How Do U.S. Hog Farmers Use Futures Contracts to Stabilize Prices?

Seungyoon Han[1]*, Emmelia Jung[1], Hailey Lee[2], Jiyoo Lee[1]

[1]Seoul Academy International School, 422 Yeoksam-ro, Gangnam-gu, Seoul 06200, Republic of Korea

[2]The Taft School, 110 Woodbury Road, Watertown, CT 06795, Watertown, USA,

*Corresponding author email: seungyoon1719@gmail.com

JEL Classification. G12; G13

Abstract.

In this paper, we examine how U.S. hog farmers utilize futures contracts to stabilize prices in a volatile commodity market. Biological lags, herd behavior, global demand shocks, and other factors can cause oscillations in income and production cycles, many of which have an unpredictable impact. Farmers, for instance, lock in prices for future sales using lean hog futures traded on the CME, which allows them to manage risk and make more rational, forward-looking decisions. The study also looks to futures' roles in price discovery and hedging, along with how vertical integration and contract farming shape risk for producers. Using Real-World Futures in Pork Production: A JBS USA Case Study.

Keywords.

Hog futures; U.S. pig market; price stabilization; vertical integration

1. Introduction

Prices in the U.S. hog industry undergo frequent fluctuations because of biological production cycles, disease outbreaks, feed expenses, and the market. For hog farmers, these undulations cause economic uncertainty and lead to reactive decisions—like herd expansion during high prices—that increase long-term instability. This pattern fuels the "pig cycle" and volatility in the larger market.

To minimize this risk, many farmers use lean hog futures contracts that help them establish a future selling price beforehand. Traded on the Chicago Mercantile Exchange (CME), these contracts serve as a means of protecting income and creating more certainty for production planning. Futures smooth broader market behavior by providing forward-looking price signals and decreasing the dependence on reactive trends.

A secure source of hog facts, however, is beneficial to producers alone. It also provides more consistent and perhaps lower pork prices to consumers. Reducing the volatility of this sector has broad-based economic value and public interest.

In this paper, we study the economic theories behind price changes — herding effect, cobweb model, pig cycle, and how those are addressed by futures contracts. We examine roles that futures play in price discovery and hedging, as well as their interaction with vertical integration and the changing size of U.S. hog producers.

2. Theoretical Basis of Cyclic Price Fluctuation in the Pig Market

2.1. Why Hog Prices Are Volatile

Hog prices are unpredictable and can be sudden at times, leaving farmers unable to keep up with the market and making poor decisions. Hog production is growing or breeding an animal, something alive, and an organism cannot be identified completely on how it may deviate from expected results.

Figure 1: Illustration of Herding Effect in Hog Market

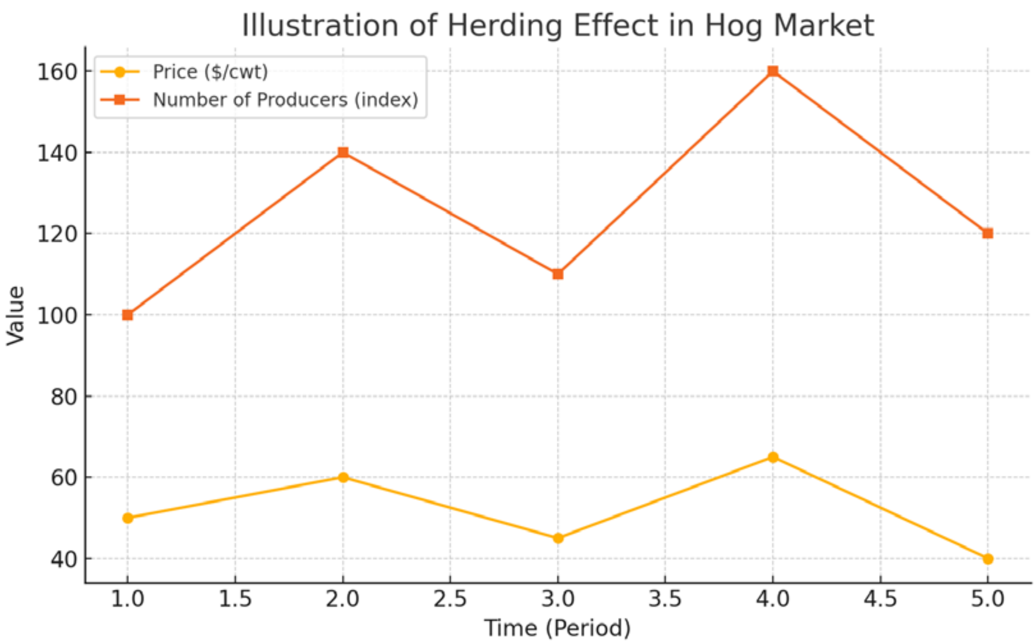


Figure 1: Illustration of Herding Effect in Hog Market presents a cyclical pattern. When prices rise (e.g., from Period 1 to 2), the number of producers increases significantly, indicating herd expansion. However, this increase in producers leads to a subsequent drop in prices (e.g., from Period 2 to 3), likely due to overproduction. This pattern repeats as prices recover (e.g., from Period 3 to 4), the number of producers rises again, followed by another price drop (e.g., Period 4 to 5) as supply exceeds demand. It captures the herding effect in the hog market, where rising prices trigger herd expansion

as farmers follow each other, leading to overproduction and price crashes. (Source USDA ERS 2025)

While the farmers monitor the others' decisions in expansion or contraction during sudden rises and falls in price, they need to think about the time it will take for the product (hog) to be bred and whether it will be profitable enough in the market.

Figure 2: Cobweb Model Showing Price and Quantity Oscillations Due to Production Lags

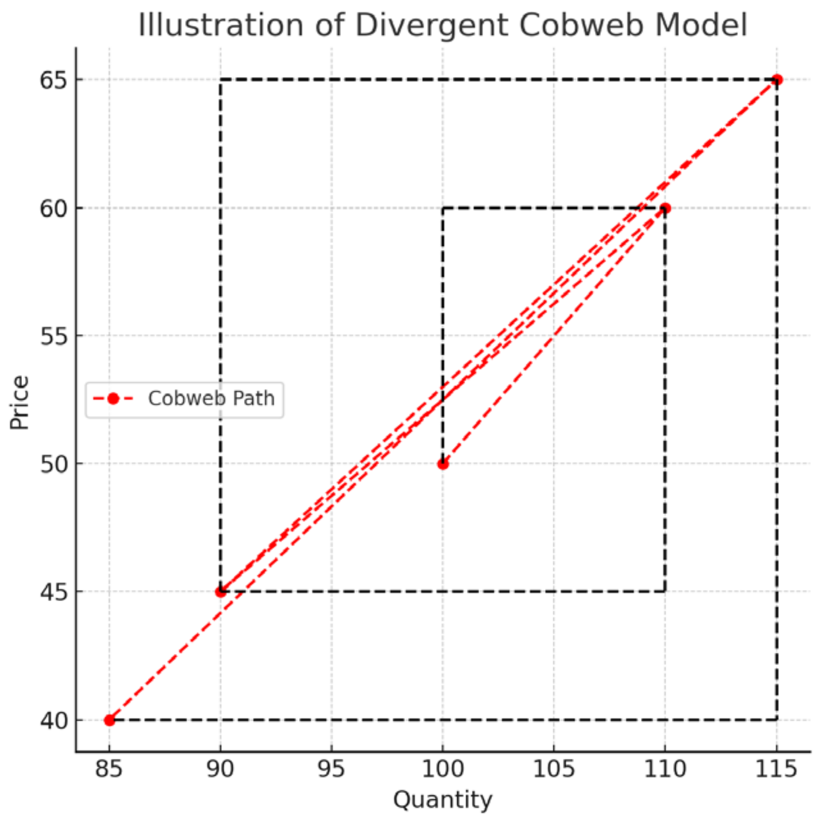


Figure 2: Illustration of Divergent Cobweb Model; shows the red dashed lines from a "cobweb" pattern, showing alternating vertical and horizontal movements. Vertical movements represent producers adjusting quantities based on past prices, while horizontal movements reflect the market price response to these quantities. This divergent cobweb model illustrates instability in the market. The increasing amplitude of the oscillations suggests the price and quantity do not converge to an equilibrium; instead, they fluctuate more widely with each cycle. This divergence occurs because producers base their supply decisions on past prices, but by the time the hogs reach the market, demand has shifted, leading to over-or undersupply.

Hog production takes about a year to 1.5 years (USDA), from breeding to slaughter, which is a biological lag. The farmers would look at today's prices and decide to expand or contract their production. They would respond by breeding more pigs than they expected would be needed. By the time that the pigs reach the market, the others in the hog industry have done the same, and this may result in a shortage or surplus of pigs., causing a crash in their prices. Hog prices are unexpected until farmers lay out their portion of products in the market, and how much the public needs the product as well.

Even if the farmer has a well-organized timetable of production(breeding) and his or her own method in marketing, they will still need to face changes within the hog population and prices. The recorded USDA data shows regular cycles in pig supplies and prices. These cycles are driven by lag times, disease shocks, global demands, and all kinds of unexpected situations. For example, the PEDV outbreak in 2024 led to expansion of breeding, and this led to the 2016-like price crash (USDA ERS, 2025). The farmer cannot predict the future. He or she cannot stop the slow or fast growth of their pigs, or the sudden spread of disease among their species of pigs or expect the number of pigs that will be required to meet global demand.

2.2. Economic Theories & Phenomenon

The herding effect is a behavioral economic phenomenon of the farmers or sellers of the market following each other's production decisions, ignoring the market signs or even their own rational analysis. This theory originates from behavioral finance and psychology and was developed by Banerjee (1992) and Bikhchandani, Hirshleifer & Welch (1992), who proved through this phenomenon that even rational individuals could follow the majority's decision if they believe that the crowd has better information.

The cobweb model represents a classic economic model showing the price and quantity cycles from production delays. This shows when producers react to past prices, but the actual goods that they create enter the market later. This causes mismatches between supply and demand. This shows how even rational farmers can unintentionally contribute to price drops or booms that lead to destabilizing the market due to time-delayed market feedback (Kaldor, 1934; Ezekiel, 1938). The model was first introduced to the public in the early 1930s by economists Nicholas Kaldor and Mordecai Ezekiel. It became one of the key theories in agricultural economics that explained the recurring price movement due to supply lags (Stewart, 1971).

A long-term cycle or pattern of boom and bust in livestock production is called the pig cycle. It is caused by the reactionary expansion and contraction of herds. This pattern was observed in Europe in the early 20th century and later was developed through research by agricultural economists in the 1930s (Coase & Fowler, 1935). It describes the recurring cycle in pig production, based on the biological lags and market response delays– closely linked with the herding effect and cobweb model.

Figure 3: Pig Cycle in U.S. Hog Market (2015~2024)

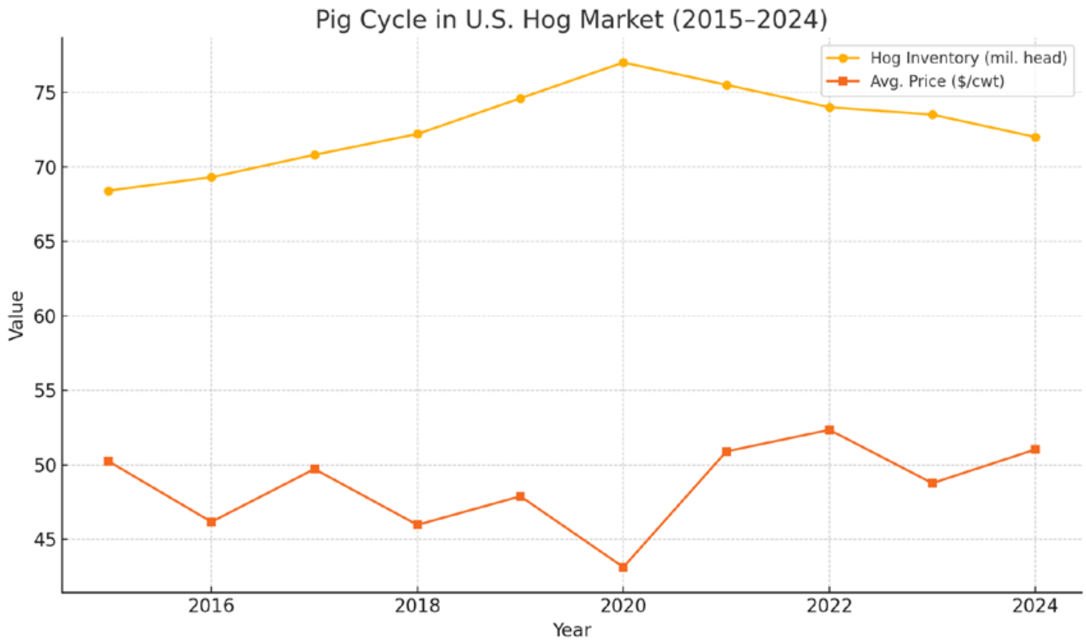


Figure 3 Pig Cycle in U.S Hog Market (2015-2024).

Source USDA ERS 2025

2.3. How futures prices provide forward-looking signals to break these cycles

To make sure farmers are given a more independent, reliable price forecast, they use futures contracts so that they don't just copy others or rely on today's price as an indicator of tomorrow's price. The futures price helps the farmers make informed decisions based on market expectations.

Looking at futures prices instead of past or current prices will help break the cobweb loop. The future prices would reflect market expectations months ahead. By using future contracts, farmers would be able to sell their productions as a set price on a specific future date with specific amounts of the production. They would no longer have to start breeding according to market prices they see. By basing the supply decisions on expected market conditions, farmers not only stabilize their own income, but also reduce the price volatility caused by the cobweb theory.

Futures prices also act as coordinating devices, allowing producers to lock in prices. By using the futures contract efficiently, it allows price locking during upswings or downturns. In high-price periods, producers can secure their future selling prices while still breeding or in the growing phase, which gives a more predictable income. In low-price cycles, farmers can use futures as a signal to delay expansion or reduce their herd size, helping them avoid overproducing. This helps break the reactive cycle that drives the pig cycle, by expanding during booms while contracting during busts. Ultimately, futures contracts serve as both a financial safety net and a guide through financial problems.

3. Hog Futures' Functions and Actual Effects

3.1. Price Discovery

Price discovery is an important process which determines spot market prices, mostly through interactions between producers and consumers. The Price discovery mechanic provides a centralized environment for transparent pricing as the market price is determined when buyers and sellers are willing to pay for a commodity based on expectation, available information, and market conditions. In the case of hog futures, the market allows buyers and sellers to agree on a specific price for the future delivery of lean hogs.

Price discovery in lean hog futures depends on various factors including volatility, liquidity, market structure, and availability of efficient information. In a volatile and liquid market, future prices are reflected quickly since there are more participants. Also, an informationally efficient market can ensure that all relevant information is reflected in the futures prices.

Even though the U.S. hog market is established relatively early, it is considered quite volatile. While pork demand remains relatively stable, the U.S. hog market faced headwinds due to economic pressure, including high feed costs and ongoing supply chain disruptions. Also, the figure below shows that the U.S. hog industry has undergone significant changes over the past 20 years due to structural changes. Since the 1990s, there has been a sharp decline in the number of hog operations, which indicates significant industry consolidation. Many small-scale farms have exited the market. However, the remaining farms are getting larger and specialized over the years. Overall, the U.S. hog inventory has remained quite constant or increased slightly. This means that despite fewer farms, efficiency has improved.

Figure 4: U.S. Hog Market

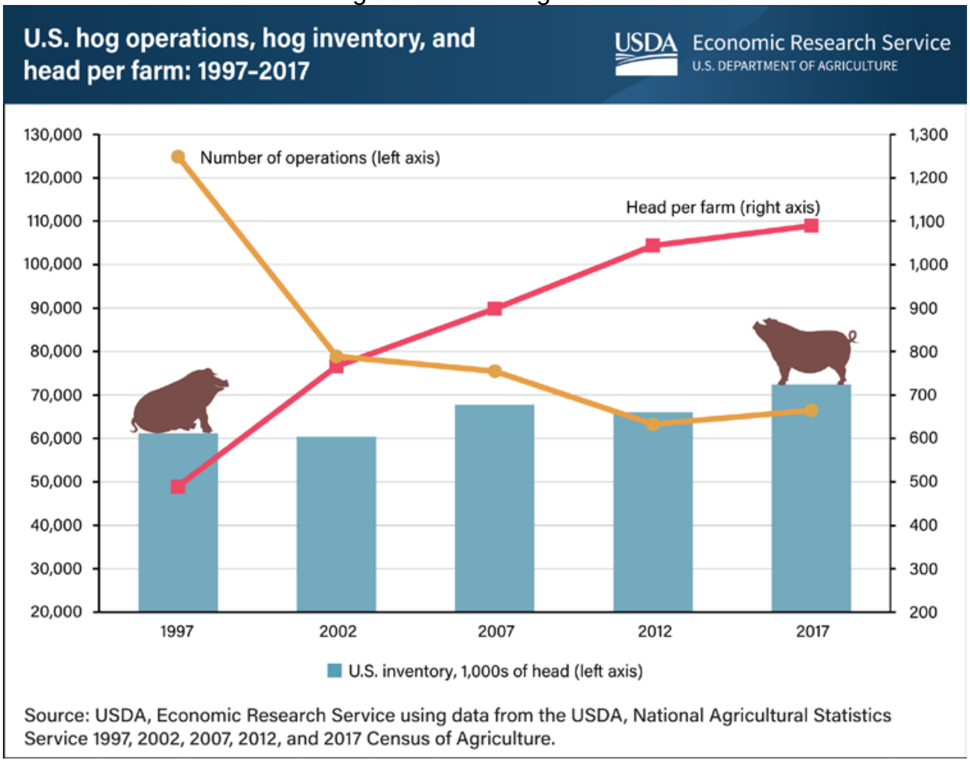


Figure 4: U.S. hog operations, hog inventory, and head per farm: 1997–2017

Source: USDA

These days, U.S. hog operations are heavily concentrated in areas in the Midwest—particularly Iowa and southern Minnesota—and in eastern North Carolina. These operations specialize in a single phase of production, which led to the increased usage of lean hog futures. The specialization of operations results in more usage of hog futures because the risk of farmers is reduced since they are paid for raising pigs, not by the price fluctuations. Furthermore, the system is much more efficient for both sellers and buyers.

As the hog futures continue to develop and supply chains become more stabilized, price discovery will enable traders to make intelligent indications of the expected supply and demand for hogs at various time intervals.

3.2. Hedging

Hedging is a risk management strategy that aims to reduce losses by purchasing investments that offer an opposite position to an existing investment. Hedging is often achieved through futures. The lean hog futures are useful hedging tools for farmers, meat processors, traders, and enterprises to protect themselves from unexpected price fluctuations in the hog market. They often face uncertainty in future hog prices due to market fluctuations driven by supply chain disruptions, feed costs, trade policies, or consumer demand. A price drop could lead to significant losses when selling hogs. By participating in futures market trading, enterprises can adapt to market changes effectively. Short hedge is a method used by sellers, for instance, farmers.

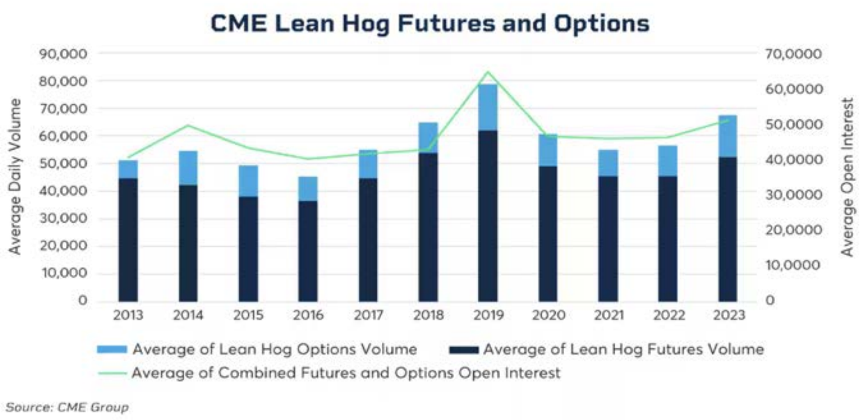
This is a hypothetical example of short hedging. Assume that in January 2025, a farmer sells a June 2025 futures contract at $85/cwt[1]. If the spot price in June drops to $80/cwt, the farmer's loss in the cash market ($5/cwt) is offset by a $5/cwt gain in the futures market, stabilizing revenue. The table below shows the efficiency of lean hog futures for hedging.

1 $/cwt indicates the realized volatility, which is calculated as the standard deviation of daily returns within a month. Realized volatility measures price fluctuations; if the volatility is high, there is a higher price risk.

Possible Scenario	**Spot Price in June ($/cwt)**	**Spot Market Revenue ($/cwt)**	**Futures Market Gain/Loss ($/cwt)**	**Total Revenue ($/cwt)**
Spot Price Drops	80	80	+5 (Sell at 85, Buy at 80)	80 + 5 = 85
Spot Price Rises	90	90	-5 (Sell at 85, Buy at 90)	90 - 5 = 85

Table. Hedging Outcomes for Lean Hog Futures (June 2025 Contract, Sold at $85/cwt)

The trading volume reflects the number of contracts traded monthly, indicating market liquidity and ease of entering and exiting futures positions. The figure below shows the lean hog futures and options' average daily trading volume throughout 2013 to 2023. As profitability declines and challenges mount, trading in CME Lean Hog futures has climbed to its highest level since 2019 when African Swine Fever impacted markets. Both trading volume and open interest – the number of unsettled contracts – have surged as market participants manage price risk. (CME Group, 2023)



3.3. Vertical Integration

Vertical integration has profoundly altered the U.S. hog industry. Large companies like Smithfield Foods, Tyson and JBS dominate multiple stages of production — owning breeding farms, feed mills, finishing operations and processing plants. Such structure maximizes supply chain efficiency, lowers production costs via economies of scale and tighter coordination (MacDonald & McBride, 2009).

For farmers, vertical integration often occurs in the form of production contracts. These contracts provide stable income and lower exposure to volatile hog prices by compensating growers a fixed fee per pig or per pound gained. However, growers give up ownership and autonomy, with integrators controlling inputs, animal genetics, and management standards (Key & McBride, 2007). In contrast, independent producers face higher risk, bearing the full brunt of market swings—such as during the 1998 price crash and the COVID-19 pandemic—when many exited the industry (Hayes, 2020).

Vertically integrated firms dominate pricing power. Today, over 95% of hogs are sold through formula contracts or internal transfers, with less than 5% sold on open markets (Bolotova, 2023). That undermines price discovery and diminishes farmers' bargaining power. Big packers are able to dictate prices well, particularly in areas where there are hardly any alternatives (Schnepf, 2022). Top integrators have already faced—and settled—antitrust lawsuits over coordinated production cuts to manipulate prices (U.S. Department of Justice, 2022).

Integration increases efficiency, as well. It enables constant supply of the plants throughout the year, uniformity of the animals, and enhanced biosecurity. The COVID-19 crisis, however, exposed vulnerabilities: plant shutdowns created hog backlogs and euthanasia, demonstrating how concentration in processing deprives that sector of flexibility and resilience (U.S. Department of Agriculture [USDA], 2021).

In general, vertical integration led to less expensive and more export-competitive U.S. pork but at the expense of farmer autonomy and market transparency. Finding balance between efficiency, competition, and resilience remains a continuing and high value policy and industry challenge.

3.4. Producer scale of U.S.' hog industry

The U.S. hog industry has undergone a massive transition toward large-scale production based on contracts. Though there remain more than 66,000 hog farms nationwide, a small number of very large operations command production. In 2017, operations that raised fewer than 2,000 hogs accounted for 87% of operations but controlled just 7% of the inventory. In contrast, the 5,000-plus hog farms represented only 5% of operations but 73% of the total inventory (USDA, 2019).

There is a major structural split between independent (hog-owning) and contract producers (hog-growing). Since the 90s, contract production has seen tremendous growth. In 2015, an estimated 69 percent of all hogs were produced under contract (Key & McBride, 2007). In 2017, roughly 55,700 independent farms sold owned hogs, and 8,500 contract growers raised hogs for others. Contracted hogs made up approximately 41 percent of total U.S. marketings that year (USDA, 2019).

Regionally, contract production is most prominent in the Southeast, especially in North Carolina, where 91% of hogs were raised under contracts. The Midwest, with strongholds in Iowa and Minnesota, retains a larger percentage of independent farms, although deployment of contracts is on the rise there as well (MacDonald et al., 2007).

This has resulted in an increasing concentration of market power. The largest 5% of farms produce close to three-quarters of U.S. hogs. Production contracts allow integrators to coordinate large supply chains and manage price risk, while independent producers experience more volatility and declining access to markets.

That consolidation has brought up concerns about competition, market transparency and rural equity. But the integrated model provides efficiency, stable income for growers and predictability for processors.

The U.S. hog industry is much more vertically integrated and based on contract production at a large scale, which has led to concentration of ownership among a small number of large firms and a lack of market transparency. As a result, although it increases efficiency and security, the model frequently values the freedom of the farmer and equilibrium in prices. Trade-off between economic efficiency, competition, and equity is still a significant policy challenge in the future.

4. Case Study

Livestock price volatility, particularly in hogs, represents a large risk for operations for meat packers. JBS USA, the country's second-largest pork producer, has a pork division that includes processing plants, contract growing operations, and exports to overseas destinations. According to the company's 2024 financial reports, JBS USA slaughters approximately 147,000 hogs daily, making it one of the top pork processors in the U.S. However, the company is highly exposed to fluctuations in hog prices caused by factors like disease outbreaks, feed costs, consumer demand, and trade policies. To mitigate this risk and stabilize profit margins, as a safeguard against the influence of price fluctuation and as an advantage gained through more stable margin operations, JBS uses futures contracts, especially Lean Hog futures contracts, in the Chicago Mercantile Exchange (CME) as risk management.

Pork prices fluctuate in the short term based on animal disease outbreaks, feed price spikes, geopolitical crises, and global demand shifts. In the African Swine Fever pandemic and COVID-19 outbreaks, for example, pork prices shifted by two-digit percentages for several weeks. These fluctuations can be material to the input costs and margins of JBS. An upward price shock may reduce profitability if the firm cannot pass on the added cost to customers in time. Lowering prices may devalue hogs' inventories or create shortages of revenues on pre-contracted sales. To prevent these risks, JBS uses futures contracts as a hedge—price fix on hogs it will buy or sell in the future. This method helps the company to budget and reduce earnings volatility.

The Lean Hog futures contract, offered by the CME Group, is a futures contract for the sale or purchase of 40,000 pounds of lean hogs on a future date. They are utilized by firms like JBS for two primary purposes: price discovery and risk transfer.

When JBS expects, it will need to buy live hogs in the future, it takes a long position in Lean Hog futures contracts, as when the market price rises, the gain on the futures contract offsets the higher price in the physical market. On the other hand, when the firm already has pork inventory or will sell pork products in the future, it can go short to lock in good prices to sell, meaning that the company will sell hogs at a fixed price. This protects JBS against potential price declines and stabilizes revenue.

This is acceptable hedging under CME regulations, allowing JBS to maintain positions over normal speculative quantities (Doering, 2011). The company actively manages hedge positions and hedge ratios to match operational exposure across its supply chain.

Besides vanilla futures contracts, a standardized agreement to buy or sell a specific asset at a predetermined price on a set future date, JBS makes use of options as hedges. A call option, for example, gives JBS the right (not the obligation) to buy futures at a fixed price. With this strategy, the company covers itself against rising prices without losing the upside potential should prices fall. Put options, conversely, can be utilized to place floors on prices when selling hogs or pork.

In its 2024 quarterly report, JBS indicated that it used "forward purchase contracts and derivatives" to manage the price of livestock and other raw materials, particularly when market volatility is expected to be high (JBS S.A., 2024). These tools are included in the company's enterprise-wide risk management system and governed by an official committee.

Hedging in the futures market helps JBS dampen earnings variability and maintain steadier operating margins. Since the cost of inputs of meat processing covers a significant chunk of the overall cost, price fixing assists the firm in planning the inventory, maintaining working capital, and setting future-looking product prices for buyers.

While hedging can limit gains during favourable market trends, JBS considers the trade-off worthwhile due to the stability it provides (JBS S.A., 2024). Studies support this approach: Li et al. (2024) found that lean hog futures reduce revenue volatility and strengthen financial resilience for large pork producers. Whalen (2020) similarly noted that although hedging comes with challenges like risks where futures and spot prices do not match, it still offers essential downside protection.

JBS refines its plans to overcome these frailties and has considered tools like CME Pork Cutout futures, which better reflect wholesale pork prices. By utilizing futures and options with disciplined efficiency, JBS realizes price stability, allows for long-term planning, and lowers risk in a very risky marketplace.

The case of JBS USA illustrates how large agribusinesses can effectively use futures markets not to speculate, but to stabilize input costs, manage cash flow, and support sustainable operations in the volatile world of meat production.

5. Conclusion

A futures contract is an essential tool for farmers and sellers to manage and prevent price risk in the highly volatile U.S. hog market. It is the most important factor in leaving the best results for both the producers of the hog market and consumers who buy the products—meat.

These contracts also serve as valuable price signals and signs for producers, as it encourages the farmers towards more strategic ways to help take in feedback from the market's flow itself and those associated with the pig cycle and the cobweb model as well.

In summary, U.S. hog farmers use futures contracts to hedge against price volatility and to secure future selling prices. The futures contracts decrease uncertainty about the income and helps stabilize decision-making based on the market flow.

6. References

Banerjee, A.V., 1992. A simple model of herd behaviour. Quarterly Journal of Economics, 107(3), pp.797–817.

Bikhchandani, S., Hirshleifer, D. & Welch, I., 1992. A theory of fads, fashion, custom, and cultural change as informational cascades. Journal of Political Economy, 100(5), pp.992–1026.

Ezekiel, M., 1938. The cobweb theorem. Quarterly Journal of Economics, 52(2), pp.255–280.

Kaldor, N., 1934. A class of equilibrium growth models. Review of Economic Studies, 1(1), pp.14–30.

Stewart, J.D., 1971. A revision of Harlow's recursive cobweb model for the hog industry from 1960 to 1968. Master's thesis. Eastern Illinois University. Available at: https://thekeep.eiu.edu/theses/3949

Coase, R.H. & Fowler, R.F., 1935. Pig-Cycle in Great Britain: An Explanation. Economica, 2(6), pp.132–147.

USDA Economic Research Service, 2025. Livestock production cycles affect long-term price outlook for cattle, hogs, and chickens. Amber Waves, March. Available at: https://www.ers.usda.gov/...

USDA Economic Research Service, 2025. Hogs Pork-Industry Structure. Available at: https://www.ers.usda.gov/...

Carlson, D., 2023. Weak demand and hefty supplies continue to weigh on hog markets. CME Group Open Markets, December. Available at: https://www.cmegroup.com/...

Eadie, J., 2025. Hog futures face volatility amid market uncertainty. SwineWeb, February. Available at: https://www.swineweb.com/...

CME Group. Lean Hog futures and options. Available at: https://www.cmegroup.com/...

MacDonald, J.M. & McBride, W.D., 2009. The Transformation of U.S. Livestock Agriculture: Scale, Efficiency, and Risks. USDA Economic Research Service.

Key, N. & McBride, W.D., 2007. Production Contracts and Productivity in the U.S. Hog Sector. USDA Economic Research Service. Available at: https://www.ers.usda.gov/...

MacDonald, J.M., McBride, W.D. & Korb, P., 2007. Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities. USDA Economic Research Service. Available at: https://www.ers.usda.gov/...

USDA, 2019. 2017 Census of Agriculture – Hogs and Pigs. Available at: https://www.nass.usda.gov/...

CME Group. Livestock risk management. Available at: https://www.cmegroup.com/...

Doering, C., 2011. CFTC fines Newedge for violating cattle limits. Reuters, February 7. Available at: https://www.reuters.com/...

JBS S.A., 2024. Management's discussion and analysis of financial condition and results of operations (June 30, 2024 Interim Report). U.S. Securities and Exchange Commission. Available at: https://www.sec.gov/...

Li, C., Wang, G., Shen, Y. & Amètépé, N.B.A., 2024. The effect of hog futures in stabilizing hog production. Agriculture, 14(3), p.335. Available at: https://doi.org/10.3390/agriculture14030335

Whalen, C., 2020. Hedging issues with CME lean hog futures. National Hog Farmer, June 1. Available at: https://www.nationalhogfarmer.com/...