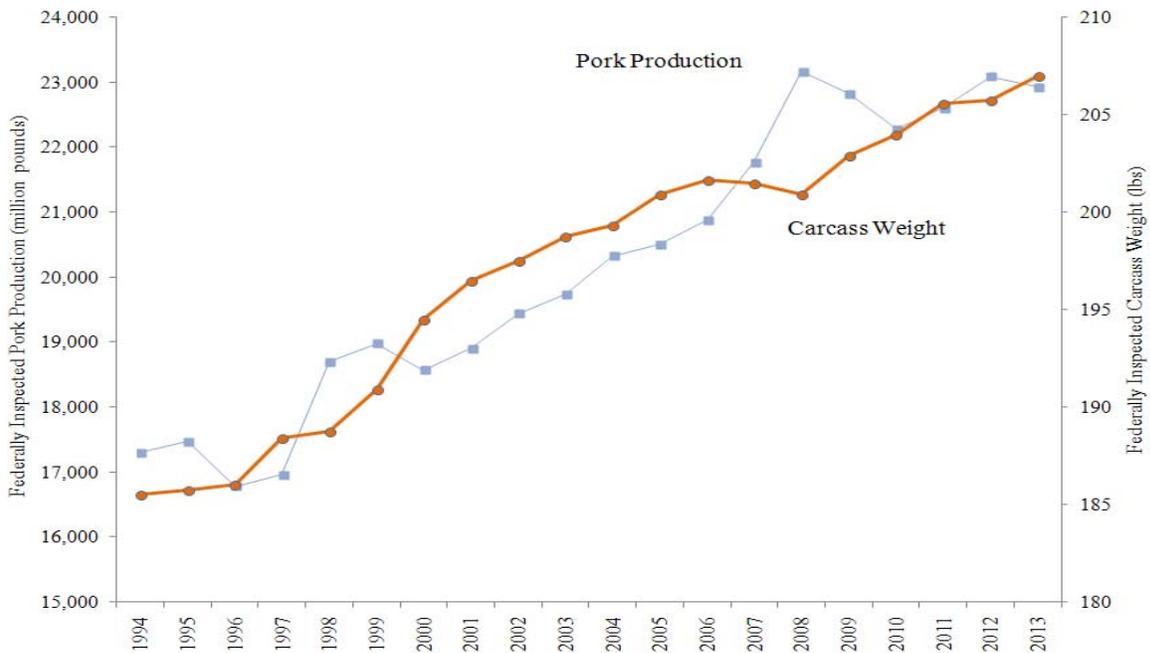
[5]USDA, ERS (Red Meat Yearbook Various Years)
[6]USDA, ERS (Red Meat Yearbook Various Years)

Slaughter capacity has expanded along with hog production. Firm plant capacity information is confidential, which makes an actual historical account difficult. The trend in annual domestic slaughter capacity is approximated here as the annual maximum daily observed head slaughter between 1990 and 2013 (Exhibit 2.3). Similarly, the trend in daily domestic slaughter production capacity by year is approximated here as the annual maximum daily observed pork production between 1990 and 2013 (Exhibit 2.4). Approximated domestic daily hog slaughter capacity and domestic monthly pork production increased by more than 20 percent and more than 40 percent, respectively, from the mid-1990s to 2013. These trends mirror the increase in hog and pork production (see Exhibits 2.1 and 2.2).

Pork processing plant managers maximize plant utilizationto reduce processing fixed costs per animal.[7] Thus, firms have an incentive to schedule slaughter to minimize excess plant capacity. One advantage of firms entering into forward pricing agreements is that firms can better schedule slaughter.

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[7] For a discussion of how variances in slaughter utilization-to-capacity impact hog prices see:
Parcell, J.L., J. Mintert, and R. Plain. "An Empirical Examination of Live Hog Demand." *Journal of Agricultural and Applied Economics*, 36(2004)773-778.

Exhibit 2.3. Approximated Daily U.S. Hog Slaughter Capacity (000 head), 1990 to 2013[8]
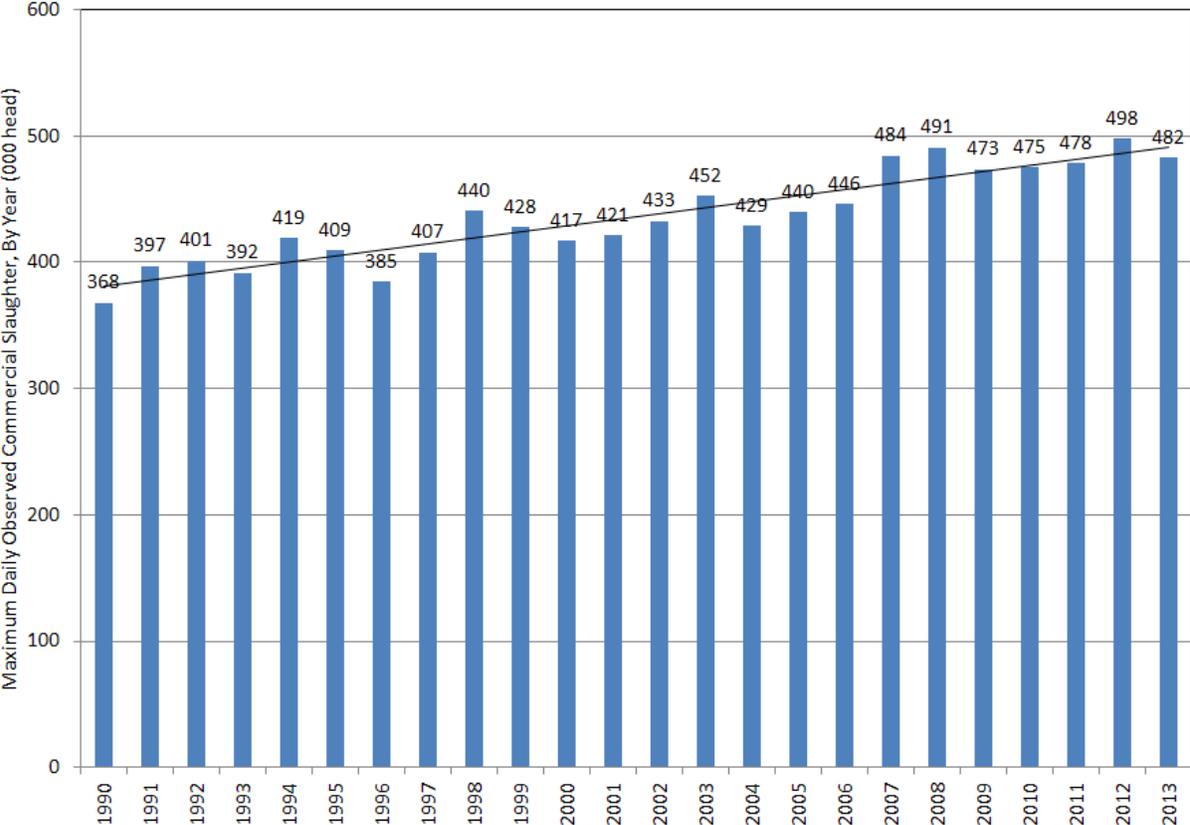
Exhibit 2.4. Approximated Daily U.S. Pork Production Capacity (million lbs), 1990 to 2013[9]
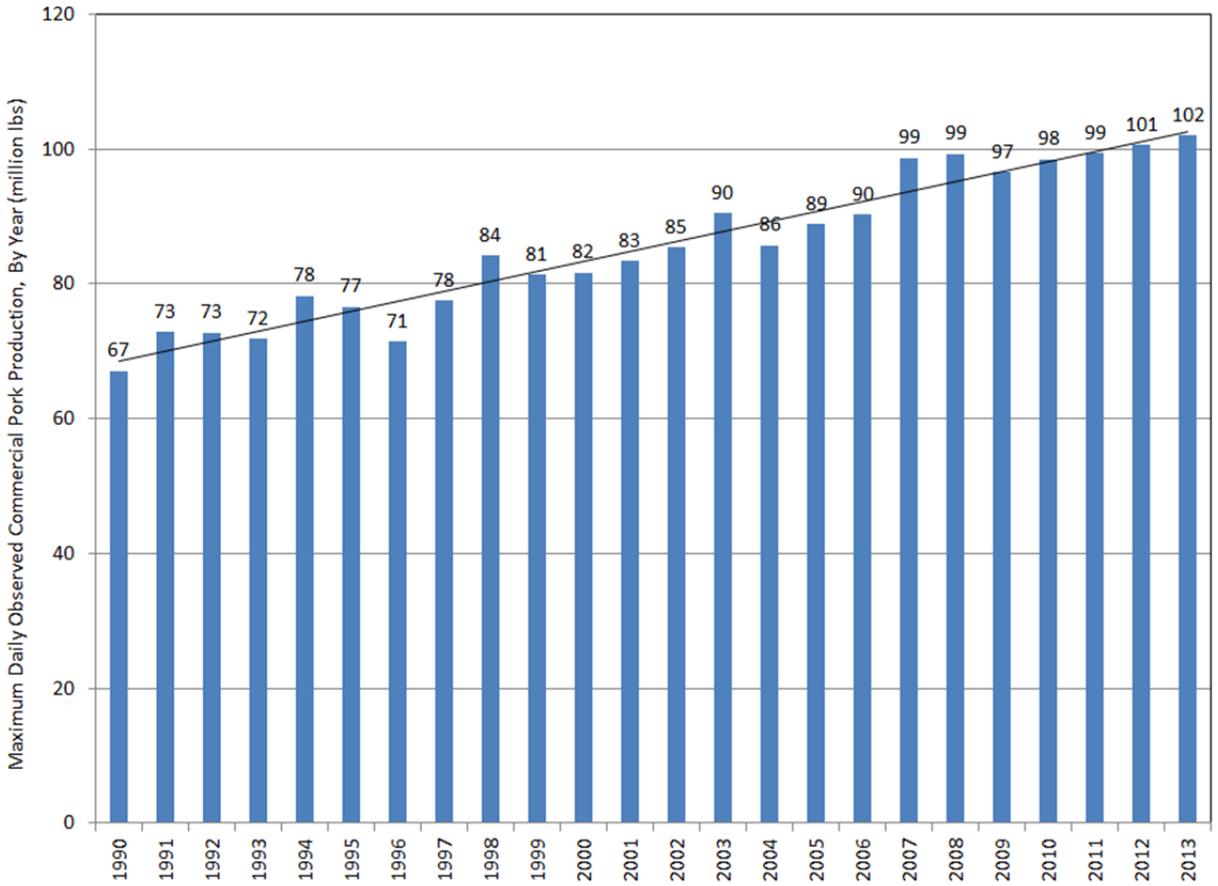
Lastly, we note the growing importance of pork exports. Between 1984 and 2013 the percentage of US pork production exported has increased from 1% of production to 22% of production, while pork production has increased by around 60%.

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[9]USDA, ERS (Red Meat Yearbook Various Years)

2.1 Processing Industry

The daily slaughter capacity of barrow and gilt processors in 2013 is presented in Exhibit 2.1.1. Currently, all barrow and gilt processing plants that slaughter at least 100,000 head of swine per year on average for the immediate preceding five years are required to report hog purchase prices to the AMS under rules of the Livestock Mandatory Reporting Act of 1999. This would equate to hog processing plants slaughtering roughly 400 head per day.[10]

The geographic dispersion of barrow and gilt slaughter plants is illustrated in Exhibit 2.1.2. Most of the plants subject to current hog price reporting, and certainly the largest volume of hogs represented, are located in the southeastern (e.g., NC, VA, and SC) and Midwestern (e.g., IA, IL, NE, MN, MO) regions of the United States. A few are also located in the West (e.g., CA). Geographic plant dispersion is important within hog price reporting. Spatial hog pricing differences are common due to regional pork pricing differences. For example, relative to Midwest prices, southeastern plants might pay a premium for hogs because of pork's higher value in the region and the higher opportunity costs incurred when producing hogs in this region.

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[10] These are only rough estimates of firms and plants because the researchers only have access to estimated slaughter capacity, not actual slaughter by year by plant. Actual slaughter by plant is confidential data not made available to the research team.

Exhibit 2.1.1. U.S. Barrow and Gilt Processors and Daily Plant Slaughter Capacities, 2013[11]

Company	Plant	Capacity (head)	Co. Total
Smithfield (Smithfield, VA)	Tar Heel , NC	34,000	
	Gwaltney, VA	10,400	
Morrell	Sioux Falls, SD	20,500	
Farmland	Crete, NE	10,400	
	Denison, IA	9,400	
	Monmouth, IL	11,400	
Prem. Std.	Milan, MO	10,300	
	Clinton, NC	10,600	117,000
Tyson Foods (IBP) (Dakota Dunes, SD)	Waterloo, IA	19,500	
	Logansport, IN	15,300	
	Storm Lake, IA	16,500	
	Col. Junction, IA	9,950	
	Madison, NE	7,925	
	Perry, IA	7,750	76,925
Swift (Greeley, CO)	Worthington, MN	20,000	
	Marshalltown, IA	20,000	
	Louisville, KY	10,000	50,000
Cargill Pork (Wichita, KS)	Beardstown, IL	19,400	
Wichita, KS	Ottumwa, IA	18,400	37,800
Hormel (Austin, MN)	Austin, MN	19,000	
	Fremont, NE	10,500	
Clougherty	Los Angeles, CA	7,800	37,800
Seaboard Farms	Guymon, OK	19,800	
Triumph Foods	St. Joseph, MO	20,000	
Indiana Packing Co.	Delphi, IN	17,000	
Hatfield Quality Meats	Hatfield, PA	10,400	
J.H Routh	Sandusky, OH	4,200	
Rantoul Foods	Rantoul, IL	4,800	
Sioux-Preme Packing	Sioux Center, IA	4,500	
Greenwood Packing	Greenwood, SC	3,000	
Pork King Packing	Marengo, IL	2,800	
Premium Iowa Pork	Hospers, IA	2,000	

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[11] Meyer, S. 20014. Paragon Economics and National Pork Producers Council. Personal correspondence Winter 2014.

Exhibit 2.1.1. (cont.) U.S. Barrow and Gilt Processors and Daily Plant Slaughter Capacities, 2013[12]

Company	Plant	Capacity (head)	Co. Total
USA Pork Products	Hazellton, PA	2,000	
Spectrum Meats	Mount Morris, IL	1,600	
Yosemite Meats	Modesto, CA	1,500	
Dakota Pork, Inc	Estherville, IA	1,500	
Leidy's	Souderton, PA	1,300	
Vin-Lee-Rom	Mentone, IN	1,150	
Martin's Pork Products	Falcon, NC	1,300	
Verschoor Meats	Sioux City, IA	1,200	
Olson Meat Company	Orland, CA	1,200	
The Pork Company	Warsaw, NC	900	
Jim's Farm Meats	Atwater, CA	850	
Independent Meats	Twin Falls, ID	750	
Peoria Packing	Chicago, IL	600	
Masami Meat Company	Klammath Falls, OR	600	
Dekalb Packing Company	De Kalb, IL	500	
Parks Family Meats	Warsaw, NC	450	
Carleton Packing Company	Carleton, OR	375	
Morris Meat Packing	Morris, IL	300	
Dealaman Enterprises, Inc.	Warren, NJ	200	
Weltin Meat Packing	Minden City, MI	175	
Southern Quality Meats	Pontotoc, MS	160	
Dayton Meat Co.	Dayton, OR	100	
Kapowsin Meats, Inc.	Graham, WA	100	

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[12]Meyer, S. 20014. Paragon Economics and National Pork Producers Council. Personal correspondence Winter 2014.

Exhibit 2.1.2. Geographic Locations of U.S. Barrow and Gilt Processing Plants, 2013[13]

13 Created through data obtained through Meyer, 2014. See footnote 10 or 11.

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2.2 Hog Procurement Trends

As hog and pork production was expanding, a major shift occurred in how live hogs were sold by producers to hog processors (Exhibit 2.2.1). In 1994, it was estimated that 62 percent of hogs were sold through negotiated (live or carcass) cash markets. However, by 2013, negotiated (live or carcass) cash sales had declined to less than 4 percent of trade nationally. In 2013, live negotiated cash sales represented less than 1 percent of total hog marketings nationally.[14] A further breakdown of hog sales methods are provided in Exhibit 2.2.2. Much of the reduced cash-negotiated hog sales has been a result of increased packer-owned hogs, which represented 28 percent of all hogs sold (or transferred inter-firm) in 2013. Formula pricing of hogs has been common for several years and has represented about 45 percent to 50 percent of annual hog marketings. During the past 10 years, the percentage of packer-sold hogs has remained flat at around 5 percent.

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[14]In reaching contract production settlements with hog contract production farms in Iowa, the consent decree between the firm and Iowa Attorney General requires that should the firm sell hogs under production contract in Iowa to a processor which it is an owned affiliate, at least twenty-five percent of the hogs processed at that processor will be purchased from a firm other than the firm with the owned affiliation. The agreement is a for two year period. Such an agreement has been reached between the Iowa Attorney General and several hog contract production firms over the past decade. What impact this has on increasing the negotiated trade nationally, or regionally, is unknown.
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Exhibit 2.2.1. Percentage of Hogs Purchased on Negotiated Cash Market, 1994 to 2013[15]
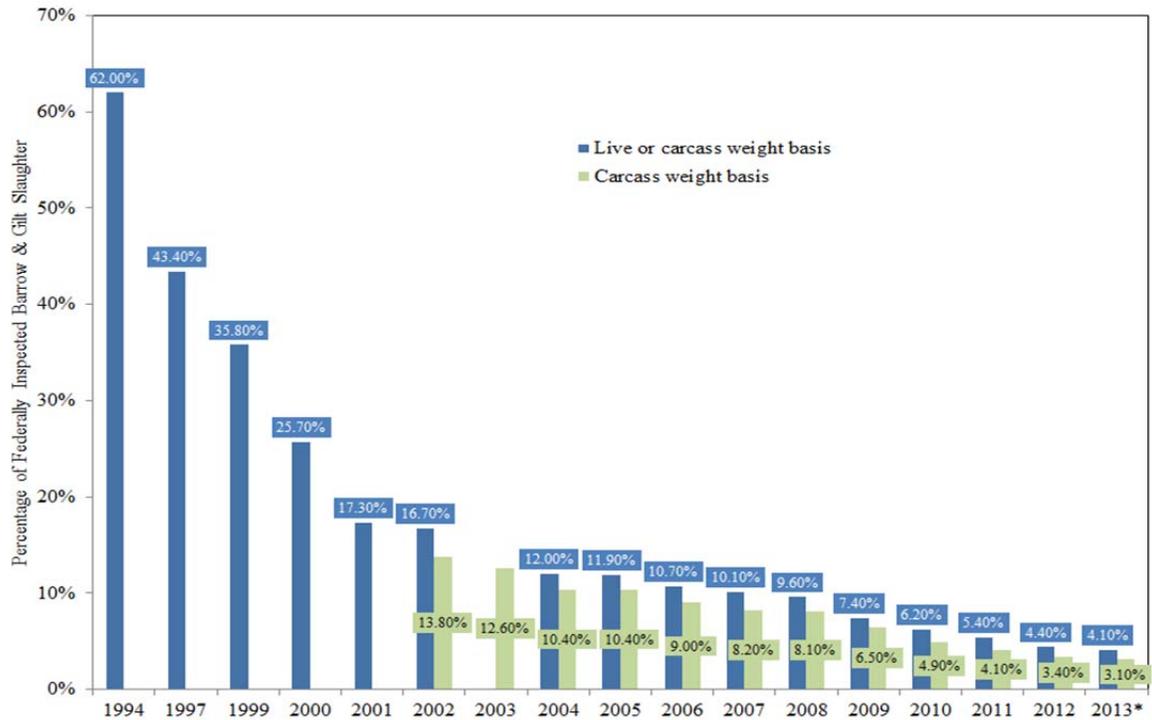
[15] Grimes, Glenn, and Ron Plain. "U.S. Hog Marketing Contract Study." Farm Marketing, University of Missouri-Columbia Dept. of Agricultural Economics. January 2009. http://agebb.missouri.edu/mkt/vertstud09.htm (22 October 2009).

[12] Plain, Ron. "U.S. Market Hog Sales, 2002-2012." Farm Marketing, University of Missouri-Columbia Dept. of Agricultural and Applied Economics. May 2013. http://agebb.missouri.edu/mkt/vertstud09.htm (5 January 2014).

Exhibit 2.2.2. Percentage of U.S. Hogs Sold using Various Pricing Arrangements, January 2004 to 2013[16]

Pricing Arrangement	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013[17]
Mandatory Price Reporting										
Negotiated (carcass)	10.4	10.4	9.0	8.2	8.1	6.5	4.9	4.1	3.4	3.1
Market formula (carcass)	38.2	38.6	35.4	35.7	35.6	41.4	36.5	36.8	38.9	39.4
Other market formula (carcass)	8.6	8.4	8.4	8.1	9.4	6.5	10.1	9.4	7.3	6.9
Other purchase agreement (carcass)	17.0	15.5	14.8	13.8	12.6	11.2	12.4	14.6	14.6	14.2
Packer sold (carcass)	2.0	2.3	5.9	6.1	5.9	5.5	5.3	4.5	4.1	3.8
Packer owned (carcass)	18.1	19.4	20.7	22.3	23.1	24.	25.2	26.5	26.6	28.1
Negotiated (live)	1.6	1.5	1.7	1.9	1.5	0.9	1.3	1.3	1.0	1.0
Non-Mandatory Price Reporting	4.2	3.9	4.4	3.9	3.9	3.9	4.3	3.0	4.0	3.5

Note: Percentages are based on denominator of total federal-inspected slaughter for the year listed.

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[16]Plain, Ron. "U.S. Market Hog Sales, 2002-2012."   Farm Marketing, University of Missouri-Columbia Dept. of Agricultural and Applied Economics. May 2013. http://agebb.missouri.edu/mkt/vertstud09.htm (5 January 2014). And, adapted from: USDA/AMS Market News Reports: summary of LM_HG201 and LM_HG200

[17] The 2013 values are author calculations. It was necessary to extrapolate annual total mandatory price reporting slaughter due to unreported information during the government shutdown. The data extrapolation involved consistency between 2012 and 2013 for mandatory price reporting reported slaughter and federal inspected slaughter.

2.3 Chapter 2 Summary

✓ *Hog production increased some 20 percent during the past 20 years.*

✓ *Pork production increased more than 40 percent during the past 20 years through both increased hog production and increased carcass weights.*

✓ *Processors use forward marketing arrangements to improve hog slaughter scheduling, which maximizes plant use and reduces fixed costs per animal processed.*

✓ *Regionalization of hog slaughter can create spatial pricing differences due to the regionalization of hog production costs and the value of pork, which may influence reported market prices for hogs based on the quantity of day-to-day purchases by a particular firm.*

✓ *Substantial declines in negotiated live and carcass pricing has resulted in less than 5 percent of hogs currently being priced using these methods.*

Chapter 3: Swine Mandatory Price Reporting Data Trends

Currently, AMS reports several daily and weekly prices and hog quality data. Chapter 4 details the transaction-level analysis of mandatory price reporting (MPR) data. The information reported in this chapter reflects available aggregated information reported as a result of MPR legislation to collect transaction data and generate publically available reports. Understanding what information is publically available is important for describing industry interest in pursuing price alternatives to the current prior day purchase negotiated weighted average prices. All data used to create exhibits in this chapter represent publically reported AMS data sourced through the Livestock Marketing Information Center (LMIC) data bank, http://www.lmic.info/.

These data are used to portray long-term price and quality trends and aid in understanding industry concerns, challenges, and opportunities for assessing alternative price discovery methods. The USDA AMS reports several daily market reports. This study is especially focused on information reported in two particular reports, the LM_HG200, *National Daily Direct Prior Day Hog Report Plant Delivered Purchase Data* (referred to as the "prior day purchase report") and the LM_HG201, *National Daily Direct Hog Prior Day Report – Slaughtered Swine* (referred to as the "prior day slaughter report").

The prior day purchase report (LM_HG200) summarizes packer hog purchase information from the previous business day. In addition to volumes of hogs purchased by type of purchase (i.e., negotiated, other market formula, swine or pork market formula, and other purchase agreement), weighted average carcass prices are also summarized for each of these purchase types as well as weighted average carcass and live basis prices for negotiated purchases (including packer sold). A hog purchase pricing matrix, representing individual plant carcass merit buying programs, is also provided in the report. For this study, the research team analyzed the weighted average negotiated purchase prices for live hogs purchased on a live basis and live hogs purchased on a carcass basis. These two series represent the negotiated purchases of hogs each day by packers, and these are the prices commonly used as base prices for formula hog purchases. As such, these two price series are arguably the most important and widely used prices reflecting cash hog market supply and demand fundamentals. The daily negotiated purchased hog data specifically refers to hogs for which a base price is established and delivery of the hogs scheduled to the packer is expected to occur sometime during the next 14 calendar days. As discussed in the previous chapter, the relative volume of hogs being purchased through daily negotiated transactions has declined markedly and raised questions regarding the representativeness or reliability of these negotiated prices.

The prior day slaughter report (LM_HG201) provides information summarizing volumes and prices of hogs slaughtered the previous business day. This report contains the base price for carcass-based purchases as well as the net price received for these purchase types. In addition, selected average carcass quality traits (weight, sort loss, backfat, loin depth, loineye area, and lean yield) are also summarized in this report. Base prices for live weight negotiated hogs slaughtered during the previous day are not reported within this report.[18] This study's main objective is to determine whether the net price received for negotiated purchases (reported in this report) can be estimated from information known at the time negotiated prices were reported in the prior day purchase report. As such, the main information of interest contained in this report includes the net price received and the base price. The latter price is only collected for carcass-based purchases in compiling this report.

3.1 Negotiated Pricing Trends and Relative Price

The daily negotiated prior day purchase live and carcass weighted average prices are shown in Exhibit 3.1.1 for January 2004 to December 2013. The price series trend together and have a 0.99 correlation coefficient. The price series are expected to trend together as a live price is derived from a carcass value by adjusting the carcass value for an average dressing percentage.

The daily negotiated prior day slaughter carcass base and net weighted average prices are shown in Exhibit 3.1.2 for January 2004 to December 2013. The price series trend together and have a 1.00 correlation coefficient. The high correlation coefficient does not imply that one series can precisely predict the other series, as the spread between the base price and net price varies day to day. It only indicates statistically that the two price series have a strong positive linear relationship.

For January 2004 to December 2013, the daily negotiated prior day slaughter weighted average net price minus the prior day slaughter weighted average base price is shown in Exhibit 3.1.3. The correlation coefficient between the price difference and carcass weighted average base price is 0.69 and between the carcass weighted average net price and price difference is 0.72. This indicates that the spread between the base and net prices varies positively, but not perfectly, with price levels. As such, other factors beyond price levels influence the spread between base and weighted average net prices. Day-to-day variability in the price spread has increased over time (see section 3.3 for the rolling 15-day coefficient of variation for these series).
The AMS also reports negotiated low and high prices for alternative purchase methods. The prior day purchase carcass base price high minus low spread and live base price high minus low are shown graphically in Exhibits 3.1.4 and 3.1.5, respectively. A smaller high-low price difference

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[18] The live negotiated price, which is the net price for purchases on a live weight basis, was established upon purchase of the animals and reported in LM_HG201.

indicates a more integrated market where different buyers are purchasing based on similar pricing signals and similar quality hogs. The carcass high-low price difference has varied from $5 per hundredweight to $20 per hundredweight during the past decade. Considerable day-to-day variation is present in the high-low price difference. The live high-low price difference is more variable than the carcass high-low price difference (see section 3.3 for the rolling 15-day coefficient of variation for these series). The observed range, for both live and carcass transactions, indicates challenges with computing an alternative weighted average price that captures all relative information.

In comparison to Exhibits 3.1.4 and 3.1.5, the carcass net price high minus low is illustrated in Exhibit 3.1.6. The high-low carcass net price differential varies consistently by more than $30 per hundredweight. Rarely is the differential less than $15 per hundredweight. That is, the single-day variability between transactions (or lots) of carcass negotiated hogs is often as much as $60 per head. One interpretation is that computing a weighted average net price from base prices may add variability over what is now observed with reported weighted average base prices.

Finally, the difference between the prior day negotiated slaughter carcass weighted average base price and the prior day purchase carcass weighted average base price and prior day purchase live weighted average base price was analyzed. Note that these prices have differences in market timing in that the prior day negotiated is yesterday's negotiated price, but the prior day slaughter base represents some combination of base prices negotiated during the past 14+ calendar days.[19] As such, if a market that has prices that trend for a while, these price series would be expected to vary relative to one another. This would mean that one could not predict one series accurately from just the other series without incorporating additional market factors. This type of "forecasting" would undermine the intent of the MPR legislation to report prices with information provided by processors.

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[19] Because for definition of negotiated trade hogs only need to be scheduled during the prior 14 calendar days, slaughter can take place beyond the 14 day window.

Exhibit 3.1.1. Daily Negotiated Prior Day Purchase Carcass and Live Base Prices, January 2004 to December 2013
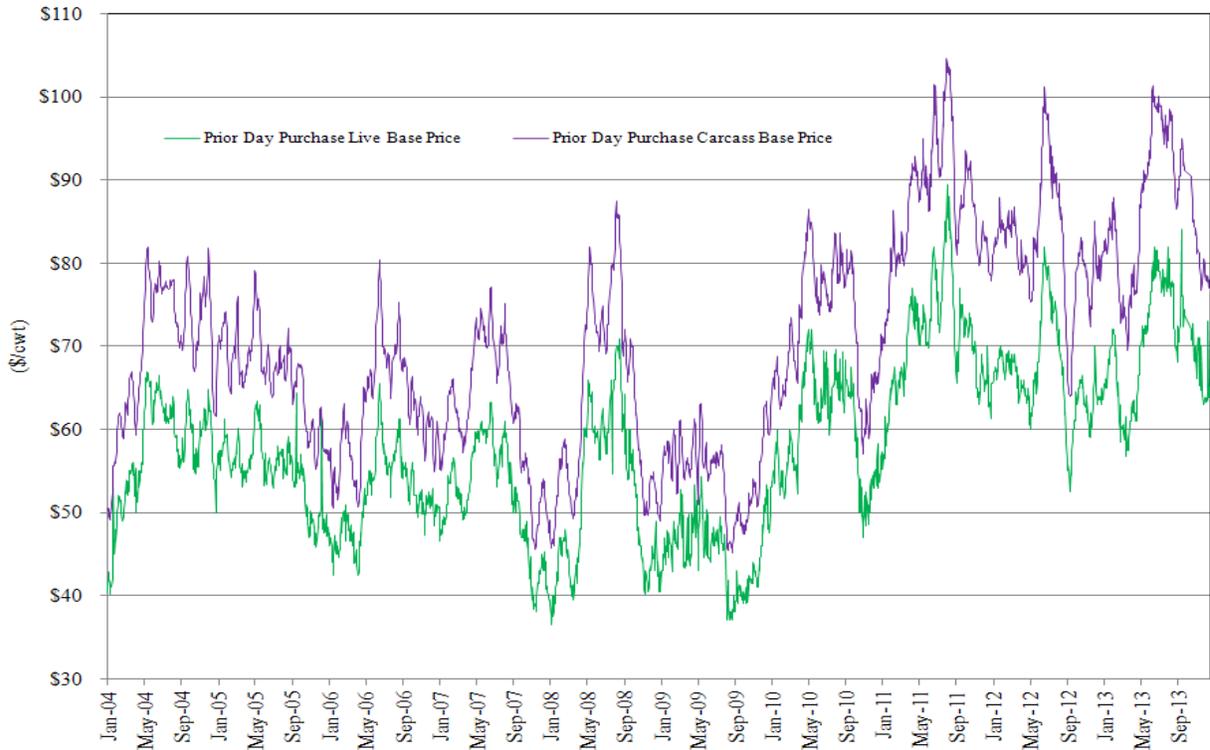

Exhibit 3.1.2. Daily Negotiated Prior Day Slaughter Carcass Base and Net Prices, January 2004 to December 2013
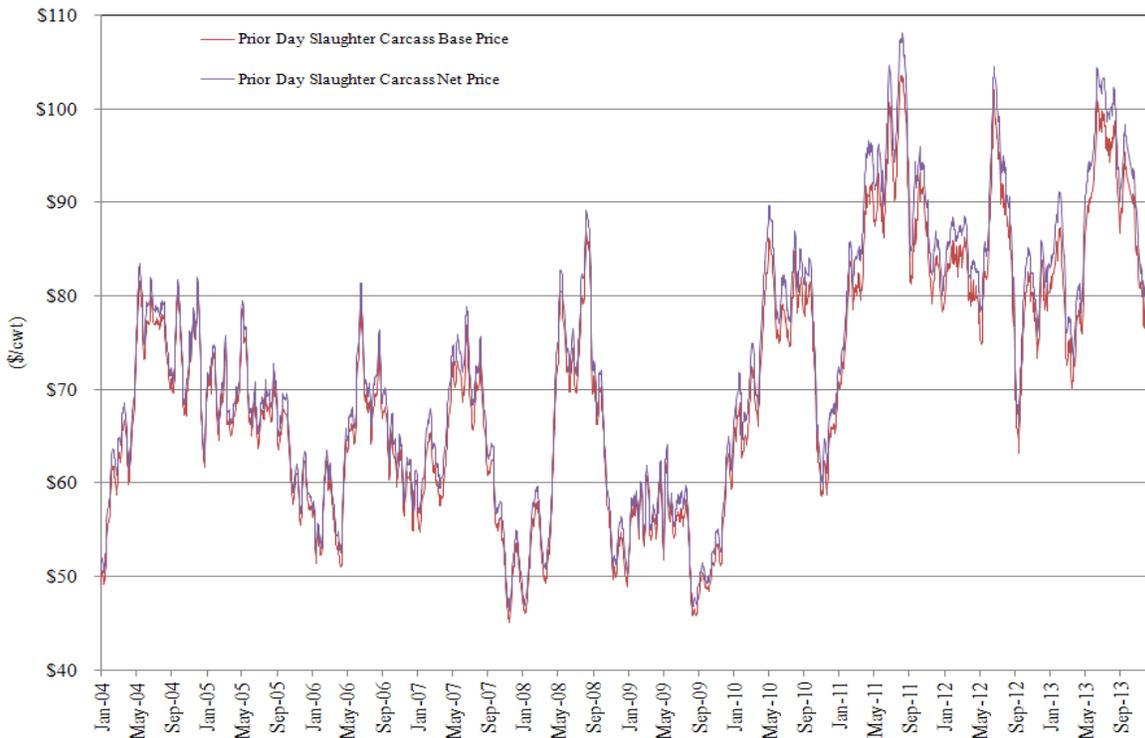
Exhibit 3.1.3. Daily Negotiated Carcass Prior Day Slaughter, Net Price Minus Base Price, January 2004 to December 2013
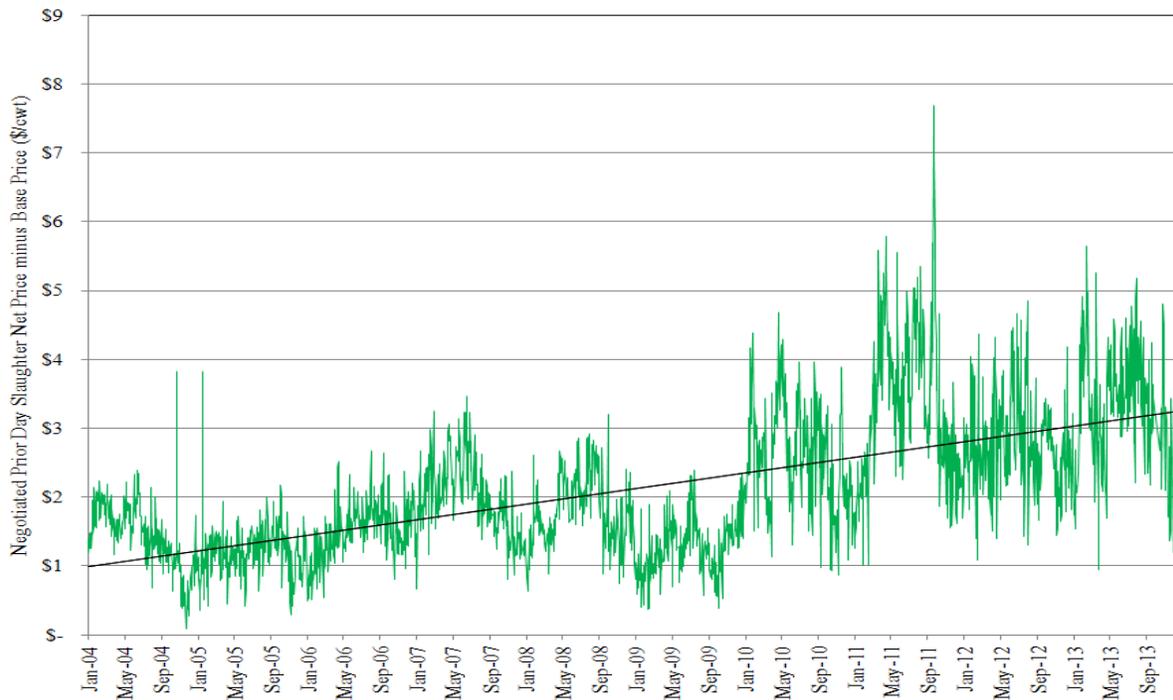
Exhibit 3.1.4. Daily Negotiated Carcass Prior Day Purchase Spread Between Low and High Base Prices, ($/cwt), January 2004 to December 2013
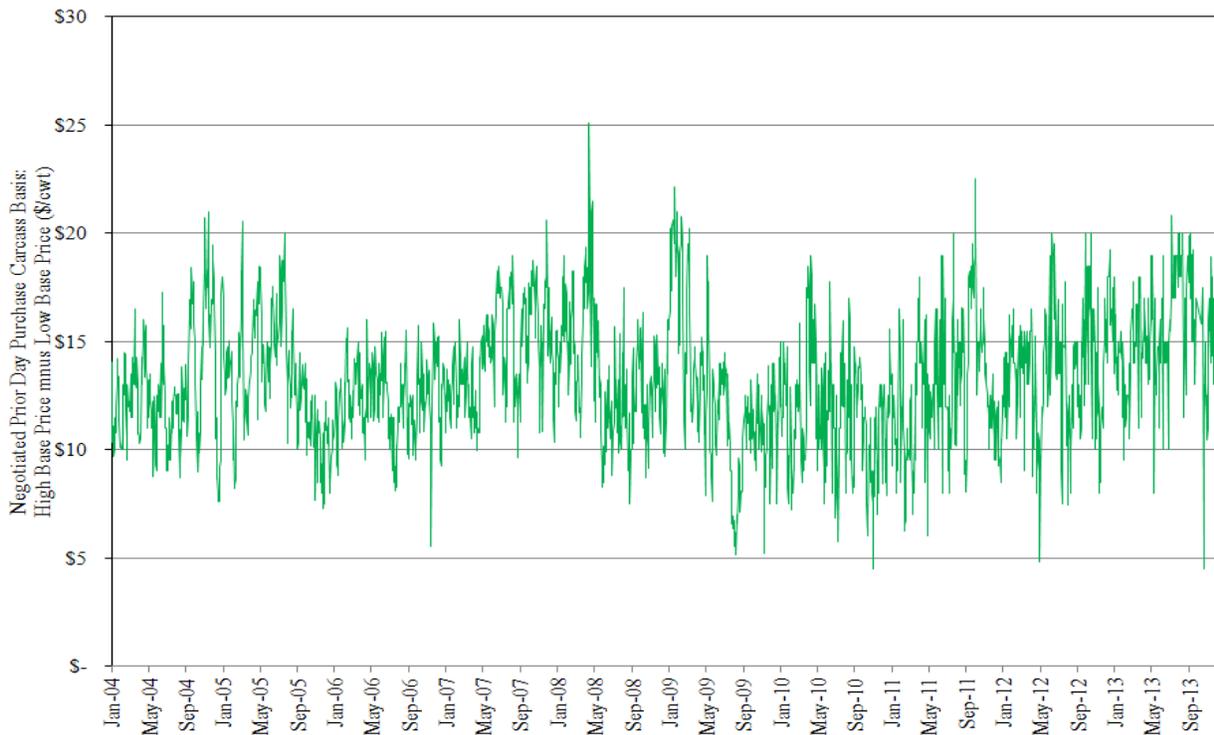
Exhibit 3.1.5. Daily Negotiated Live Prior Day Purchase Spread Between Low and High Base Prices ($/cwt), January 2004 to December 2013
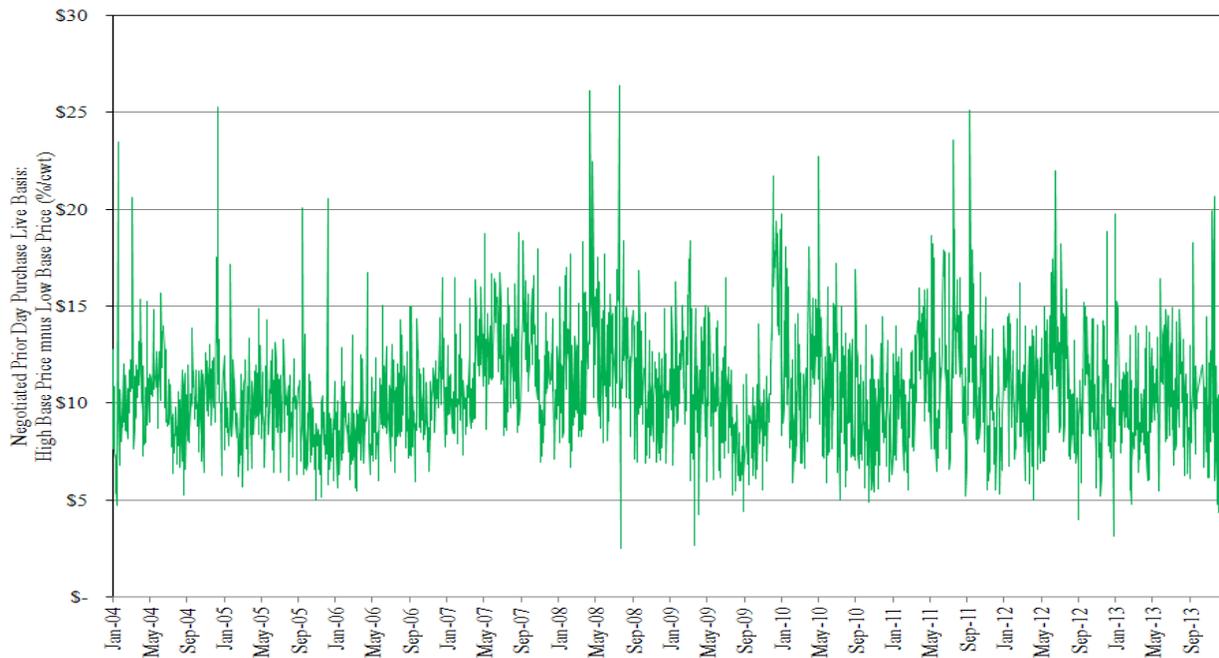
Exhibit 3.1.6. Daily Negotiated Carcass Prior Day Slaughter Spread Between Low and High Net Prices ($/cwt), January 2004 to December 2013
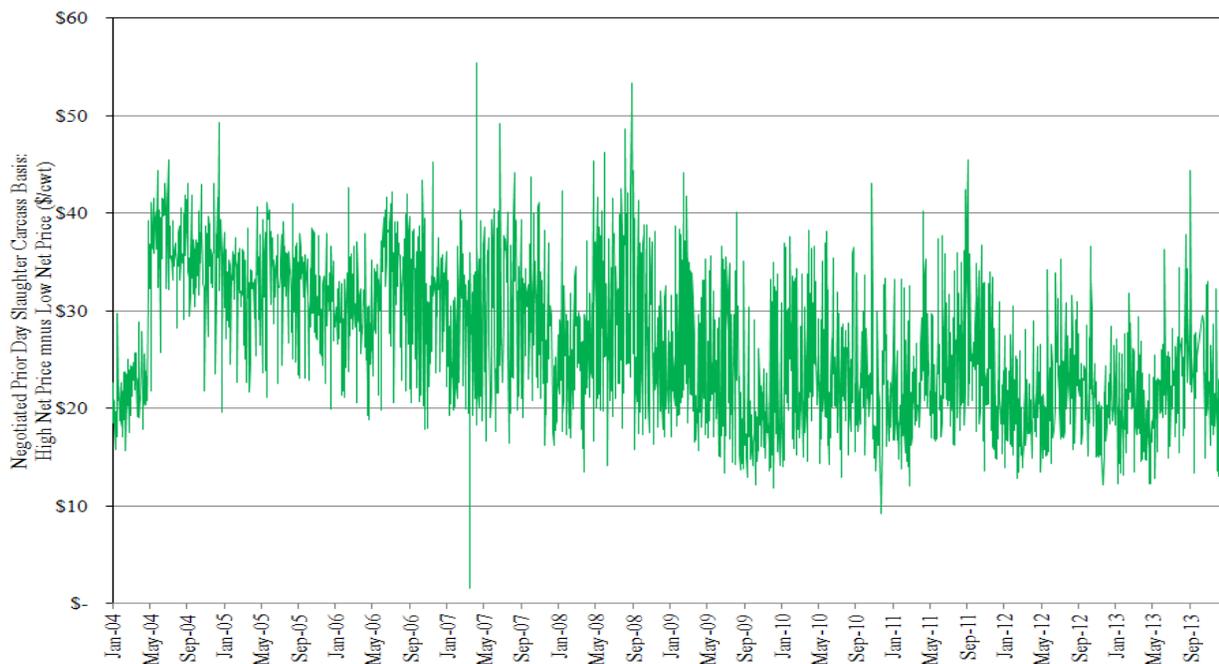
3.2 Negotiated Hogs Purchase Shares

One pork industry concern with negotiated hog trade is that hogs marketed through negotiated trade may not accurately reflect market supply and demand fundamentals, particularly if negotiated hog trade is thinning. Lawrence and Grimes (2006) reported that as many as 57 percent of swine forward pricing agreements have a base price tied to a negotiated trade price.[20] Although this particular concern is beyond the current study's scope, understanding the trend in negotiated trade is important for the degree of confidence when inferring a computed weighted average net price from purchase prices. An increasing share of negotiated transactions increases confidence in the reported weighted average price, and a decreasing share of negotiated transaction reduces confidence in the reported weighted average price.

Exhibit 3.2.1 shows the historical percentage of both carcass and live hogs sold through negotiated means relative to total hogs procured. The trend has been consistently downward . Negotiated trade declined from around 20 percent in 2005 to commonly less than 5 percent in 2013. That is, of the nearly 107 million hogs marketed in 2013, approximately 5.1 million head were marketed through a combination of carcass or live negotiated trade.

Exhibits 3.2.2 and 3.2.3 show the daily percentage of negotiated purchase carcass and live transactions, respectively, from January 2004 to December 2013. While the trade volume for both has trended down over time, the carcass negotiated trade volume has lost the greatest market share by declining from around 23 percent in 2004 to around 6 percent in 2013. Live negotiated trade volume has commonly represented less than 4 percent of total hog marketings during the past decade. The daily live negotiated hog trade, as a percentage of daily total hog trade, has on certain days spiked up to 10 percent or more. The negotiated live trade continues to play a minor role in hog procurement for certain situations.

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[20] Lawrence, J., and G. Grimes. "Production and Marketing Characteristics of the U.S. Pork Producers, 2006." University of Missouri-Columbia Dept. of Agricultural and Applied Economics working paper No. AEWP 2007-5. Accessed at: http://agebb.missouri.edu/mkt/ (13 January 2014).

Exhibit 3.2.1. Prior Day Purchases Live and Carcass Negotiated Number of Head Reported Over Total Head Reported for All Purchase Types that Day (%), January 2004 to December 2013
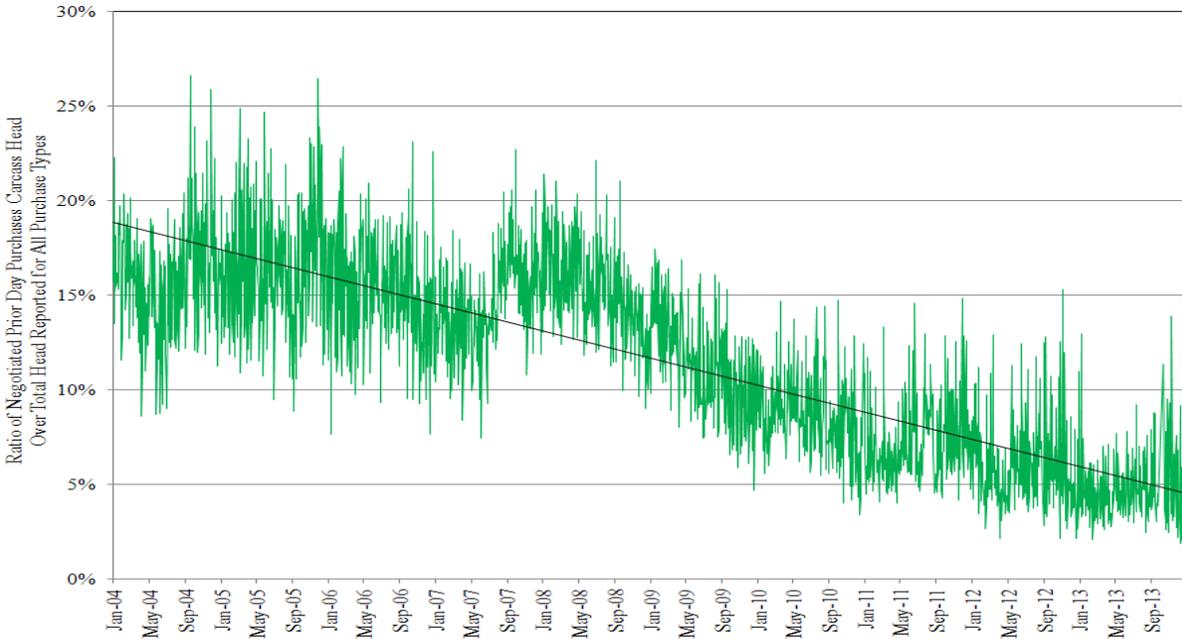
Exhibit 3.2.2. Prior Day Purchases Carcass Negotiated Number of Head Reported Over Total Head Reported for All Purchase Types that Day (%), January 2004 to December 2013
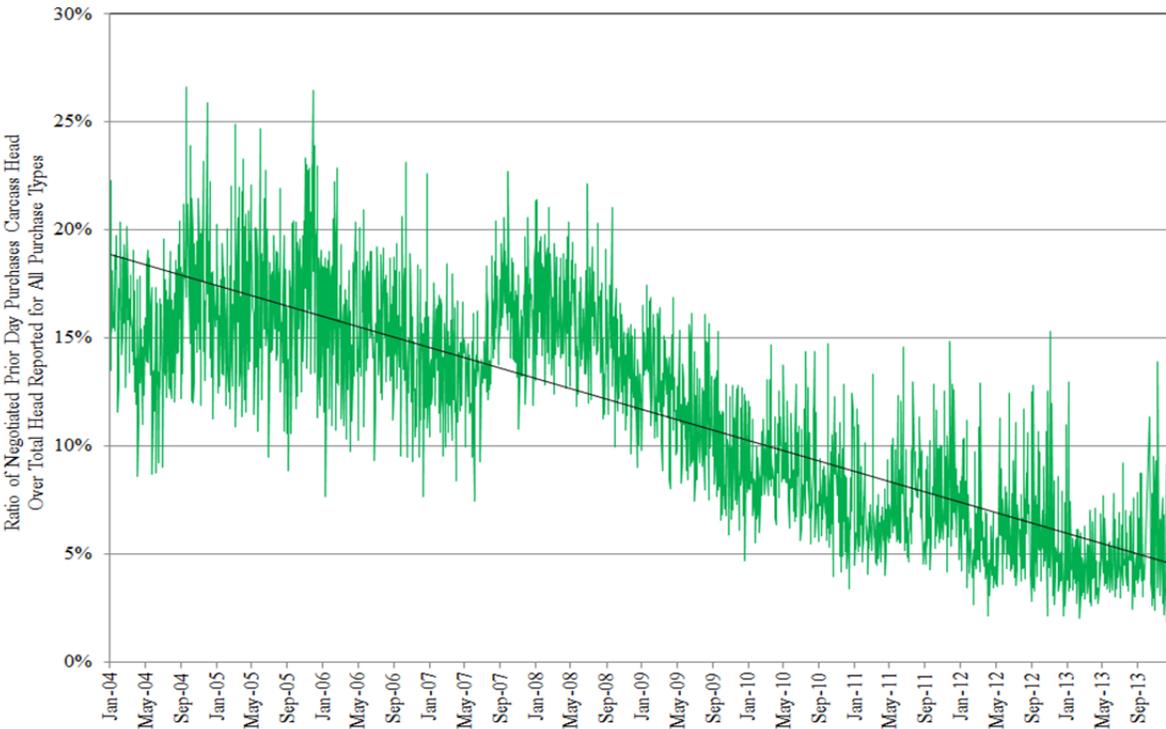
Exhibit 3.2.3. Ratio of Negotiated Prior Day Live Purchased Head over Total Head purchased that Day (%), January 2004 to December 2013
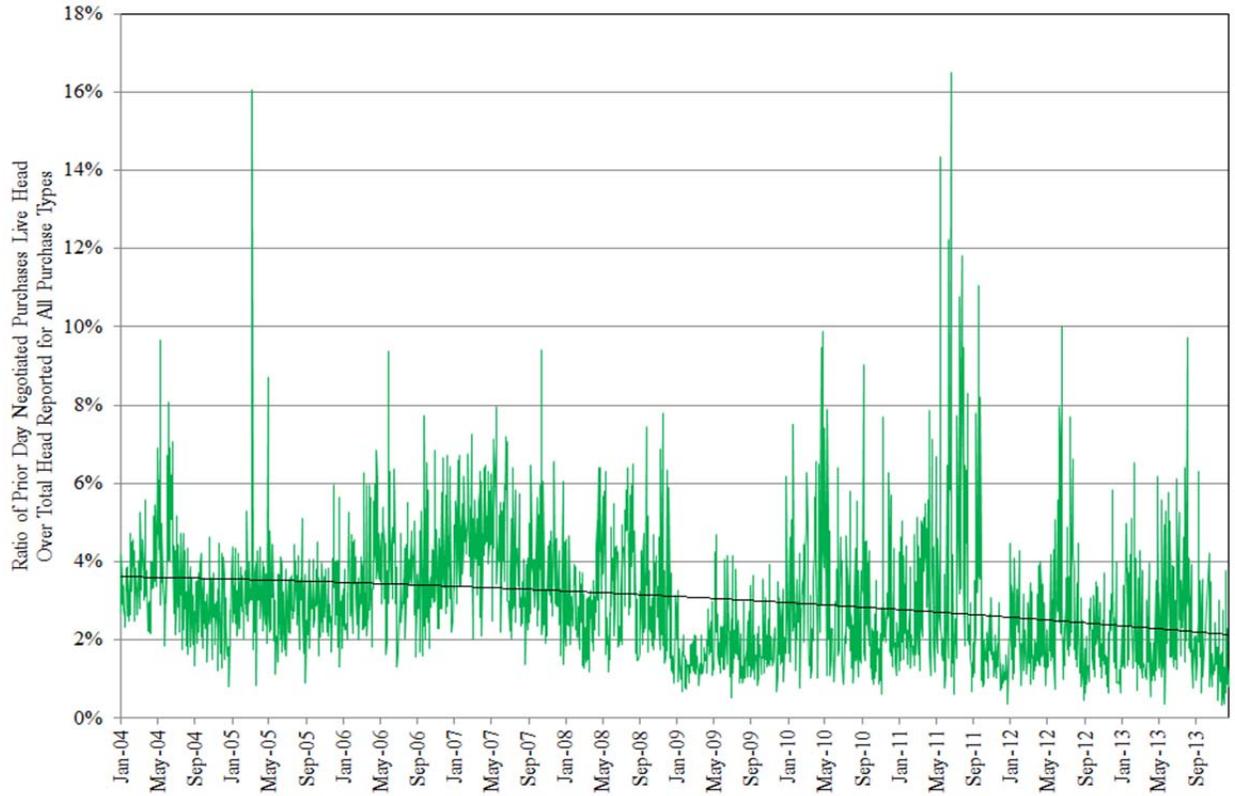
## *3.3 Relative Price Variation Trends by Purchase Method*

Section 3.1 outlined the trend in daily prices for various prices reported as a result of hog mandatory price reporting. Hog producers and hog processors often use price data for strategic and operational decision making. These decisions depend on the ability to confidentially predict prices and ensure that the predicted prices will closely represent actual prices. Prices that are more stable, or follow some pattern, are more easily predicted than prices that have higher variance. One challenge when analyzing the relative variance between price series is that price levels differ between items. For example, looking at 10 years of data for two different hog price series, such as negotiated purchase live weighted average base price and negotiated carcass weighted average net price, may show the exact same measures of dispersion. This may lead to the erroneous conclusion that both series have a price risk profile similar to each other. However, the risk is dependent of the overall price level. Economists and statisticians use the coefficient of variation to compare relative risk, which is:

Coefficient of variation (%) = (standard deviation/average) × 100.

The coefficient of variation allows for comparing or measuring price dispersion while accounting for the absolute level of prices. Higher coefficient of variation values indicate greater relative price risk, and lower coefficient of variation values indicate less relative price risk. A 15-day rolling average coefficient of variation for various negotiated hog price series is presented in Exhibit 3.3.1. The prior day purchases swine/pork formula price is reported here because of its tendency to have a base price tied to the negotiated base price. Data from June 2011 to December 2013 were used to visually observe relative dispersion differences between the price series. No price series indicates a strong tendency for lower relative price dispersion.

Next, the coefficient of variation was computed for various high to low price spreads. The high-low coefficients of variation are shown in Exhibit 3.3.2. Data from June 2011 to December 2013 were used to visually observe relative dispersion differences and trends between the high-low price series. The negotiated live high-low spread relative dispersion value has tended to trend above the other prices. Recently, the negotiated live high-low price spread has been observed to exceed the other price series by between 50 percent and 70 percent. The high-low slaughter carcass net price spread does not stand out as having lower relative price uncertainty to the high-low purchase carcass base price.

Exhibit 3.3.1. Daily Rolling 15-Day Coefficient of Variation for Weighted average Base Price for the Five Comparison Price Series', June 2011 to December 2013
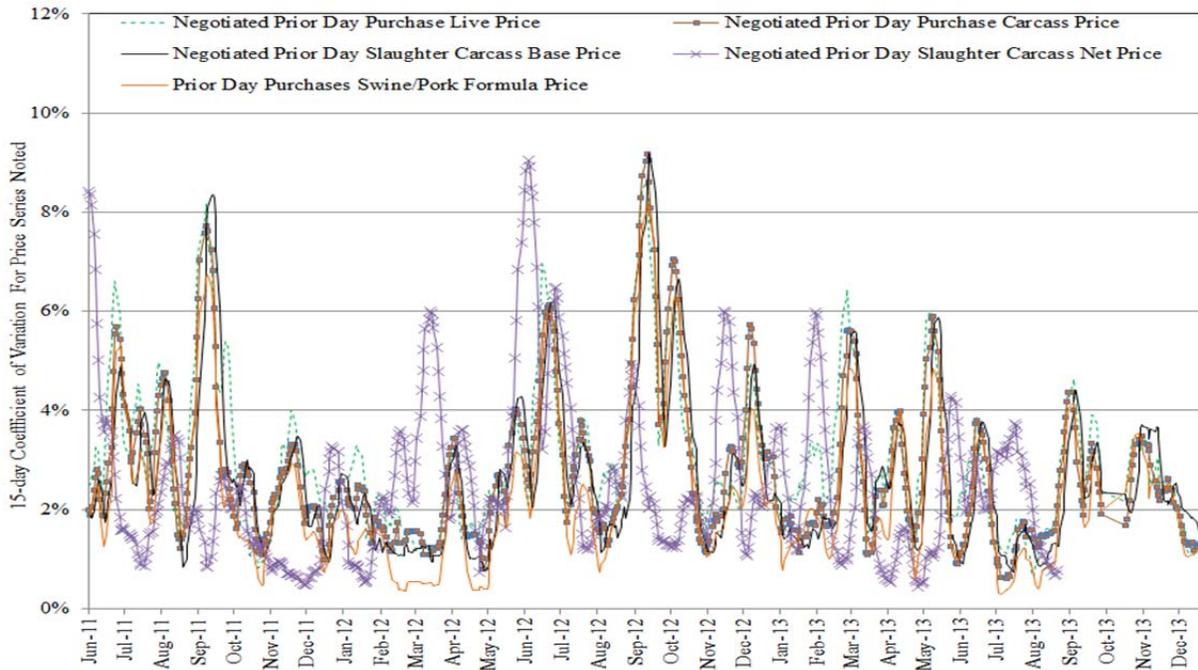
Exhibit 3.3.2. Daily Rolling 15-Day Coefficient of Variation for High Price Minus Low Base Price for Prior Day Carcass Purchases, Live Purchases, and Carcass Slaughter (%), June 2011 to December 2013
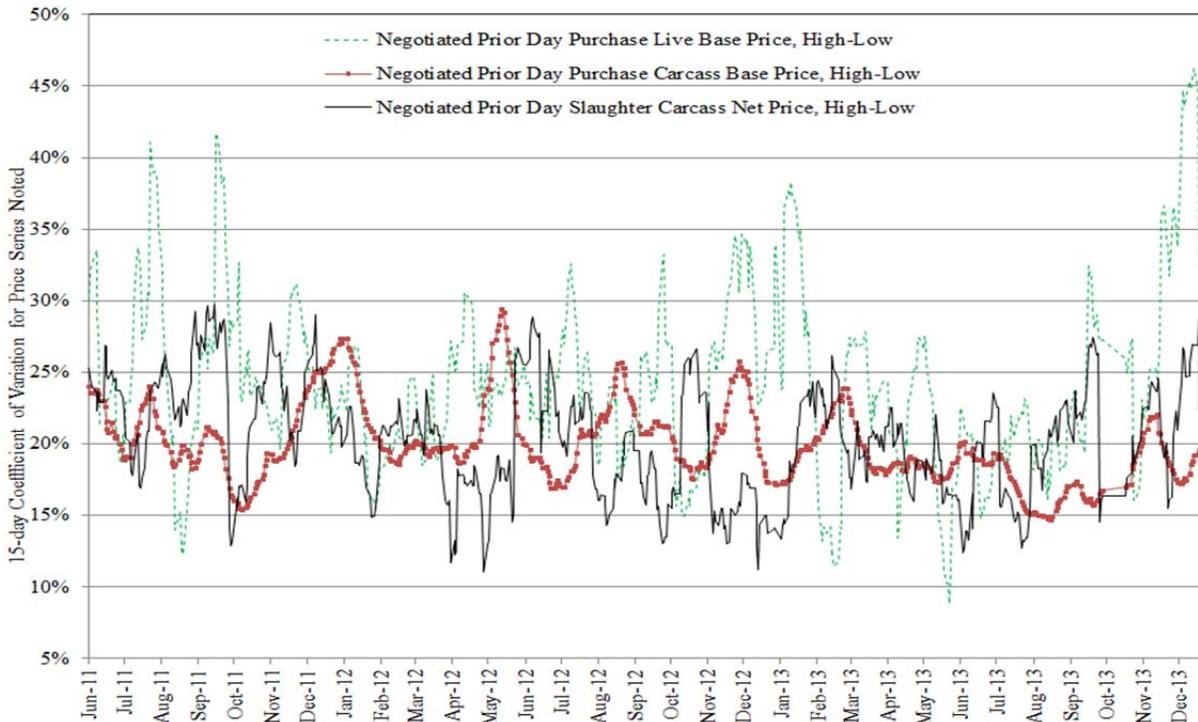
3.4 Comparison of Hog Quality by Purchase Method

The transaction level net price is derived by starting with the base price and adjusting the base price by adding premiums and subtracting discounts for the quality attributes associated with the hogs comprising the transaction (or lot). Processors establish buying programs that list baseline quality attributes for every transaction. A premium is applied to the transaction when the average hog quality is above the baseline. A discount is applied to the transaction when the average hog quality is below the baseline. Or, for the case of carcass weight, a discount may be applied when the carcass weight falls either below a lower level threshold or above an upper level threshold. The premiums and discounts are usually not applied symmetrically. That is, the premium level and discount level are not the same for a similar deviation above or below the baseline. When hog purchases are made, little animal attribute information known about the transaction is available. See Appendix Exhibit A5 for a list of information collected for prior day purchase transactions.

For computed weighted average net prices to add value to the pork industry, the AMS would need to compute a price that would be more informative than the existing reported weighted average base prices. Thus, any adjustment from a base price to a net price must assume that animal quality data is either predictable or consistent day-to-day. Understanding historical quality information trends by purchase method helps to make inferences regarding the reliability of AMS-computed net prices, derived from the base prices and available quality information, for industry use.

Exhibits 3.4.1 through 3.4.5 show trends in quality attribute levels for carcass weight, percent lean, loin area, backfat, and sort loss, respectively, by purchase method. Carcass weight indicates a presence of seasonality, and the seasonal low-to-high weight range has been increasing over time (Exhibit 3.4.1). The day-to-day carcass weight variability has increased for negotiated carcass trade, which decreases the likelihood of confidently computing a relevant purchase net price using slaughter data. Furthermore, the negotiated trade carcass weight data vary notably from carcass weights observed for alternative purchase methods. Thus, there is no value in aggregating data between purchase methods to reduce the issue of small sample size with the prior day negotiated slaughter data.

Percent lean has trended upward over time for alternative purchase methods other than negotiated carcass transactions (Exhibit 3.4.2). This finding again indicates that transactions other than negotiated carcass transactions are useless in providing information for deriving a computed net price from the purchase price. Negotiated carcass loin area has followed a slowly increasing trend in the mean with little variation around the mean (Exhibit 3.4.3). Mean backfat has followed a downward trend with all purchase types following a similar pattern (Exhibit 3.4.4.). Negotiated trade carcass sort loss has become increasingly variable during the past three

years (Exhibit 3.4.5). The sort loss range is as much as $0.50 under to more than $3 under. Sort loss is determined based on whether barrows and gilts fall within the individual's packer's established carcass weight, or lot, variation range. Recall, at the time a purchase transaction occurs, a lot's carcass weight is unreported because it is unknown. Thus, making the adjustment from a base price to a computed net price would be difficult given the day-to-day variability in sort loss and not knowing an actual carcass weight for the lot.

An important caveat to the discussion in the last paragraph relates to what data is required to be reported under the Mandatory Price Reporting Act. Only data that a packer collects must be reported. Over the past five years one firm, and possibly one additional firm, discontinued collecting quality data on all hogs purchased. Thus, the firm no longer provides quality data as part of the MPR Act.[21] If a particular firm, or firms, routinely purchases hogs of quality sufficiently different from the market's average quality, for a particular purchase type, then the firm's decision to discontinue collecting quality data could move the industry average quality for that purchase method. Firms have discontinued collecting quality data because the cost savings from collecting the data and assigning discounts and premiums outweighs the cost associated with the probability of accepting hogs of inferior quality. That is, the firm is able to project quality based on the quality history of animals being delivered. Because quality data is aggregated for MPR reporting it is unknown how (or when) this change in procurement method impacted the quality averages for a particular purchase method.

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[21] A side note is that the volume reported, by purchase method, refers only to the number of transactions used in computing the weighted average reported price.

Exhibit 3.4.1. Prior Day Slaughter: Daily Carcass Weight by Purchase Method (lbs) January 2004 to December 2013
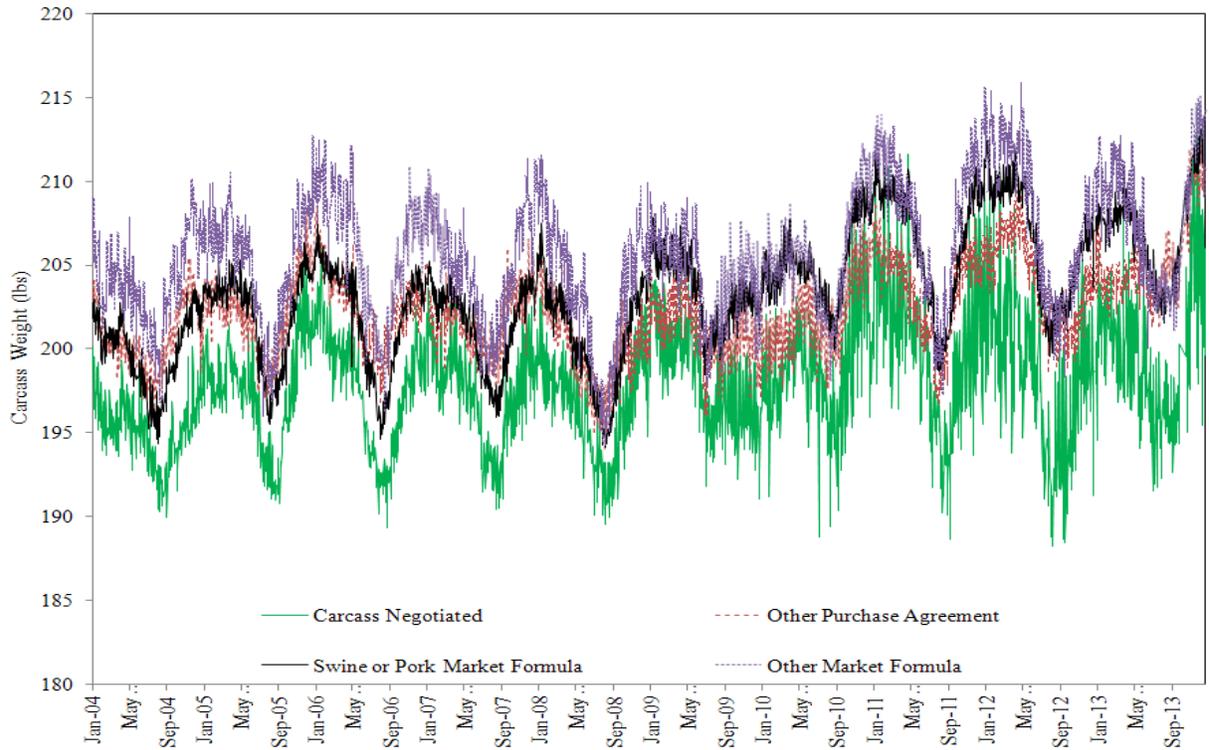
Exhibit 3.4.2. Prior Day Slaughter: Percent Lean by Purchase Method (%), January 2004 to December 2013
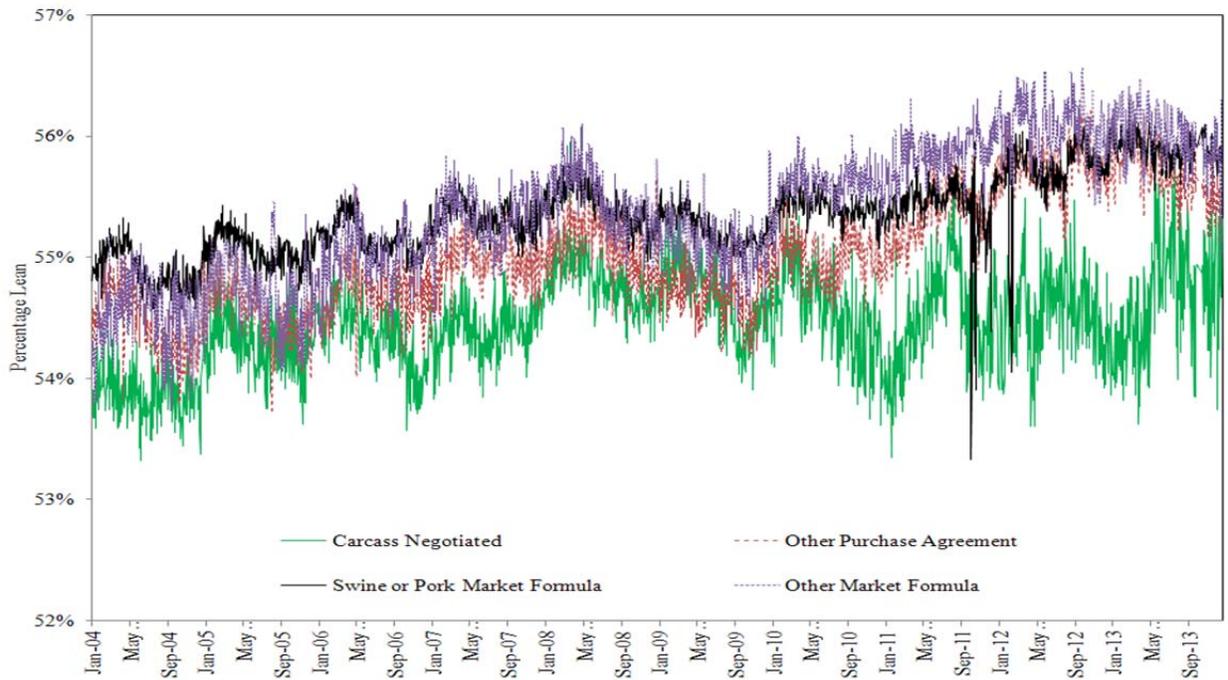
Exhibit 3.4.3. Prior Day Slaughter: Loin Area by Purchase Method (inches), January 2004 to December 2013
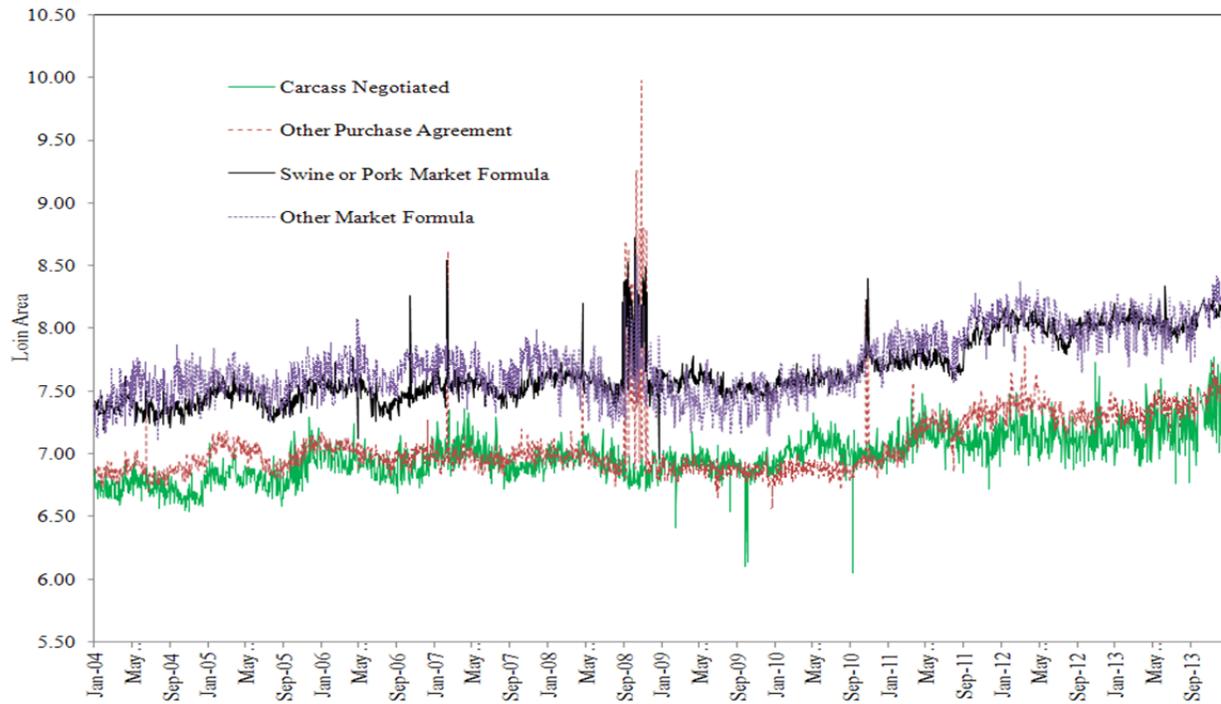
Exhibit 3.4.4. Prior Day Slaughter: Backfat by Purchase Method (inches), January 2004 to December 2013
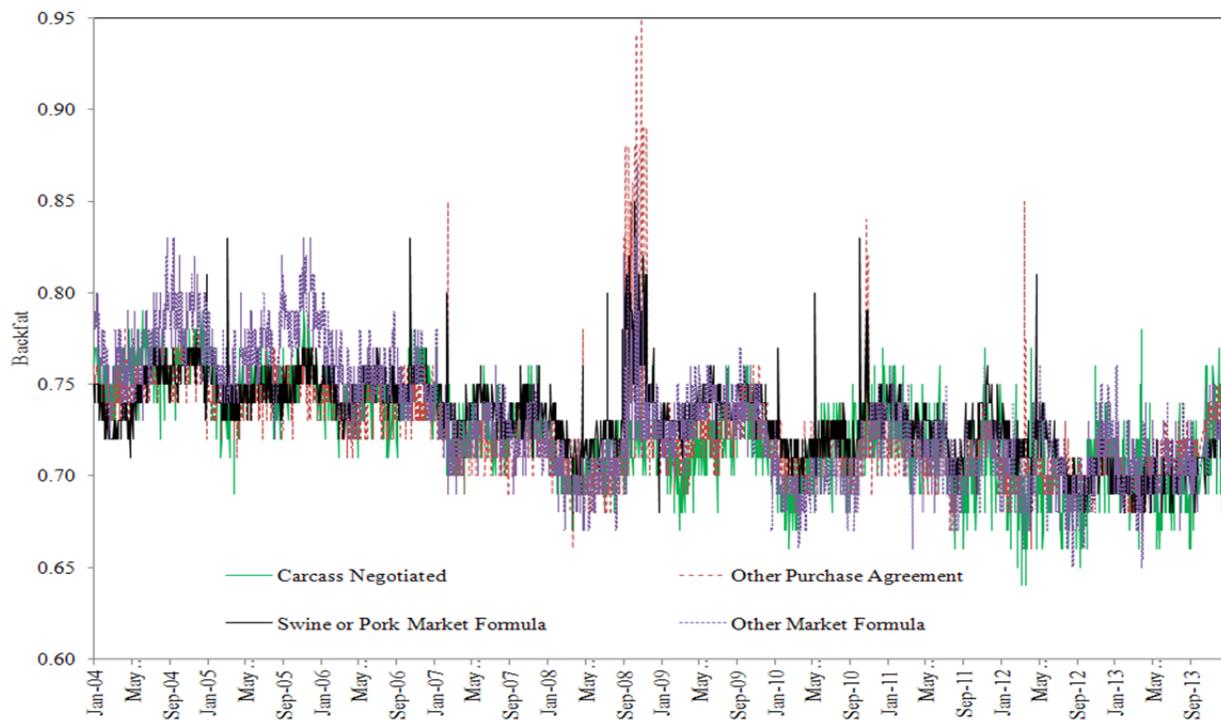
Exhibit 3.4.5. Prior Day Slaughter: Sort Loss by Purchase Method ($/cwt), January 2004 to December 2013
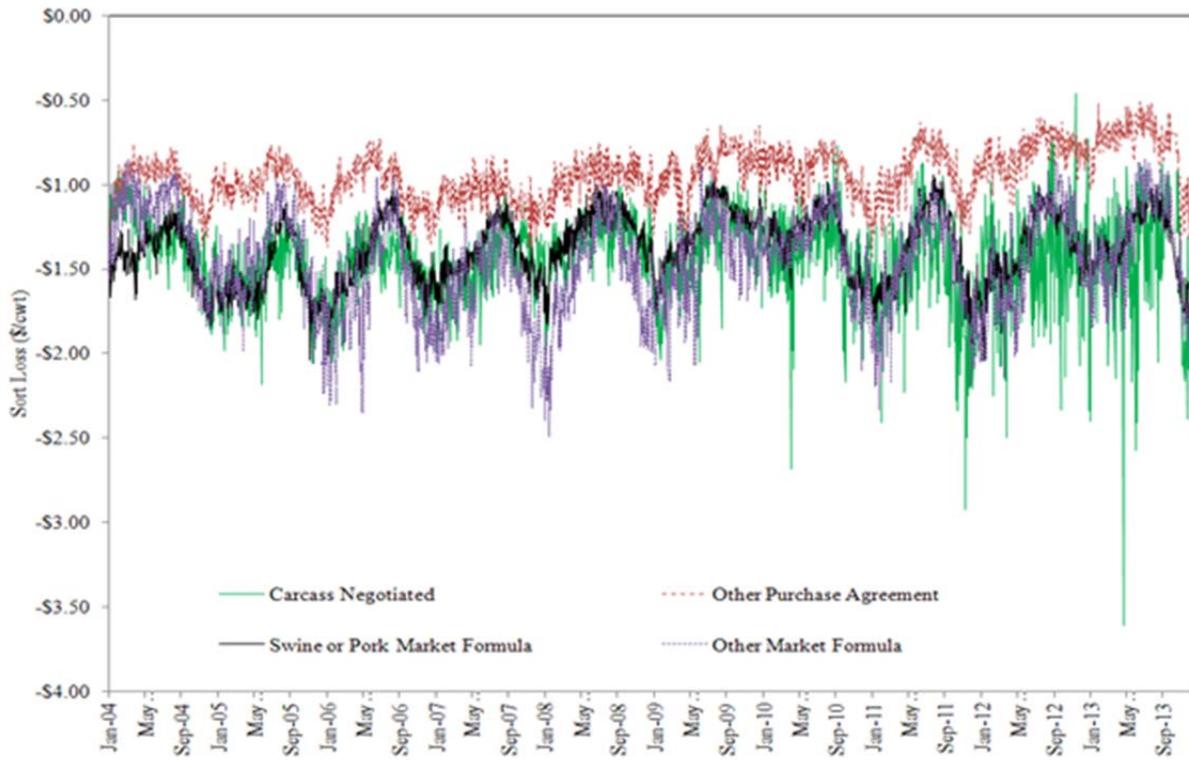
3.5 Chapter Summary

✓ *To derive a computed weighted average net price from base prices, it is important that the quality of hogs aggregated between purchase and slaughter is consistent or predictable day to day.*

✓ *Carcass weight has strong seasonality, and day-to-day carcass weight, by purchase method, varies considerably*

✓ *Purchase method negotiated trade percent lean indicates a differentiated hog relative to alternative purchase methods.*

✓ *Level of loin area tends to be the least variable quality attribute, but carcass negotiated trade level of loin area has been increasing in variability.*

✓ *The sort loss level for negotiated carcass trade is unpredictable.*

✓ *Using quality information from alternative purchase agreement methods other than negotiated trade is not feasible due to differences in quality attribute levels between purchase agreement methods.*

Chapter 4. Analysis of Mandatory Price Reporting Transactions Data

This analysis assesses the ability to accurately predict the negotiated weighted average net price given the base prices for individual transactions at the time the base price is reported by the AMS (i.e., the day the prior day purchase report is released). For prior day purchases, negotiated base prices are collected and reported as a weighted average base price, but the net price received cannot be determined until the hogs are slaughtered and price adjustments for carcass merits are made. Once hogs are slaughtered, the net price is reported by the AMS in the prior day slaughter report.

To evaluate the validity of computing and reporting a projected negotiated weighted average net price from prior day purchase negotiated base price, a four-phase process was used. The goal was to evaluate whether a computed weighted average net price can be predicted accurately the day the purchased base price is reported. The four phases involve 1) replicating the transaction data consistent with data reported in AMS reports; 2) evaluating correlations between the base price and the net price; 3) using those correlations between base and net prices to project a net price; and 4) evaluating whether the projected net price is useful information.

In addition, the research team evaluated whether an alternative prior day negotiated weighted average base price computation could yield a price that provides more information on the day-to-day impact of market conditions. In particular, the team analyzed how nonmarket factors impact the day-to-day variation in the currently reported negotiated weighted average base price. If nonmarket factors affect the weighted average base price, then accounting for nonmarket factors may allow for an alternative weighted average base price to be more reflective of day-to-day market changes.

Three guiding principles were used here in analysis and reporting of results. First, to ensure data confidentiality plant and company identification information was all randomized to prevent anyone from matching results with a particular company. Second, to ensure credibility and validity, the team replicated the process that the AMS uses to create both live and carcass base prices for prior day purchase reports and both the base and net prices for prior day slaughter reports. Third, the analysis must yield alternative price information that is easily replicated, which requires a transparent methodology, and that is useful to the pork industry.

4.1. Data and Data Procedures

Individual transaction data that are reported by packers daily to USDA were analyzed in this section to replicate data reported by the AMS in daily prior day purchase reports. Data available for this analysis were all data required to be reported by hog processors under mandatory price reporting. A detailed breakdown of data is described in Exhibits A3 through A5 in this report's Appendix section.[22]

Thirty months of recent prior day purchase barrows and gilts data for live and carcass transactions and prior day slaughter barrows and gilts data for carcass transactions, representing daily data between June 6, 2011, and December 17, 2013, were used for analysis.[23] This time period was chosen to reflect current industry practices and provide sufficient data for this analysis. A total of 32 pork packing plants owned by 17 pork packing firms are represented in the mandatory price reporting hog purchase and slaughter transaction databases during the 30-month window. Data were scrubbed for errors, AMS-established thresholds, and MPR confidentiality guidelines. Data requested for this analysis are listed in Exhibits 4.1.1 and 4.1.2 for prior day purchase negotiated trade and prior day slaughter negotiated trade, respectively.

Exhibit 4.1.1. Transactions Data for Prior Day Purchase Negotiated Live and Carcass Trade

Variable
Plant identifier
Firm identifier
Lot purchase identifier
Base prices for the lot ($/cwt): live prices and carcass prices
Number of head in the lot
Average live weight for the lot a. For animals purchased on a live weight basis, this is a projected weight because weights are unknown until the animals are slaughtered. b. No weight is submitted to AMS for animals sold on a carcass basis.
State of origin of lot
Transaction date

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[22] The USDA AMS Compliance and Enforcement Division routinely visits hog processing plants for compliance visits on mandatory price reporting. This ensures that hog processors are following the regulations set forth in the MPR Act. See Appendix A2 for a historical list of compliance visit data.

[23] The total number of transactions included in the prior day purchase data was 82,656 (20,232 for 2011, 32,636 for 2012, and 29,788 for 2013). The total transactions included in the prior day slaughter data was 121,813 (32,784 for 2011, 48,789 for 2012, and 40,250 for 2013).

To replicate the AMS-reported weighted average prices and head counts for the prior day purchase negotiated live report data, the research team used the same data filters that the AMS uses: 1) eliminating any transaction with fewer than 10 head; 2) eliminating any transaction with a projected live weight less than 240 pounds or greater than 300 pounds; and 3) including both packer and producer sold transactions. The team was able to exactly replicate AMS-reported price information using these filters.

To replicate AMS-reported weighted average prices and head counts for the prior day purchase negotiated carcass report data, the same data filters were used that the AMS uses: 1) eliminating any transaction with fewer than 10 head and 2) including both packer and producer sold transactions. The team was able to exactly replicate AMS-reported price information by following this protocol.

Exhibit 4.1.2. Transactions Data for Prior Day Slaughter Negotiated Carcass Trade[24]

Variable
Plant identifier
Firm identifier
Lot slaughter identifier
Base price for the lot ($/cwt): carcass prices only
Average net price for the lot ($/cwt): carcass prices only
Number of head in the lot[25]
Average live weight for the lot
Average carcass weight for the lot
Average sort loss for the lot
Average backfat measure for the lot
Average loin area for the lot
Average lean percentage for the lot
Transaction date

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[24] Only carcass transactions are reported for prior day slaughter trade.

[25] Note, that the average head in a lot between slaughter and purchase may not match due to death loss between when the purchase price was set and when the lot was slaughtered (up to 18 days later) due to sort loss, pens being split up at delivery, or additional factors unknown at the time the purchase price was set.

To replicate AMS-reported weighted average prices and head counts for the prior day slaughter negotiated carcass report data, the data were filtered based on the AMS protocol by 1) eliminating any transaction with fewer than seven head; 2) including only producer sold transactions; 3) eliminating transactions reflecting sort loss transactions[26]; 4) eliminating transactions occurring on a live basis[27]; and 5) eliminating any transaction with a reported average lot carcass weight of less than 100 pounds. The team was able to exactly replicate AMS-reported price information to within a few cents per hundredweight by following this protocol.

Since base prices for prior day live negotiated purchases are not reported in the prior day slaughter report (only base prices for slaughter purchases are reported in the prior day slaughter report), live negotiated base prices could not be compared with net prices using the prior day slaughter data. One possible way to attempt to predict the net price from the prior day slaughter report with the base price, from the prior day negotiated live hog purchases, would require matching the slaughter report transactions with the purchase transactions. If hog deliveries reported in the prior day slaughter report could be accurately matched with those reported in the prior day purchases for live negotiated sales, then analysis could be conducted by comparing prices for individual negotiated live purchases with their respective net prices.

The research team attempted to match the prior day purchase and prior day slaughter transactions for live hog negotiated sales. The analysis suggests that it is virtually impossible to match the purchase and slaughter transactions for live sales. Only 87 of the nearly 24,000 live negotiated transactions during the 30-month time period (June 2011 to December 2013) were able to be matched by using the lot and plant identification values reported by packers in each of the two AMS reports. If the team relaxed plant identification and used only lot identifier, this increased to 167 matches, which is still less than 1 percent of the live negotiated transactions. Furthermore, many of these transactions were not perfect matches, and the number of head often deviated by more than 100 head. As such, the team sees no reliable way to consistently match a representative set of live negotiated prior day purchase transactions to prior day slaughter transaction data. Therefore, limited opportunity is available for using existing AMS data to predict net prices from base prices for negotiated live hog purchases. Instead, other alternatives for predicting net prices were necessary as described in the next section.

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[26] AMS personnel daily sort and view data for the exact cut between sort loss transactions and normal transactions. Replicating this manual step would be immensely time consuming and was judged unnecessary for the precision needed for this project. In lieu of visual choice of the daily break point, the researchers chose the most common breakpoint price during the 30 months of data. This price was $45/cwt, which eliminated a few transactions.
[27] AMS personnel visually separate live and carcass transactions. Replicating this step was judged unnecessary for accomplishing the goals of this project. In lieu of visual choice of the daily break point, the researchers eliminated all of those transactions where the ratio of net price to base price was greater than 1.25.

4.2. *Predicting Net Price from Base Price*

Net price varies considerably relative to the base price. Understanding how base prices relate to net prices is important for measuring the reliability of computing net price from a base price. Fortunately, prior day slaughter data contain both base and net prices for comparison. Recall, there is not a unique identifier between a purchase transaction and a slaughter transaction. Exhibits 4.2.1 through 4.2.3 illustrate the scatter plot of the net price versus the base price for carcass-based transactions collected from the prior day slaughter report data for the last half of 2011 and all of 2012 and 2013, respectively. Each dot in a chart represents a net price on the vertical axis matched with its respective negotiated base price on the horizontal axis. The chart only includes carcass-based purchases because the base price for negotiated live hogs is not collected in the AMS prior day slaughter report. Readily apparent from the chart is the variability in the negotiated net price around the base. The net prices frequently differ from the base prices by $2 per hundredweight or more in either direction.

Exhibit 4.2.1. Scatter Plot of Prior Day Slaughter Negotiated Carcass Net Price Versus Base Price ($/cwt), by Lot, June 2011 to December 2011
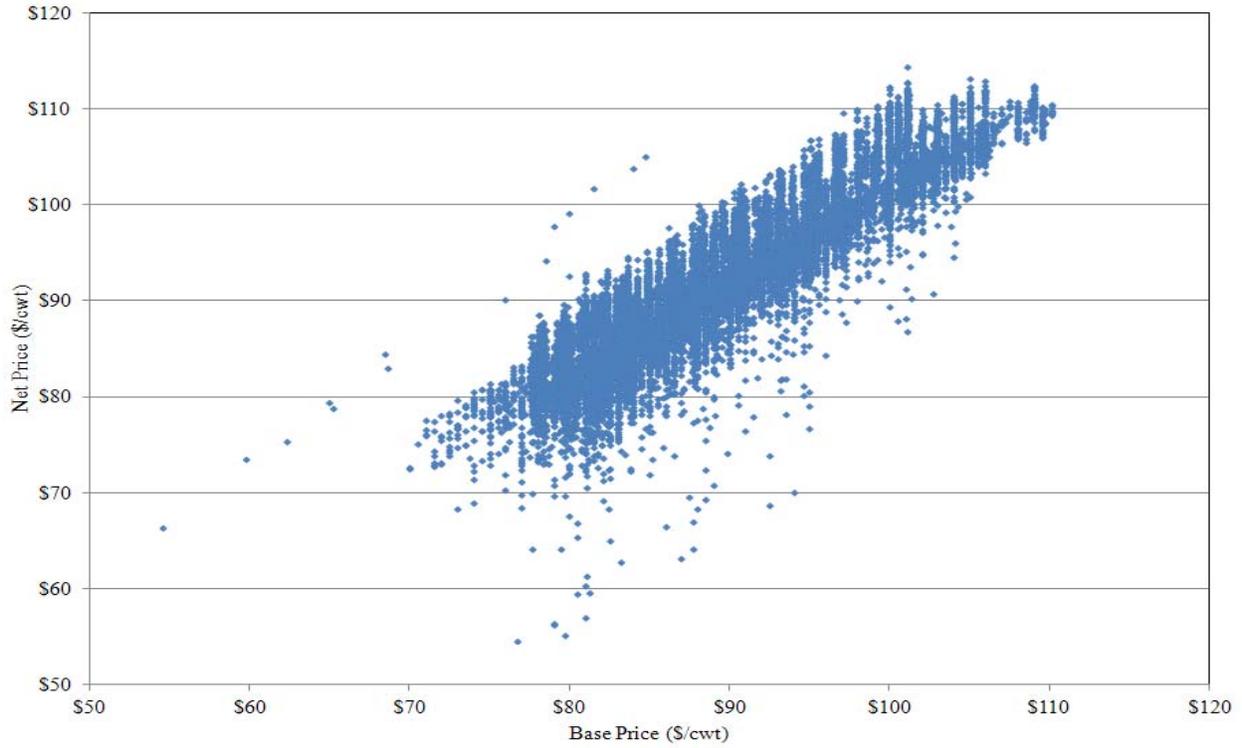

Exhibit 4.2.2. Scatter Plot of Prior Day Slaughter Negotiated Carcass Net Price Versus Base Price ($/cwt), by Lot, January 2012 to December 2012
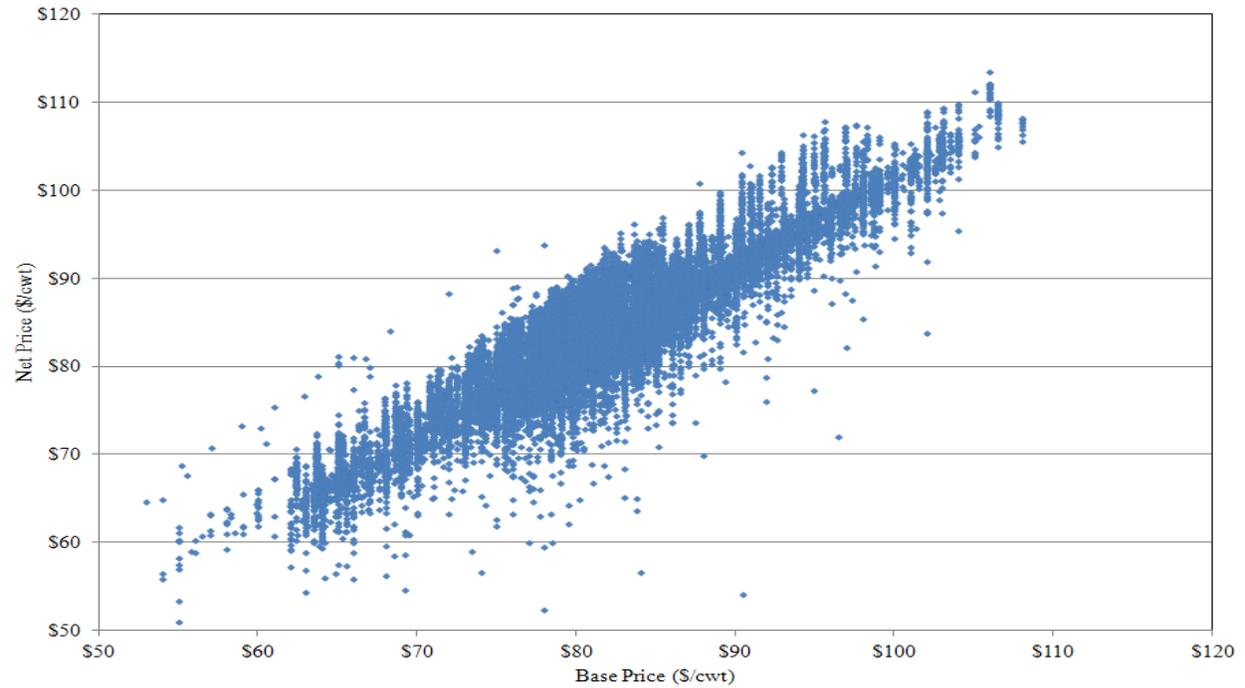
Exhibit 4.2.3. Scatter Plot of Prior Day Slaughter Negotiated Carcass Net Price Versus Base Price, by Lot, January 2013 to December 2013
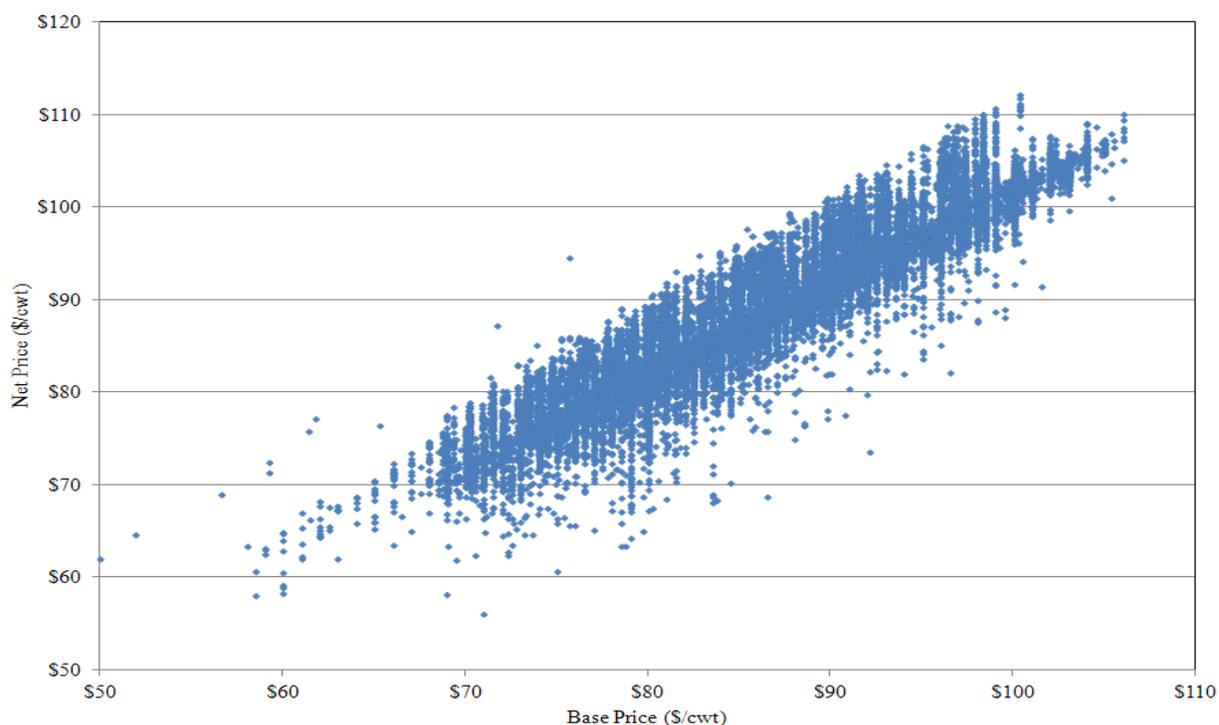
To further illustrate how the net price differs from the base price, the prior day carcass net price and base price differences were plotted in Exhibits 4.2.4 through 4.2.6 for the last half of 2011 and all of 2012 and 2013, respectively. These charts further illustrate the magnitude of variation in net prices around negotiated base prices. Individual net prices differ from base prices by economically important amounts every day.

Because so many transactions were presented in the previous charts, it is difficult to discern the precise distribution of the prior day slaughter net prices around the base from the charts alone. Thus, Exhibits 4.2.7 through 4.2.9 provide the distribution of the prior day slaughter net price minus the base price for each year, respectively.

For the last half of 2011 (Exhibit 4.2.7), on average, the net price was $2.47 per hundredweight greater than the base price with a standard deviation of $3.38 per hundredweight. Although 45 percent of transaction net prices were between zero and $3 per hundredweight greater than base prices, 37 percent were more than $3 per hundredweight greater, and 9 percent were greater by $7 per hundredweight or more. On the other extreme, 6.5 percent of net prices were more than $2 per hundredweight below the base price.

For 2012 (Exhibit 4.2.8), on average, the net price was $2.14 per hundredweight greater than the base price with a standard deviation of $3.13 per hundredweight. Although 52 percent of

transaction net prices were between zero and $3 per hundredweight greater than base prices, 30 percent were more than $3 per hundredweight greater, and 7.5 percent were greater by $7 per hundredweight or more. On the other extreme, 6.5 percent of net prices were more than $2 per hundredweight below the base price.

For 2013 (Exhibit 4.2.9), on average, the net price was $2.55 per hundredweight greater than the base price with a standard deviation of $3.22 per hundredweight. Although 47 percent of transaction net prices were between zero and $3 per hundredweight greater than base prices, 38 percent were more than $3 per hundredweight greater, and 9 percent were greater by $7 per hundredweight or more. On the other extreme, 5.5 percent of net prices were more than $2 per hundredweight below the base price.

The main conclusion is that there is a substantial range of net prices around the base prices, and this circumstance reflects the myriad of carcass quality differences present in the pork industry. No simple method exists to adjust the base price to predict the net price. Next, the capability of predicting net prices using information that may be available when the base price is established was explored.

Exhibit 4.2.4. Negotiated Prior Day Slaughter Carcass Net Price Minus Base Price, by Lot ($/cwt), June 2011 to December 2011
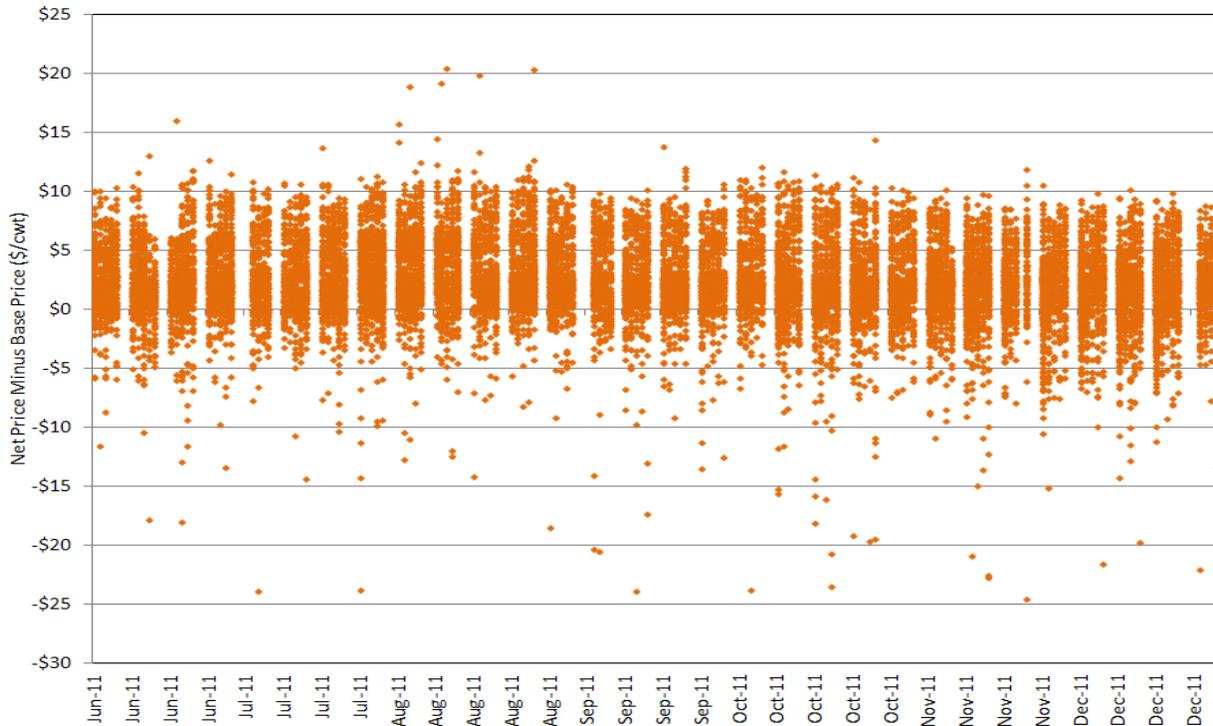
Exhibit 4.2.5. Negotiated Prior Day Slaughter Carcass Net Price Minus Base Price, by Lot ($/cwt), January 2012 to December 2012
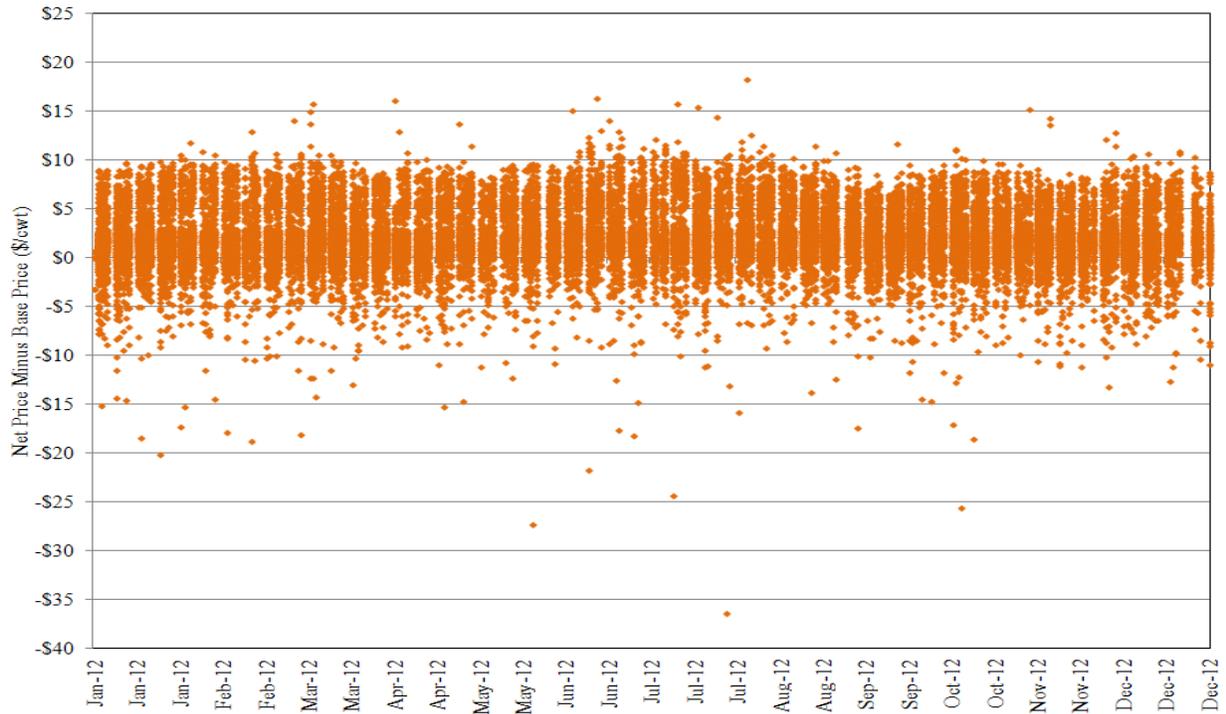
Exhibit 4.2.6. Negotiated Prior Day Slaughter Carcass Net Price Minus Base Price, by Lot ($/cwt), January 2013 to December 2013
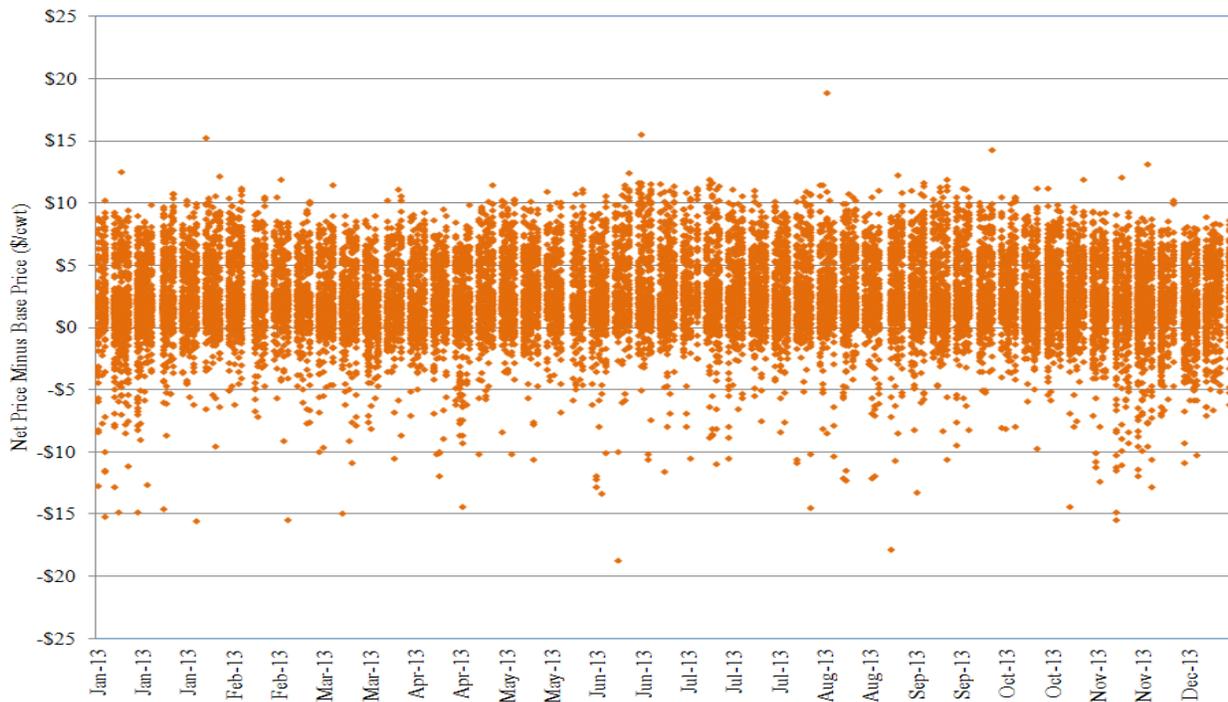
Exhibit 4.2.7. Negotiated Prior Day Slaughter Net Carcass Price Minus Base Price, Last Half of 2011

| Summary Statistic	Net Price minus Base Price ($/cwt)	Percentage of Transactions (%)
	Less than -$3.00	4.2%
	-$3.00 to -$2.01	2.3%
	-$2.00 to -$1.01	3.7%
	-$1.00 to -$0.01	7.2%
	$0.00 to $.99	11.7%
	$1.00 to $1.99	16.6%
	$2.00 to $2.99	17.1%
	$3.00 to $3.99	8.4%
	$4.00 to $4.99	7.2%
	$5.00 to $5.99	7.2%
	$6.00 to $6.99	5.3%
	$7.00 to $7.99	3.9%
	$8.00 or more	5.3%
	Total	100.0%
Average	$2.47	
Std Dev	$3.38	
Minimum	-$22.38	
Maximum	$20.39	

Exhibit 4.2.8. Negotiated Prior Day Slaughter Net Carcass Price Minus Base Price, 2012

Summary Statistic	Net Price minus Base Price ($/cwt)	Percentage of Transactions (%)
	Less than -$3.00	4.1%
	-$3.00 to -$2.01	2.5%
	-$2.00 to -$1.01	4.3%
	-$1.00 to -$0.01	7.6%
	$0.00 to $.99	13.4%
	$1.00 to $1.99	20.1%
	$2.00 to $2.99	18.5%
	$3.00 to $3.99	5.9%
	$4.00 to $4.99	5.6%
	$5.00 to $5.99	5.8%
	$6.00 to $6.99	4.9%
	$7.00 to $7.99	3.5%
	$8.00 or more	3.9%
	Total	100.0%
Average	$2.14	
Std Dev	$3.13	
Minimum	-$36.41	
Maximum	$18.24	

Exhibit 4.2.9. Negotiated Prior Day Slaughter Net Carcass Price Minus Base Price, 2013

Summary Statistic	Net Price minus Base Price ($/cwt)	Percentage of Transactions (%)
	Less than -$3.00	3.7%
	-$3.00 to -$2.01	1.8%
	-$2.00 to -$1.01	3.6%
	-$1.00 to -$0.01	6.8%
	$0.00 to $.99	12.6%
	$1.00 to $1.99	18.2%
	$2.00 to $2.99	15.8%
	$3.00 to $3.99	7.5%
	$4.00 to $4.99	7.0%
	$5.00 to $5.99	8.1%
	$6.00 to $6.99	5.9%
	$7.00 to $7.99	4.1%
	$8.00 or more	4.9%
	Total	100.0%
Average	$2.55	
Std Dev	$3.22	
Minimum	-$18.63	
Maximum	$18.89	

4.3. Predicting Net Price from Information Available when the Purchase Base Price is Established

Of interest is whether the net price can be predicted at the time the prior day purchase report is released based upon the information available at the time the base purchase price is negotiated. The negotiated purchase base price represents prices for hogs to be delivered to plants during the next 14 calendar days. The goal was to determine whether the differences between the slaughter net price and the purchase base price discussed above can be predicted based upon information available at the time the AMS prior day purchase negotiated price report is released. This is one of this study's central objectives.

At the time negotiated hogs are purchased, very little is known about the hogs. Prior day purchase data reported to AMS are the date of the negotiation, the number of head in the lot, the estimated weight for live weight purchases (but not for carcass purchases), the plant and company that bought the hogs, the state of origin of the hogs, and the negotiated base price. This is all the information that is known at the time of negotiated purchase transaction that could be used to predict the net price at the time the hogs are delivered to the packer during the next two weeks. Because AMS does not collect net prices for live weight purchases and also does not collect an estimated weight for negotiated carcass purchases,[28] this eliminates use of estimated average hog weight as a potential predictor of net carcass price. The origin of the hogs is strongly related to the plant that purchased the hogs, so adjusting prices by purchasing plant essentially adjusts for origin.

To develop a model to predict net price based upon base price using information that is available on the day that the purchase is negotiated, a regression model was developed to explain the difference between net price and base price. The model regressed the difference in net price minus base price as a function of head (*Head*); head squared (*Head^2*), which allows for a nonlinear relationship; binary variables for plants that purchased the hogs (*Plant*); and monthly dummy variables to account for seasonality (*Month*). This model was used to predict net prices given base prices. In essence, this predicts net prices for each transaction *based upon information available at the time the purchase was negotiated* and that was potentially relevant for predicting how the net price might differ from the negotiated base price. Lot size, plant purchasing the hogs, and seasonality were accounted for in the model to forecast net price given the base price. The model is formally (*e* is a random error term and *i* refers to individual transaction)[29]:

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[28] The live price is the net price because no adjustments are made to the price paid for quality in the lot. Thus, no quality information is known for animals procured through the live negotiated trade.

[29] Regression analysis was used to allow for simultaneous evaluation of multiple factors. The variation of regression would be to conduct data sorts and apply averages from the sorts to adjust the base price to a computed net price.

$$Net\ Price_i - Base\ Price_i = b_0 + b_1 head_i + b_2 head^2{}_i$$

$$+ b_{2+k} \sum_{k=2}^{K} Plant_{ik} + b_{2+K+m} \sum_{m=2}^{12} Month_{im} + e_i$$

The errors (e) from this model illustrate our ability to predict net prices based on information available to the AMS at the time the negotiated base price is established and at the purchase transaction. If the errors are generally near zero, this indicates that a reliable estimate of net prices based upon purchase base prices could be devised at the time the base is determined. Errors deviating from zero suggest reduced ability to accurately predict net prices.

The errors for each day during the last half of 2011 and all of 2012 and 2013 for every carcass negotiated transaction in predicting net price are illustrated in Exhibits 4.3.1, 4.3.2, and 4.3.3, respectively.[30] The distribution of the errors, from these charts, is summarized in Exhibits 4.3.4, 4.3.5, and 4.3.6 for 2011, 2012, and 2013, respectively.

For the last half of 2011, for 41 percent of transactions, the net price could be predicted to within $1 per hundredweight (up or down) accuracy using information available at the time the base is negotiated. In contrast, 59 percent of predicted net prices would be wrong by more than $1 per hundredweight. Furthermore, 11 percent of predicted net prices would be wrong by at least $3 per hundredweight (either too high or too low).

For 2012, for 43 percent of transactions, the net price could be predicted to within $1 per hundredweight (up or down) accuracy using information available at the time the base is negotiated. In contrast, 57 percent of predicted net prices would be wrong by more than $1 per hundredweight. Furthermore, 9.6 percent of predicted net prices would be wrong by at least $3 per hundredweight (either too high or too low).

For 2013, for 44 percent of transactions, the net price could be predicted to within $1 per hundredweight (up or down) accuracy using information available at the time the base is negotiated. In contrast, 56 percent of predicted net prices would be wrong by more than $1 per hundredweight. Furthermore, 11.3 percent of predicted net prices would be wrong by at least $3 per hundredweight (either too high or too low).

This illustrates the difficulty with predicting the net price for negotiated purchases at the time the negotiated base is established at the time of the purchase transaction. The magnitude of error

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[30] The model was also estimated excluding the number of head and head squared variables, but results were very similar and conclusions were identical to those reported here.

estimating net prices at the time negotiated base prices are reported is excessively large to provide useful market information in reporting predicted net prices.

Mandatory livestock reporting regulations do not require processors to report a common lot identifier between purchase transactions and slaughter transactions. So, prior day slaughter negotiated carcass base and net prices were used to analyze the ability to predict a net price from a base price. By using only the slaughter data, base prices were able to be matched with net prices and all associated market and nonmarket factors. By not being able to match purchase and slaughter transactions, only the time dimension between when a negotiated purchase price is established for a lot and when the lot is slaughtered (between one and 14 days after the purchase price is set) was left out. That is, the team was not able to confidently match slaughter transactions occurring today with purchases that occurred sometime during the previous 14 days. Ideally, the analysis would match purchase transactions with slaughter transactions; however, this not possible.

Exhibit 4.3.1. Errors Predicting Negotiated Carcass Net Price at the Time the Negotiated Base is Established ($/cwt), June 2011 to December 2011
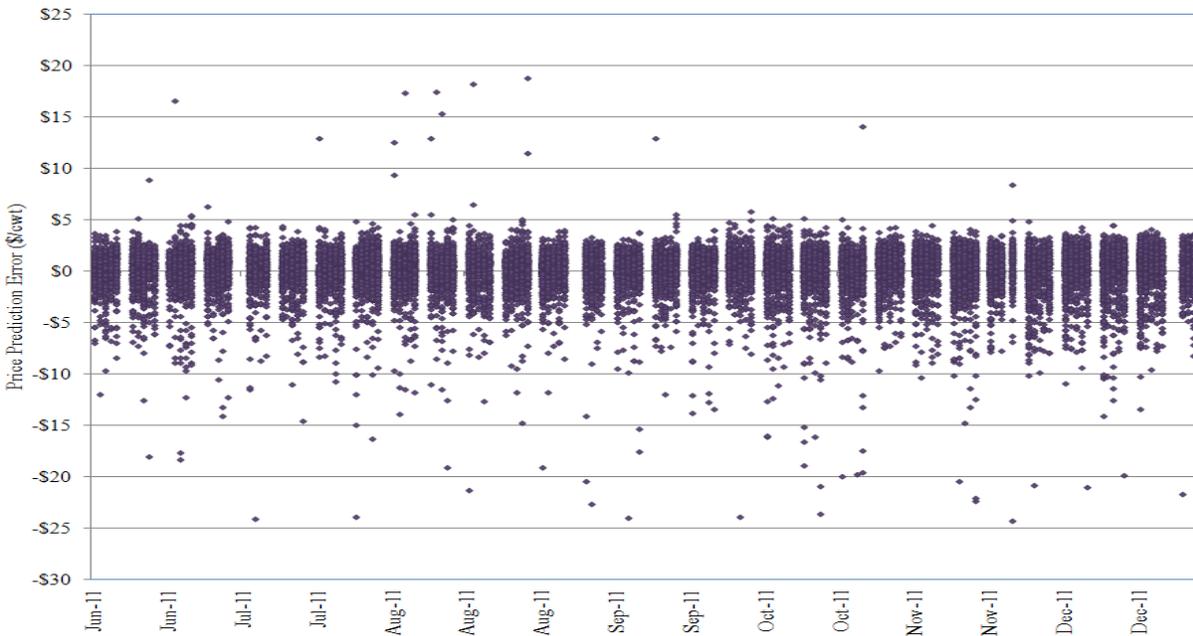
Exhibit 4.3.2. Errors Predicting Negotiated Carcass Net Price at the Time the Negotiated Base is Established ($/cwt), January 2012 to December 2012
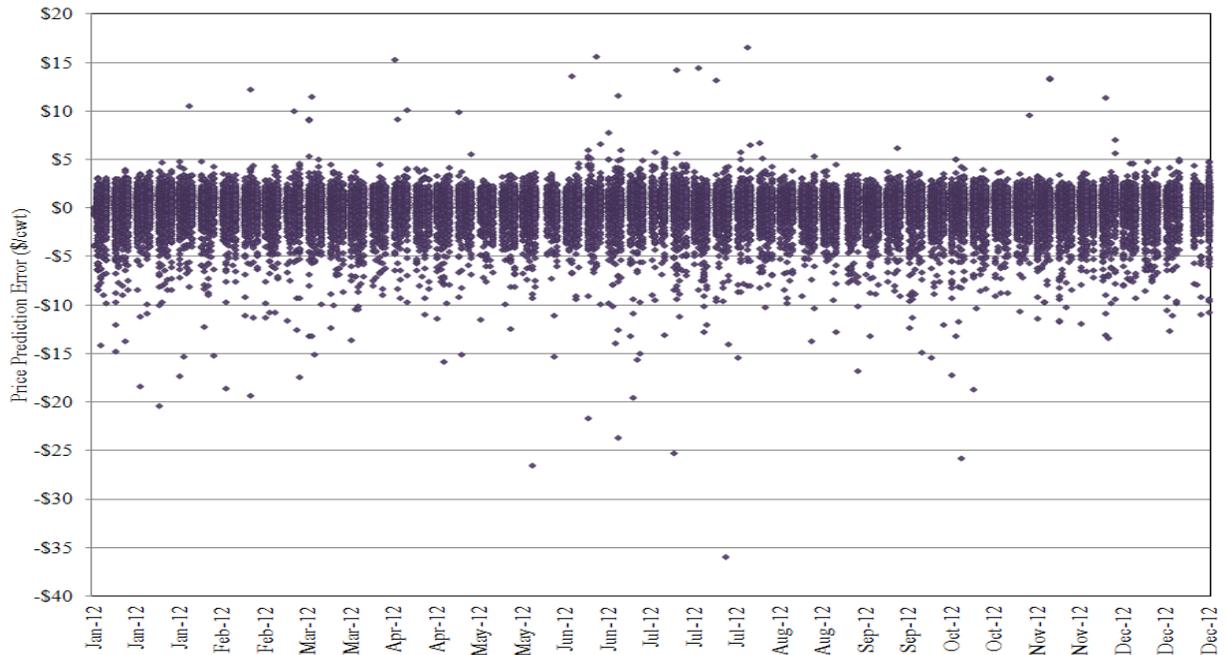

Exhibit 4.3.3. Errors Predicting Negotiated Carcass Net Price at the Time the Negotiated Base is Established ($/cwt), January 2013 to December 2013
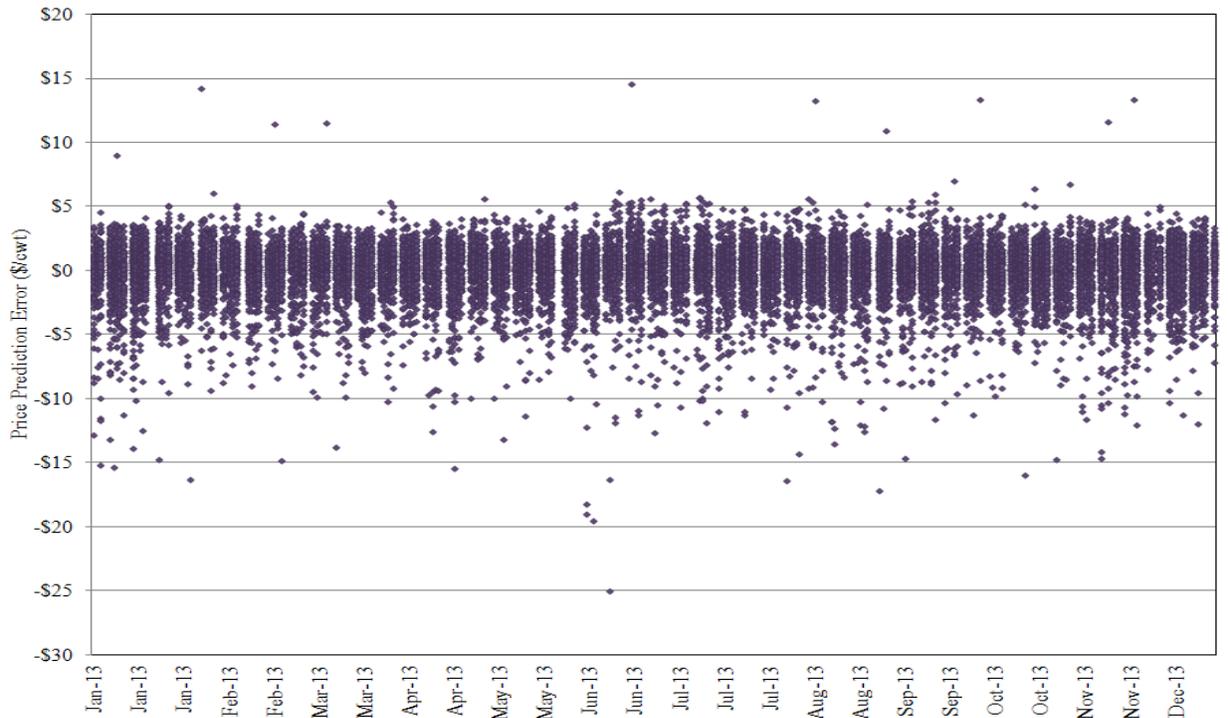
Exhibit 4.3.4. Error Predicting Net Price when Base Price is Negotiated, Last Half of 2011

Summary Statistic		Error Predicting Net Price	Percentage of Transactions (%)
		Less than -$6.00	1.9%
		-$6.00 to -$5.01	1.0%
		-$5.00 to -$4.01	1.9%
		-$4.00 to -$3.01	3.1%
		-$3.00 to -$2.01	5.6%
		-$2.00 to -$1.01	9.8%
		-$1.00 to -$0.01	18.3%
		$0.00 to $0.99	25.7%
		$1.00 to $1.99	20.5%
		$2.00 to $2.99	8.7%
		$3.00 to $3.99	2.6%
		$4.00 or more	0.9%
		Total	100.0%
Average	$0.00		
Std Dev	$2.20		
Minimum	-$25.00		
Maximum	$14.56		

Exhibit 4.3.5. Error Predicting Net Price when Base Price is Negotiated, 2012

Summary Statistic		Error Predicting Net Price	Percentage of Transactions (%)
		Less than -$6.00	1.9%
		-$6.00 to -$5.01	1.0%
		-$5.00 to -$4.01	1.7%
		-$4.00 to -$3.01	3.1%
		-$3.00 to -$2.01	5.7%
		-$2.00 to -$1.01	9.6%
		-$1.00 to -$0.01	17.3%
		$0.00 to $0.99	25.5%
		$1.00 to $1.99	24.4%
		$2.00 to $2.99	8.0%
		$3.00 to $3.99	1.5%
		$4.00 or more	0.5%
		Total	100.0%
Average	$0.00		
Std Dev	$2.16		
Minimum	-$35.85		
Maximum	$16.63		

Exhibit 4.3.6. Error Predicting Net Price when Base Price is Negotiated, 2013

Summary Statistic	Error Predicting Net Price	Percentage of Transactions (%)
	Less than -$6.00	2.4%
	-$6.00 to -$5.01	1.0%
	-$5.00 to -$4.01	1.8%
	-$4.00 to -$3.01	3.1%
	-$3.00 to -$2.01	5.6%
	-$2.00 to -$1.01	9.9%
	-$1.00 to -$0.01	17.2%
	$0.00 to $0.99	23.6%
	$1.00 to $1.99	22.0%
	$2.00 to $2.99	10.7%
	$3.00 to $3.99	2.2%
	$4.00 or more	0.7%
	Total	100.0%
Average	$0.00	
Std Dev	$2.39	
Minimum	-$24.25	
Maximum	$18.84	

### 4.4. *Base Price Sensitivity to Market Buyer Participation*

Hog processors are regionally dispersed (see Exhibits 2.2.1 and 2.2.2) and use different procurement strategies between firms and/or plants. Thus, day-to-day firm participation may impact day-to-day variability in the weighted average negotiated base price.

Exhibits 4.4.1 and 4.4.2 display the number of firms and plants, respectively, participating in the daily negotiated live and carcass trade between June 2011 and December 2013. If market participation becomes too small, then the mandatory price reporting confidentiality requirement (see Appendix Exhibit A1) would be cause for discontinuing negotiated price reporting. For neither carcass nor live negotiated trade is there current concern that the price series will be discontinued due to the mandatory price reporting confidentiality requirement. The mandatory price reporting confidentiality requirement not only protects processors from firm-specific data being reported, but the requirement also protects information users from accessing information that is based on a significantly small unrepresentative sample of market activity.

The daily largest four-plant share was computed to examine the concentration of plants purchasing (see Exhibits 4.4.3 and 4.4.4). This share is for the four plants accounting for the highest percentage of trade on a particular day. Thus, from one day to the next, the four plants could be an entirely different plant buying group. The largest four-plant shares have been upward trending during the past 30 months. Only in the case of negotiated live purchases is there an indication of the share consistently approaching 1.0.

Exhibit 4.4.1. Number of Different Firms that Bought Negotiated Hogs, Separately for Carcass and Live, by Day, June 6, 2011, to Dec. 17, 2013
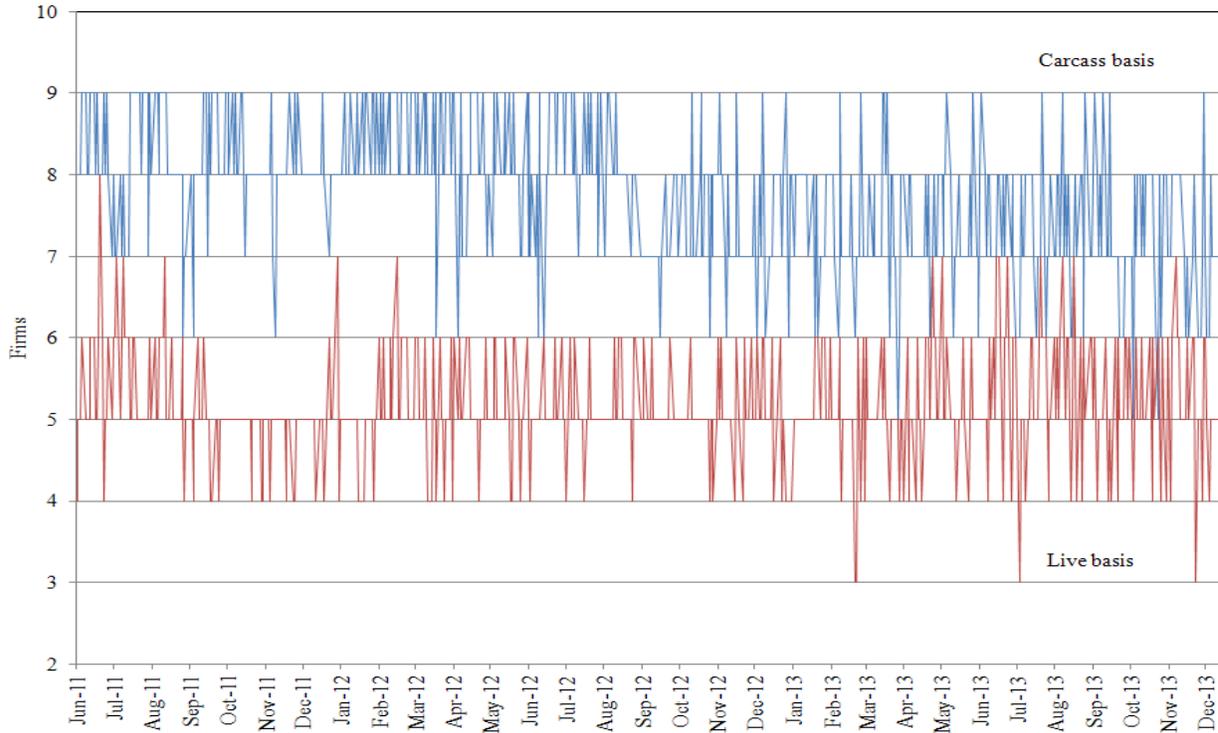
Exhibit 4.4.2. Number of Different Firms that Bought Negotiated Hogs, Separately for Carcass and Live, by Day, June 6, 2011, to Dec. 17, 2013
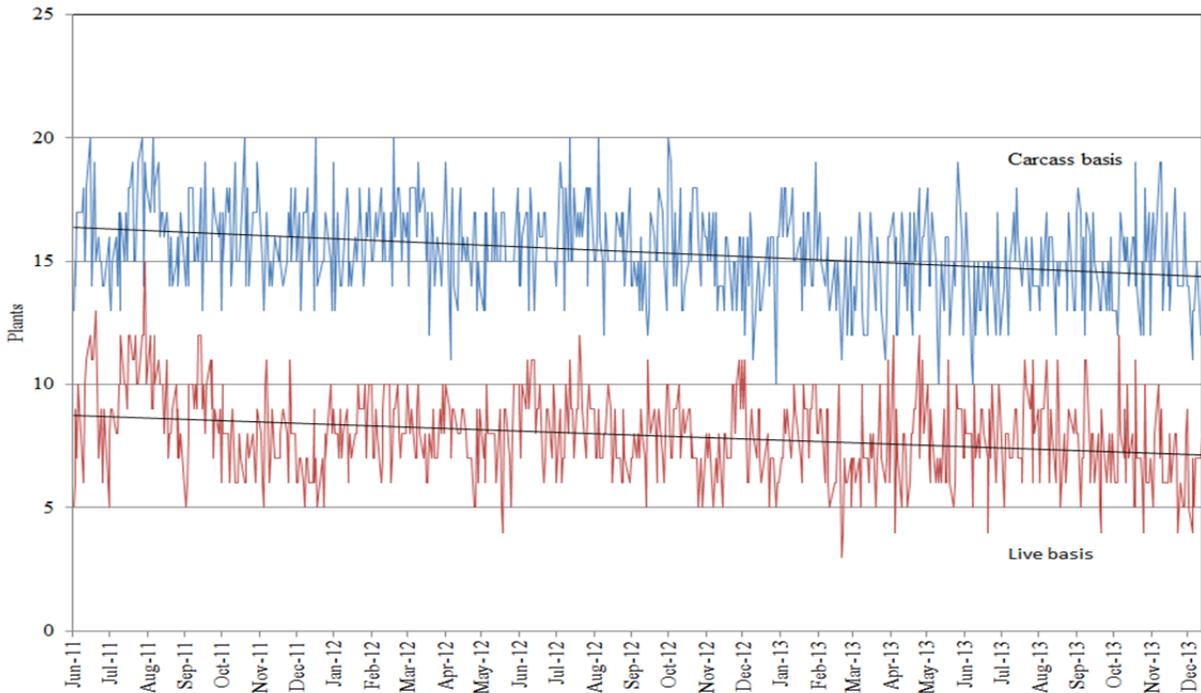
Figure 4.4.3. Shares of Purchases by the Plants with the Four Largest Shares by Day, Carcass and Live Negotiated Purchases Combined, June 2011 to December 2013
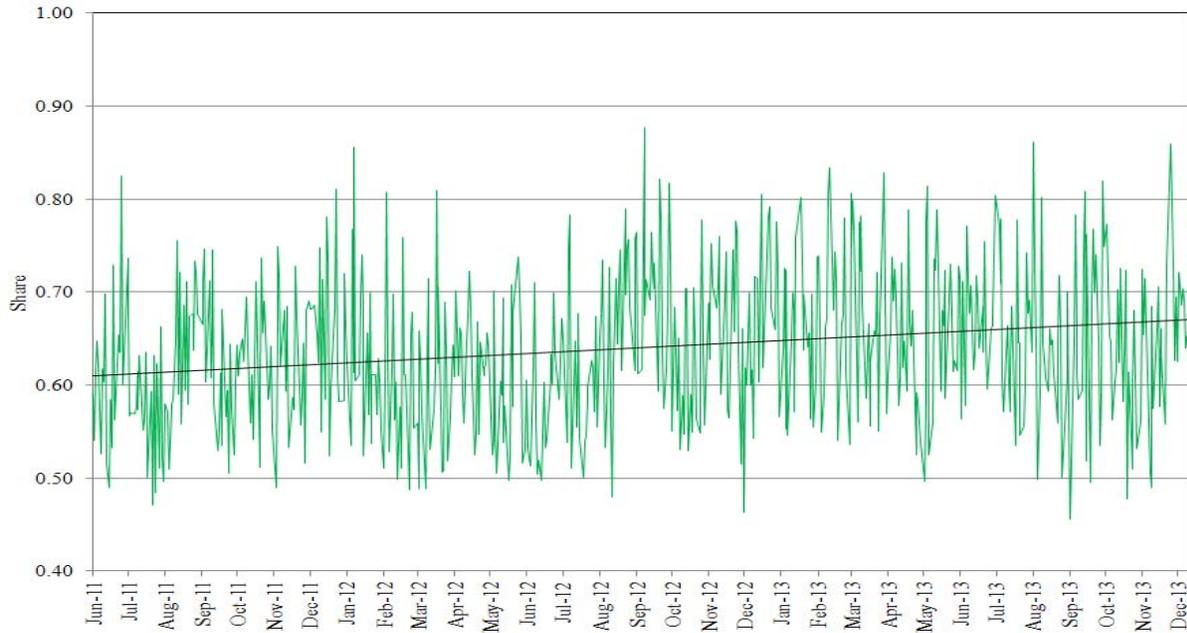
Exhibit 4.4.4. Shares of Purchases by the Plants with the Four Largest Shares by Day, Separately for Carcass and Live Negotiated Purchases, June 2011 to December 2013
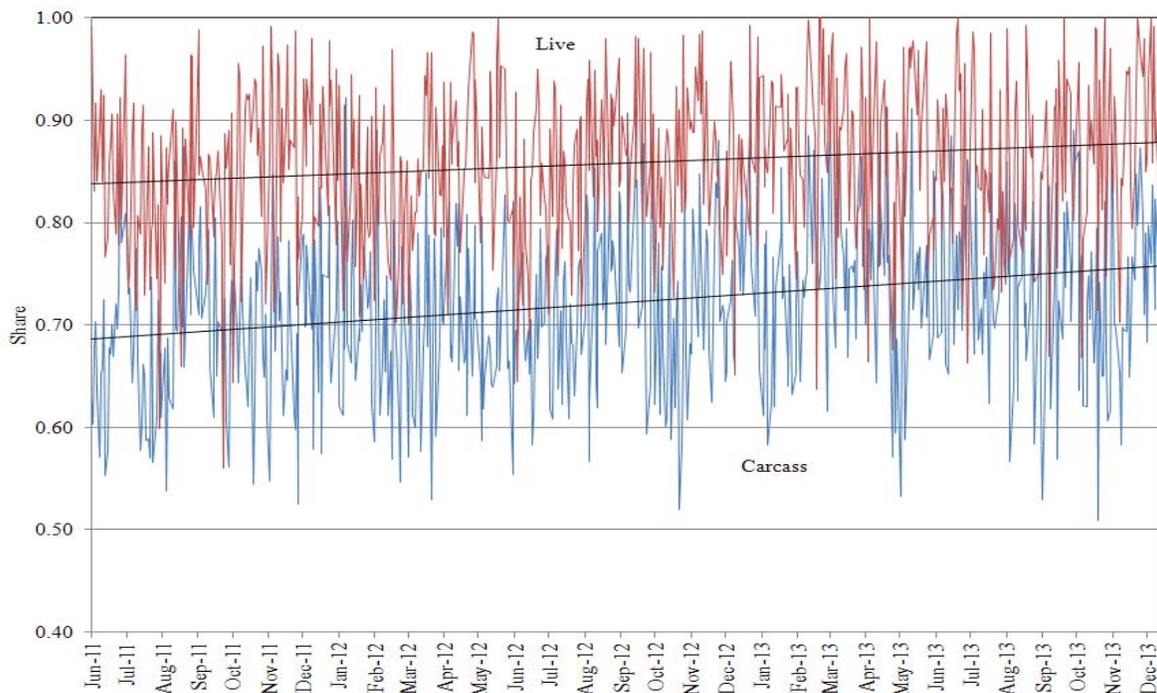
To determine the daily prior day purchase weighted average reported price sensitivity to who is participating in the market each day, the changes in the reported daily weighted average base price were computed by removing each plant's purchases each day one plant at a time, recalculating the weighted average, and comparing that to the reported weighted average. For example, if plant one bought 10 lots of hogs in the negotiated carcass market on a particular day, all of those purchases were removed from the carcass purchases, the weighted average base price for that day was recalculated, and the recalculated weighted average price was compared to the AMS-reported weighted average price. This was done for each plant that purchased hogs each day from June 6, 2011, to December 17, 2013.

This study refers to each of these plant-by-day prices as plant-day prices. That is, if a plant buys hogs today, regardless of the number of head, that constitutes one plant-day. Four plants all buying each of 10 days would constitute 40 plant-days. Overall, 32 plants had purchased at least one lot of hogs (either carcass or live negotiated) during the 30-month time frame, though several of these plants did not purchase regularly in one or both negotiated markets. Overall, for negotiated carcass purchases, total plant-days equaled 9,888 plant-days (number of plants that purchased each day summed across all days), total plant-days equaled 5,116 plant-days for live negotiated purchases during the 30-month time period.

If the new weighted average price calculated by eliminating a plant was lower than the AMS-reported base price, this was considered a decline in the change in base price. That is, if removing a plant's purchases results in a lower reported weighted average base price for a day, this is recognized as a decline in the weighted average base price as a result of removing that plant's purchases on that day. If removing a plant's purchases results in a higher weighted average base price than the AMS-reported weighted average base price that day, this is recognized as an increase in the weighted average base price.

Exhibit 4.4.5 reports the distributions of changes in weighted average base prices that result from removing individual plants' purchases. For about 4 percent of plant-days for the carcass prices and 3 percent of plant-days for the live price, individual plant purchases impact the weighted-average AMS-reported base price by $1 per hundredweight or more in absolute value. During 84 percent of plant-days for carcass purchases and 75 percent of plant-days for live purchases, weighted averages calculated by removing individual plants would be within $0.25 per hundredweight (higher or lower) of the AMS-reported weighted average price. If no plant's purchases influenced the AMS-reported weighted average base price any day, then 100 percent of the plant-days would be near zero. The fact that 16 percent of carcass purchase plant-days and 25 percent of live purchase plant-days have more than $0.25 per hundredweight base price influence on the AMS prices indicates that the plant being included in the market quote for a single day does influence reported weighted-base average prices frequently by at least $0.25 per hundredweight, especially for live purchases.

Exhibit 4.4.5. Distribution of How Much Daily Prior Day Purchase Weighted Average Base Price Would Change As Plants Included in the Weighted Average are Dropped One at a Time, June 6, 2011, to Dec. 17, 2013

	Percentage of Plant-Days	
Change in Weighted Average Price ($/cwt)	Negotiated Carcass Price	Negotiated Live Price
Decline by $1.00 or more	1.7%	2.4%
Decline by $0.25 to $0.99	7.6%	11.7%
Change between -$0.25 and $0.25	83.9%	74.6%
Increase by $0.26 to $1.00	4.7%	10.7%
Increase by more than $1.00	2.2%	0.6%
Total	100.0%	100.0%

Note: A plant-day refers to any plant that bought at least one lot of hogs during a day.

Similar to the plant purchases, the weighted average base price distributions were also calculated including or excluding entire companies each day in the reported weighted average base price. In this analysis, all purchases by each company each day were removed one at a time and the weighted average negotiated carcass and live base prices were recalculated. During the 30-month time period, there are a total of 5,005 company-days (sum of companies that bought each day across all days) for carcass negotiated purchases and 3,876 company-days for live negotiated purchases.

As shown in Exhibit 4.4.6, for 64 percent of carcass and 67 percent of live negotiated purchase company-days, the weighted average base price would be within $0.25 per hundredweight of the reported AMS price regardless of whether any individual company (each removed one at a time) was included in the weighted average price reported by AMS. Thus, for 36 percent of carcass and 33 percent of live negotiated reported weighted averages, the company being included in the weighted average each day does influence prices by at least $0.25 per hundredweight (up or down). Of course, these numbers by firm are larger than the by plant numbers reported above of 16 percent carcass and 25 percent live purchases because several companies own more than one plant, and as such, removing a company from the weighted average, involves frequently removing more individual transactions from the daily data than if just an individual plant is removed.

Exhibit 4.4.6. Distribution of How Much Daily Prior Day Purchase Weighted Average Base Price Would Change As Companies Included in the Weighted Average are Dropped One at a Time.

Change in Weighted Average Price ($/cwt)	Percentage of Company-Days	
	Negotiated Carcass Price	Negotiated Live Price
Decline by $1.00 or more	4.8%	5.1%
Decline by $0.25 to $0.99	14.1%	13.1%
Change between -$0.25 and $0.25	63.9%	67.2%
Increase by $0.26 to $1.00	12.7%	13.8%
Increase by more than $1.00	4.5%	0.8%
Total	100.0%	100.0%

Note: A company-day refers to any packing firm that bought at least one lot of hogs during a day.

Because of the percentage of observations in the tails (above a $0.50/cwt move up or down) reported in Exhibits 4.4.5 and 4.4.6 we further investigated whether individual plants may be independently influencing the weighted average market price. During the June 6, 2011, to December 17, 2013 period a plant may have participated in the market a total of 643 plant reporting dates. We computed the percentage of trading days, of the 643 plant reporting dates that a specific plant influenced the weighted average price by at least $0.50/cwt. and at least $1/cwt. The results are reported in Exhibit 4.4.7 for negotiated carcass transactions and Exhibit 4.4.8 for negotiated live transactions. Only plants purchasing greater than 5% of the trading days were analyzed. While we recognize the daily participation of individual plant purchases is an important factor to consider, to protect confidentiality we categorized percentage of days a purchase was made (of the 643 trading days) as less than fifty percent or greater than or equal to fifty percent. Plants were randomly assigned a row in each table, and the row order is not the same between tables, i.e., one cannot compare row one of Exhibit 4.4.7 and row one of Exhibit 4.4.8. Interpretation of the exhibit values is important.

For row one of Exhibit 4.4.7, the value of 0.6% represents that removing this particular plant from the weighted average price resulted in the national weighted average price declining by $0.50/cwt or more 0.6% of the 643 days. There is only one plant that raises concern over its purchasing presence influencing the national weighted average base price. The plant represented by row one in Exhibit 4.4.7 shows a strong tendency to be $0.50/cwt. or more below the national weighted average carcass base price. Put another way, whether this plant purchases hogs or not on a given day causes the weighted average reported market price to move by a $1/cwt. or more

32.8% of the trading days analyzed here. The fact the reported market price can change by an economically important amount depending upon whether the plant is in or out of the market is a non-market factor affecting day-to-day reported price movement. What about the net price?

For the plant of concern here, we next looked at the impact removing the plant has on the weighted average reported net slaughter price. Removing the plant from the weighted average net slaughter price causes a $0.50/cwt. or more increase 4.5% of the time. This value is still significant even though the frequency of impact is substantially less than for the reported purchase base price affect. Regardless of finding a lower impact for the plant's net price, based on the information available when the base price is established there will still be poor predictability of a weighted average net price from the base price. What is the implication of this finding?

The finding of one influential plant creates a quandary for AMS. First, mandatory price reporting requires AMS to report all data collected, so AMS cannot arbitrarily drop a plant. Second, due to confidentiality disclosing the plant identifier is not an option, so a plant exemption cannot be requested in the process of MPR reauthorization. Third, the presence of the plant in the report means that hog buyers and sellers will observe day-to-day price movements depending on whether this plant is in the market on a given day and how large of market share this plant represents from one day to the next. What is the solution?

We suggest that AMS consider tracking individual plant price effect for all (barrows and gilts, carcass and live, and sow) negotiated prices reported, i.e., AMS could follow a similar methodology used here to measures the change in price due to dropping a plant.[31] AMS could develop a rule for switching plants from negotiated to other market arrangements, for when a plant is considered to have a non-market related impact on the weighted average price. For example, AMS could confirm type of negotiated purchases with the plant.[32]

We, also, suggest that AMS examine segmenting negotiated purchase data weighted average price into thirds based on the number of animals represented by a particular report. For example, if the negotiated barrows & gilts carcass purchase data includes 6,000 head of hogs, then the breakpoints would be at 2,000 and 4,000 head. The concept involves ordering transactions (or lots) from low price to high price. Divide the number of hogs into three equal portions.[33] Each hog in each third has a price assigned to it. The weighted average price is then computed for

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[31] While the plant we found causes the weighted average base price to decrease merely by the presence of the plant purchasing hogs, the other consideration is that plants purchasing value added hogs (for example, antibiotic free, natural) could similarly influence the weighted average price higher for the case of a thin market.

[32] We also believe this methodology minimizes the chance of reports being discontinued due to the 3/70/20 rule.

[33] For this scenario, a pen may be split between two categories.

each third. This information would give the industry an idea of the variability of prices within the reported weighted average price.

Within thinly traded markets a set of outlier transaction is more likely to have a significant impact. We did not examine whether through the process of eliminating one plant's transactions that the problem may become recursive, i.e., the removal of one plant triggers another plant to have a more sizeable price impact on the weighted average, etc.

Exhibit 4.4.7. Percentage of the 643 Trading Days over the June 2011 - December 2013 Period that the Weighted Average Carcass Base Price would have Changed by Excluding Individual Plants from the Weighted Average.[1]

	Percent of Days Bought[2]	Decline by $0.50/cwt or more	Decline by $1/cwt or more	Increase by $0.50/cwt or more	Increase by $1/cwt or more
Each Row Represents a Unique Processing Plant (Only plants with a Participation Rate Greater than 5% Reported)	≥50%	0.6%	0.6%	60.8%	32.8%
	≥50%	1.1%	1.1%	0.3%	
	≥50%	0.3%	0.3%		
	≥50%			2.3%	0.2%
	≥50%	1.2%	1.2%	0.3%	
	≥50%	2.8%	2.8%	0.2%	
	≥50%	0.8%	0.8%		
	≥50%	4.7%	4.7%		
	≥50%	0.2%	0.2%		
	<50%	10.7%	10.7%		
	≥50%	0.2%	0.2%	0.2%	
	<50%		0.0%	0.3%	0.0%
	≥50%		0.0%	0.9%	0.0%
	≥50%	0.3%	0.3%	0.2%	
	<50%			0.8%	0.2%
	≥50%	0.3%	0.3%	1.6%	
	<50%	1.9%	1.9%		
	≥50%	0.3%	0.3%	0.2%	
	<50%	0.6%	0.0%		0.0%

1. To restrict plant identifiers the row placement of plants differs between Exhibit 4.4.7 and Exhibit 4.4.8.
2. To restrict plant identifiers we coded the percent of trading days a plant buys, of the 643 trading days total, as greater than or equal to 50% or less than 50%.

Exhibit 4.4.8. Percentage of the 643 Trading Days over the June 2011 - December 2013 Period that the Weighted Average Live Base Price would have Changed by Excluding Individual Plants from the Weighted Average.[1]

	Percent of Days Bought[2]	Decline by $0.50/cwt or more	Decline by $1/cwt or more	Increase by $0.50/cwt or more	Increase by $1/cwt or more
Each Row Represents a Unique Processing Plant (Only plants with a Participation Rate Greater than 5% Reported)	≥50%	1.2%	1.2%	1.4%	
	<50%	0.5%	0.5%		
	<50%	0.3%	0.3%		
	<50%	0.5%	0.5%		
	≥50%	7.6%	7.6%	0.9%	
	<50%	0.2%	0.2%	0.2%	
	≥50%	1.6%	1.6%		
	≥50%	0.2%	0.2%		
	≥50%	0.3%	0.3%		
	≥50%	0.6%	0.6%		
	≥50%	4.0%	4.0%		
	<50%	0.2%	0.2%		
	≥50%			12.1%	2.3%
	<50%	1.6%	1.6%		
	<50%			0.2%	

1. To restrict plant identifiers the row placement of plants differs between Exhibit 4.4.7 and Exhibit 4.4.8.
2. To restrict plant identifiers we coded the percent of trading days a plant buys, of the 643 trading days total, as greater than or equal to 50% or less than 50%.

4.5. *Regional Trends in Prices and Volumes*

Using MPR publically available data we examined the regional trends in negotiated prior day purchase base price and volume.   The western cornbelt trade and eastern cornbelt trade are subsets of the national trade. Iowa-Minnesota trade is not shown here because it is subset of the regional data. Generally, the national report is a weighted average of both the data reported in the eastern cornbelt report and the western cornbelt report.   The price and volume trends are examined to determine changes in procurement patterns.

Exhibit 4.5.1 shows the historical path of negotiated eastern cornbelt and western cornbelt prices. The price series tend to follow a similar path over the 14 year period. Regional volume is presented in Exhibit 4.5.2. Not surprising, volume in both regions has trended downward. The western cornbelt volume has dropped more than the eastern cornbelt volume. What are the implications of the substantial decline in western cornbelt volume relative to the drop in eastern cornbelt volume?

Exhibit 4.5.3 represents the ratio of the western cornbelt price to national price and the ratio of the eastern cornbelt price to the national price. Two observations are noteworthy from the data in this exhibit. First, the western cornbelt price is generally above the national average price (above 1.00 in the exhibit) and the eastern cornbelt price is generally below the national average price (below 1.00 in the exhibit). Second, eastern cornbelt price relative to the national price is much more variable than is the western cornbelt price relative to the national price. Next, we combine the price information with relative share of the national trade.

Exhibit 4.5.4 represents the relative shares of western cornbelt and eastern cornbelt hogs contributing to the national totals. This exhibit confirms the trend in data observed in Exhibit 4.5.2. By combining the information in Exhibits 4.5.2, 4.5.3 and 4.5.4 the following conclusion can be made.   Current period day-to-day national average trade is likely to reflect either a majority of western cornbelt hogs or a majority of eastern cornbelt hogs. This is a change from the past where the western cornbelt trade was a dominant contributor to computing the national price. Currently, there is no clear dominant regional market or is the market evenly represented day-to-day. Also, the national average price today is more reflective of eastern cornbelt prices than in the past, which indicates the national average price is more susceptible to the variability in the eastern cornbelt prices.   Is there a solution?

Our recommendation is that the pork industry participants interested in the national weighted average use a weighting matrix other than head reported for a specific date. For example of a particular trading date in January 2014,

Western Cornbelt Negotiated Carcass Trade:	2749 head	$83.14/cwt.
Eastern Cornbelt Negotiated Carcass Trade:	2450 head	$80.55/cwt.

Now, the national weighted average price would be computed as equal to weights based on observed volume:

$$= [(2749 \times \$83.14) + (2450 \times \$80.55)]/(2749+2450) = \$81.92/\text{cwt.},$$

here the volume is 49% eastern cornbelt and 51% western cornbelt.[34] An alternative weighting matrix, where the national average would be computed as equal to a twenty-day average is:

$$= [(0.62 \times \$83.14) + (0.38 \times \$80.55)] = \$82.10/\text{cwt.}$$

The regional prices do not change, only the weighting function changes. While this example shows that the new computed price increased over the reported price, the price could have as easily decreased if another time period would have been chosen. Computing alternative volume weights over a longer time period removes day-to-day price swings due to which region represents a majority of the market share from one day to the next. Anyone in the industry can run this computation without AMS facilitating the computation, i.e., industry participants can choose their preferred number of days to compute a national weighted average price.

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[34] Daily volume weights do not always equate to one when adding the eastern cornbelt trade and western cornbelt trade. Of the 3157 days reviewed these two regions account for 95% or more of hogs reported in the national weighted average price 95% of the time.

Exhibit 4.5.1. Daily Prior day Purchase Negotiated Base Price for the Western Corn and Eastern Corn Belt, September 2001 through January 2014.
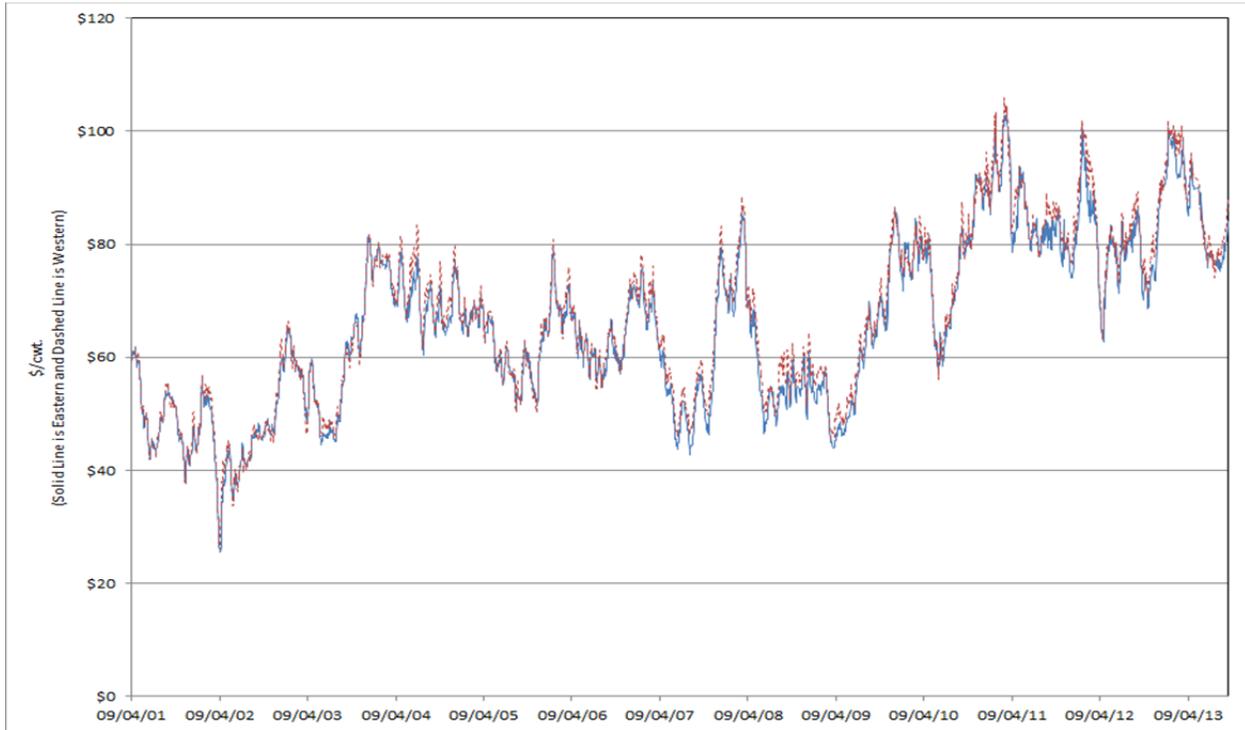

Exhibit 4.5.2. Daily Prior day Purchase Negotiated Volume for the Western Corn Belt Price and Eastern Corn Belt, September 2001 through January 2014.
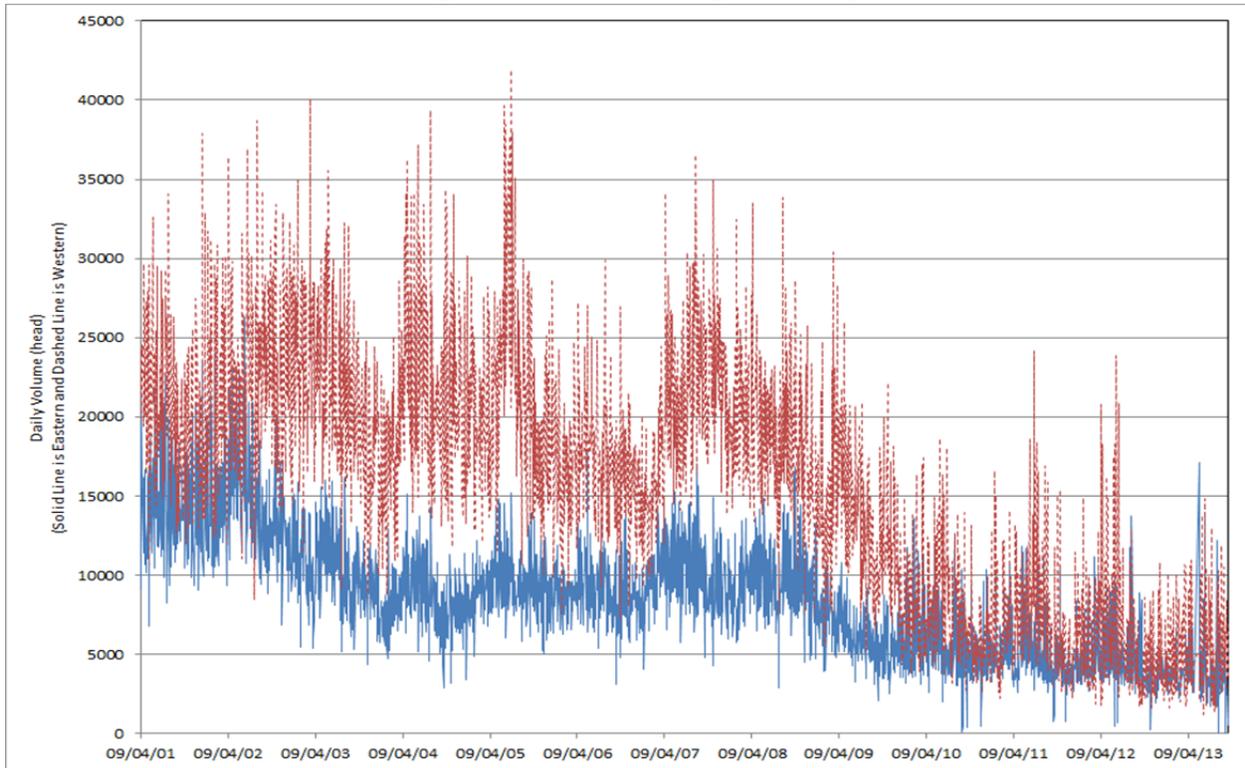
Exhibit 4.5.3. Daily Prior day Purchase Negotiated Ratio of Western Corn Belt to the National and the Ratio of Eastern Corn Belt to the National, September 2001 through January 2014.
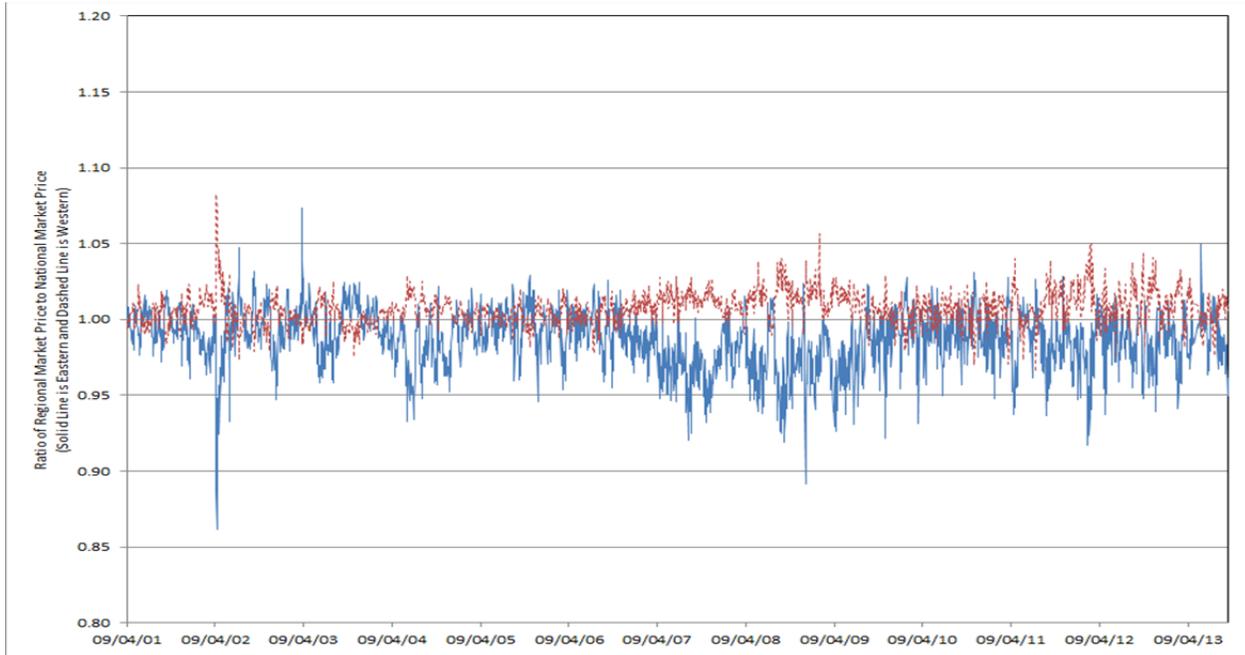
 Exhibit 4.5.4. Daily Prior day Purchase Negotiated Volume for the Western Corn Belt to the National and the Ratio of the Eastern Corn Belt to the National, September 2001 through January 2014.
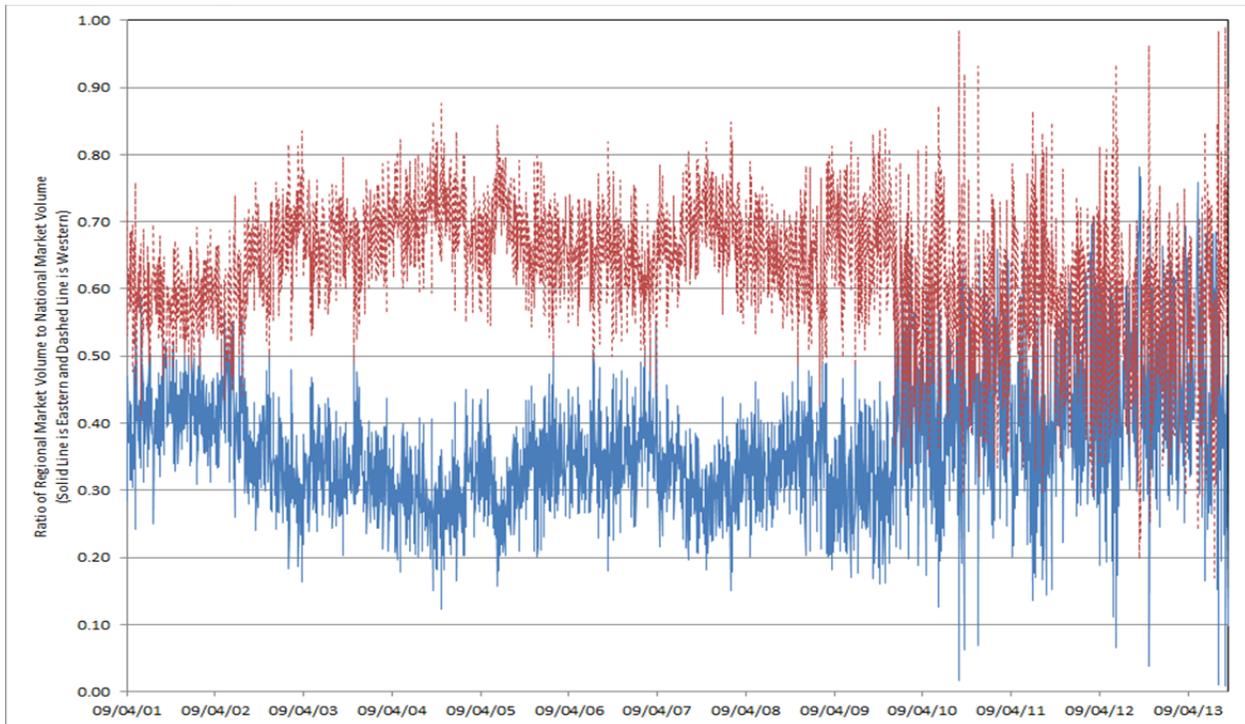
4.6. Chapter Summary

✓ *Analyzing 30 months of recent transactions on negotiated live and carcass purchases from the AMS demonstrates challenges in predicting net prices at the time negotiated prices are established.*

✓ *For more than one-third (half) of the transactions, the difference between the net price and the negotiated base price is more than $3 per hundredweight ($2 per hundredweight) in absolute value.*

✓ *Multiple regression analysis, a statistical tool for aggregating across data sorts, was used to predict net price based on information that would be known at the time the base price is established. For more than 10 percent (20 percent) of transactions, the predicted net price would be off by more than $3 per hundredweight ($2 per hundredweight) using this method to predict net prices.*

✓ *The particular plant participating in the market purchasing hogs can influence market-reported negotiated base price. During 84 percent of plant-days for carcass purchases and 75 percent of plant-days for live purchases, single plants impact the weighted average reported prices by $0.25 per hundredweight in absolute value. However, for 3 percent to 4 percent of plant-days, the particular plant participating in the market impacts reported base price by $1 per hundredweight or more. And, we found that one plant can have a significant impact on the day-to-day weighted average market price change. That one plant moved the market by $0.50/cwt over 60% of the trading days.*

✓ *We suggest that AMS consider tracking individual plant price effect for all (barrows and gilts, carcass and live, and sow) negotiated prices reported, i.e., AMS could follow a similar methodology used here to measures the change in price due to dropping a plant. AMS could develop a rule for switching plants from negotiated to other market arrangements, for when a plant is considered to have a non-market related impact on the weighted*

average price. Impacts of alternative rules should be explored if this approach were taken to assess impacts on reported prices.

✓ *We suggest that AMS examine segmenting negotiated purchase data weighted average base price into thirds based on the number of animals represented by a particular report. For example, if the negotiated barrows & gilts carcass purchase data includes 6,000 head of hogs, then the breakpoints would be at 2,000 and 4,000 head. The concept involves ordering transactions (or lots) from low price to high price. Divide the number of hogs into three equal portions. Each hog in each third has a price assigned to it. The weighted average price is then computed for each third. We recommend assessing how this new reported set of three weighted average prices would perform and what information it would add to current base price reporting.*

✓ *We recommend that the industry participants consider a multi-day (say 20) volume weight average to compute the national average price from the regional prices. This will mitigate day-to-day price fluctuations that are due to non-market factors.*

Chapter 5. Conclusions and Recommendations

The hog market has undergone dramatic structural change during the past decade. Among the major changes have been substantial reductions in daily negotiated hog purchases with associated increases in formula marketing agreements that rely upon thinning negotiated prices for bases. The thinning base price raises concerns regarding whether the market is subject to manipulation and whether the base price is a reliable representation of market supply and demand fundamentals each day. In essence, the efficiency of the negotiated cash hog market trade is being questioned. Indeed, this report's data analysis indicates that the particular packer participating in the market does potentially influence the reported weighted average negotiated base prices, though most of the time (75 percent) by a modest ($0.25 per hundredweight or less) amount. Nonetheless, there are times when an individual packing plant's purchases have much greater impact on reported weighted average negotiated prices.

This study's main objective was to assess the ability of the AMS to accurately compute (predict) net prices received for hogs at the time the negotiated base prices are reported. Several approaches were used to assess the ability of the USDA AMS to predict the base prices at the time the negotiated base prices are established.

Overall, this study concludes that no sufficiently accurate method to predict net prices at the time base prices are negotiated can be created. This conclusion is based on thorough analysis of daily reported base prices and net prices from the past 10 years and detailed analysis of all individual transactions data on negotiated base and net prices from the past 30 months. The errors in translating base prices into expected net prices would be too large to make this computation and reporting of it have value for the hog industry.

5.1 Recommendations

Going forward the AMS and hog industry should consider several actions:

- This study does not recommend that the AMS report computed net prices, derived from negotiated base prices, at the time negotiated base prices are established. The errors in this projection would be too large to make this information have any added value to the hog industry.

- The inability to predict net prices at the time base prices are established is not a problem associated with packer submission of information, AMS data collection, mandatory price reporting, or AMS reporting. Instead, it's related to the nature of the hog market. Too

much unpredictable variation in hog quality is present across transactions, and over time, to enable reliably computing net prices at the time the base prices are established.

- Tremendous variation exists among net purchase prices in the hog industry. This suggests strong price incentives are present for producing hogs that meet packer preferences for carcass weight and quality. Producers could benefit from continued information that shows them how much value they forfeit when they market hogs that do not take advantage of, or that do not fit well into, a particular packer's value matrix. If transactions costs are low (search costs and transportation costs) and if the term of the hog marketing contract allows, then hog producers might consider shopping around the hogs sold through negotiated trade.

- Thinning negotiated base prices are apparent, and those using these reported prices as bases in marketing agreements might want to explore other alternatives if recent trends continue.

- Individual producers may be more able to predict their net prices more effectively than the AMS can predict a net price for the entire market or than the AMS can predict even for individual transactions. Transactions are not distinguished by a unique seller identifier, so the AMS cannot correlate purchase transactions with slaughter transactions. Individual hog producers, however, do know this information for their own transactions. Individual hog producers who can consistently produce a relatively predictable set of carcass quality attributes can likely predict the net prices that they will receive more accurately than can the AMS or than the researchers can using only AMS data.

- We suggest that AMS examine segmenting negotiated purchase data weighted average base price into thirds based on the number of animals represented by a particular report. The concept involves ordering transactions (or lots) from low price to high price. Divide the number of hogs into three equal portions. Each hog in each third has a price assigned to it. The weighted average price is then computed for each third. We recommend assessing how this new reported set of three weighted average prices would perform and what information it would add to current base price reporting.

- We suggest that AMS consider tracking individual plant price effect for all (barrows and gilts, carcass and live, and sow) negotiated prices reported, i.e., AMS could follow a similar methodology used here to measures the change in price due to dropping a plant. AMS could develop a rule for switching plants from negotiated to other market arrangements, for when a plant is considered to have a non-market related impact on the weighted average price. Impacts of alternative rules should be explored if this approach were taken to assess impacts on reported prices.

- We recommend that the industry participants consider a multi-day (say 20) volume weight average to compute the national average price from the regional prices. This will mitigate day-to-day price fluctuations that are due to non-market factors.

Appendices

Appendix Exhibit A1. Mandatory Price Reporting Confidentiality Guidelines

The 3/70/20 confidentiality guideline requires the following three conditions:

• At least three reporting entities need to provide data at least 50 percent of the time over the most recent 60-day time period.

• No single reporting entity may provide more than 70 percent of the data for a report over the most recent 60-day time period.

• 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.

Source: http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3019136

Appendix Exhibit A2. Hog Processing Plants Quarterly Plant Compliance Visits Data

| | Plants Audited This Quarter | Lots Audited This Quarter | Lots with Non-Compliances | | | | Total Non-Compliance Issues This Quarter | Unresolved Non-Compliance Issues Brought Forward | Total Non-Compliance Issues | Non-Compliance Issues Resolved This Quarter | Non-Compliance Issues Carried Forward |
			1	2	3	4					
First quarter 2009	19	272	0	0	14	3	17	20	37	12	25
Second quarter 2009	29	336	0	0	15	1	16	25	41	13	28
Third quarter 2009	19	346	0	0	9	6	15	28	43	21	22
Fourth quarter 2009	29	418	0	0	7	8	15	22	37	10	27
First quarter 2010	18	230	0	0	6	2	8	27	35	21	14
Second quarter 2010	28	431	0	0	11	0	11	14	25	13	12
Third quarter 2010	28	265	0	0	10	0	10	12	22	12	10
Fourth quarter 2010	19	362	0	0	2	0	2	10	12	3	9
First quarter 2011	19	343	0	2	7	1	10	9	19	2	17
Second quarter 2011	25	246	0	0	5	0	5	17	22	5	17
Third quarter 2011	21	331	0	0	2	0	2	17	19	1	18
Fourth quarter 2011	20	317	0	0	0	0	0	18	18	7	11
First quarter 2012	23	432	0	0	2	0	2	11	13	10	3
Second quarter 2012	23	416	0	0	1	0	1	3	4	4	0
Third quarter 2012	24	266	0	0	6	3	9	0	9	9	0
Fourth quarter 2012	23	393	0	0	3	3	6	0	6	6	0
First quarter 2013	17	348	0	0	3	0	3	0	3	3	0
Second quarter 2013	13	206	0	0	2	2	4	0	4	2	2
Third quarter 2013	19	342	0	0	1	1	2	2	4	2	2

Source: LMR Quarterly Plant Compliance Visits, Swine Reporting;

http://www.ams.usda.gov/AMSv1.0/LMRQuarterlyPlantReviewArchive

Appendix Exhibit A3. Swine Mandatory Price Reporting Form LS118

USDA

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL MARKETING SERVICE

SWINE PRIOR DAY REPORT

CLASS CODE	PURCHASE TYPE CODE	OWNERSHIP CODE
1 = BARROWS/GILTS 2 = SOW 3 = BOARS/STAGS	1 = NEGOTIATED 2 = OTHER MARKET FORMULA 3 = SWINE OR PORK MARKET FORMULA 4 = OTHER PURCHASE ARRANGEMENT 5 = PACKER-SOLD NEGOTIATED 6 = PACKER-SOLD OTHER MARKET FORMULA 7 = PACKER-SOLD SWINE OR PORK MARKET FORMULA 8 = PACKER-SOLD OTHER PURCHASE ARRANGEMENT 9 = PACKER-OWNED	1 = PACKER-OWNED 2 = PACKER-SOLD 3 = ALL OTHER

1. IDENTIFICATION NUMBER

2. COMPANY NAME

3. PLANT STREET ADDRESS

4. PLANT CITY

5. PLANT STATE

6. PLANT ZIP CODE

7. CONTACT NAME

8. PHONE NUMBER (include area code)

9. REPORTING DATE (mm/dd/yyyy)

10. REPORTING TIME (1 = 10:00 a.m.; 2 = 2:00 p.m.)   (NOT APPLICABLE)

11. SLAUGHTERED SWINE - Lot Identification

12. SLAUGHTERED SWINE - Class Code

13. SLAUGHTERED SWINE - Purchase Type Code

14. SLAUGHTERED SWINE - Head Count

15. SLAUGHTERED SWINE - Base Price ($/cwt.)

16. SLAUGHTERED SWINE - Average Net Price ($/cwt.)

17. SLAUGHTERED SWINE - Average Live Weight (pounds)

18. SLAUGHTERED SWINE - Avg. Carcass Weight (pounds)

19. SLAUGHTERED SWINE - Average Sort Loss ($/cwt.)

20. SLAUGHTERED SWINE - Average Backfat (inches)

21. SLAUGHTERED SWINE - Average Loin Depth (inches)

22. SLAUGHTERED SWINE - Average Lean Percentage

23. PURCHASED SWINE - Lot Identification

24. PURCHASED SWINE - Ownership Code

25. PURCHASED SWINE - Class Code

26. PURCHASED SWINE - Purchase Type Code

27. PURCHASED SWINE - Head Count

28. PURCHASED SWINE - Avg. Live Weight (pounds)

29. PURCHASED SWINE - Base Price ($/cwt.)

30. ORIGIN (State postal)

LS-118 (05/13) *Destroy previous edition*

Appendix Exhibit A3 (continued). Swine Mandatory Price Reporting Form LS118

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL MARKETING SERVICE
SWINE PRIOR DAY REPORT

NOTE: According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0186. The time required to complete this information collection is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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31. SCHEDULED SWINE - Head Count for Day 1		38. SCHEDULED SWINE - Head Count for Day 8	
32. SCHEDULED SWINE - Head Count for Day 2		39. SCHEDULED SWINE - Head Count for Day 9	
33. SCHEDULED SWINE - Head Count for Day 3		40. SCHEDULED SWINE - Head Count for Day 10	
34. SCHEDULED SWINE - Head Count for Day 4		41. SCHEDULED SWINE - Head Count for Day 11	
35. SCHEDULED SWINE - Head Count for Day 5		42. SCHEDULED SWINE - Head Count for Day 12	
36. SCHEDULED SWINE - Head Count for Day 6		43. SCHEDULED SWINE - Head Count for Day 13	
37. SCHEDULED SWINE - Head Count for Day 7		44. SCHEDULED SWINE - Head Count for Day 14	

Appendix Exhibit A4. LS-118B: Swine Prior Day Report - Slaughtered Swine, see A3 also

Field Order	Livestock Form Item Label	Item Number	Required?	Allowable Values
1	Plant ID	null	Yes	(Plant Establishment Number)
2	Reporting Date (mm/dd/yyyy)	9	Yes	(If not current date, data will be recorded as late)
3	Reporting Time	10	Yes	
4	Lot Identification	11	Yes	
5	Class Code	12	Yes	
6	Purchase Type Code	13	No	
7	Head Count	14	Yes	
8	Base Price ($/ cwt.)	15	No	
9	Average Net Price ($/cwt.)	16	No	
10	Average Live Weight (lbs.)	17	No	
11	Average Carcass Weight (lbs.)	18	No	
12	Average Sort Loss ($/cwt.)	19	No	
13	Average Backfat (inches)	20	No	
14	Average Loin Depth (inches)	21	No	
15	Average Lean Percentage	22	No	

Allowable Values:

Reporting Time (Item Number 10):
 3 - Not Applicable
Class Code (Item Number 12):
 1 - Barrows/Gilts
 2 - Sow
 3 - Boars/Stags
Purchase Type Code (Item Number 13):
 1 - Negotiated
 2 - Other Market Formula
 3 - Swine or Pork Market Formula
 4 - Other Purchase Arrangement
 5 - Packer Sold Negotiated
 6 - Packer Sold Other Market Formula
 7 - Packer Sold Swine or Pork Market Formula
 8 - Packer Sold Other Purchase Arrangement
 9 - Packer Owned

Appendix Exhibit A5. LS-118B: Swine Prior Day Report - Purchased Swine, see A3 also

Field Order	Livestock Form Item Label	Item Number	Required?	Allowable Values
1	Plant ID	null	Yes	(Plant Establishment Number)
2	Reporting Date (mm/dd/yyyy)	9	Yes	(If not current date, data will be recorded as late)
3	Reporting Time	10	Yes	
4	Lot Identification	23	Yes	
5	Ownership Code	24	Yes	
6	Class Code	25	Yes	
7	Purchase Type Code	26	Yes	
8	Head Count	27	Yes	
9	Average Live Weight (lbs.)	28	No	
10	Base Price ($/ cwt.)	29	No	
11	Origin	30	Yes	AK - WY

Allowable Values:

Reporting Time (Item Number 10):
   3 - Not Applicable

Ownership Code (Item Number 24):
   1 - Packer Owned
   2 - Packer Sold
   3 - All Other

Class Code (Item Number 12):
   1 - Barrows/Gilts
   2 - Sow
   3 - Boars/Stags

Purchase Type Code (Item Number 13):
   1 - Negotiated
   2 - Other Market Formula
   3 - Swine or Pork Market Formula
   4 - Other Purchase Arrangement
   5 - Packer Sold Negotiated
   6 - Packer Sold Other Market Formula
   7 - Packer Sold Swine or Pork Market Formula
   8 - Packer Sold Other Purchase Arrangement
   9 - Packer Owned

Origin (Item Numer 30):
   State abbreviations