

The Impact of Macroeconomic Factors and Production Lags on the U.S. Beef Export Market (2010-2020)

Introduction

Minimizing trade deficits and maximizing export value are the primary goals of every government seeking to sustain a robust agricultural economy. Therefore, identifying and understanding the macroeconomic factors that cause fluctuations in export performance is just as important as finding what domestic programs should be implemented to support local farmers. The United States is one of the world's largest producers and exporters of beef, a premium global commodity whose trade performance has long been under scrutiny by policymakers, economists, and the agricultural sector. Since the late 20th century, international trade has evolved into a vital pillar of the American meat industry. While domestic policies were initially implemented to stabilize production and prevent shortages, later in the 20th century, international exports were looked upon as a crucial mechanism to increase the standard of living for rural communities and absorb surplus production.

However, the modern global economic climate presents complex new challenges. The cost of domestic production, fluctuating currency values, and shifting international demand create a highly volatile environment for exporters. Therefore, this is the rationale behind why studying the interaction between macroeconomic variables and agricultural exports is essential. Questions regarding how exchange rates and domestic production costs affect overall beef exports have

become increasingly prevalent in economic discourse. To address this, it was hypothesized that an increase in the overall strength of the U.S. dollar would have a direct correlation with a decrease in total export volume due to reduced purchasing power abroad. Furthermore, it was hypothesized that the impact of domestic feed costs would show a delayed, rather than immediate, impact on export prices due to the biological growth cycles inherent in livestock production.

Literature Review

Numerous studies have been conducted over the past few decades to devise answers to the complexities of agricultural trade. One prominent study conducted by No, Davis, and Harvey (2015) sought to find how exchange rates affected pricing in U.S. meat exports. They argued that exporters do not simply pass on all costs to foreign buyers; instead, they often adjust their prices to stay competitive, a process known as pricing-to-market (PTM). Utilizing previous economic definitions, the authors noted that PTM involves the "destination-specific adjustment of mark-ups in response to exchange-rate changes," which implies that "currency changes are not fully transmitted into export prices with divergent movements in different markets" (No et al., 2015, p. 1). This confirms that export pricing is highly adaptable depending on the specific country receiving the goods.

Understanding the supply side is equally critical. Anderson and Trapp (2000) analyzed the dynamics of beef cattle supply, focusing on the biological realities of livestock production. They

noted that because cattle take a substantial amount of time to mature, production decisions and cost shocks experienced today do not alter the market supply for several months. Their research validates the necessity of applying time lags when measuring the impact of input costs on final meat prices.

In a more recent context, Almadani et al. (2021) discussed how external shocks and logistical bottlenecks can supersede traditional economic indicators. Analyzing recent historical crises, the authors stated, "This study demonstrates the disastrous consequences of America's excessive dependence on global value chains" (Almadani et al., 2021, p. 1). This highlights that while prices and currencies matter, physical supply chain integrity is a massive underlying variable in export success.

Additionally, Keithly Jones (2006) argued that it is not just the value of a currency that affects trade, but its unpredictability. In his analysis of red meat utilization, Jones found that "exchange rate volatility to impact the level of commodity trade" is highly significant, as unpredictable currency swings discourage international buyers from committing to long-term American contracts (Jones, 2006, p. 7).

Finally, a foundational study by Liu, Chung, and Meyers (1993) analyzed the difference between domestic factors (like U.S. inflation) and foreign factors (like importing countries' exchange rates). They concluded that "foreign macroeconomic variables exert more significant and persistent effects on U.S. meat exports than domestic macroeconomic variables" (Liu et al.,

1993, p. 210). This pivotal finding suggests that the economic health and currency strength of the importing country dictate export success far more than the domestic costs faced by the American farmer.

Data and Methodology

This study uses multi-variable linear regression to analyze the factors driving U.S. beef exports. The formula for the regression follows a standard linear model where the dependent y-variable is the Export Price Index (EPI) for beef, defined as the measurable value of beef leaving the country. The independent x-variables include the Nominal Broad Dollar Index (NBDI), specific bilateral exchange rates, and the Producer Price Indices (PPI) for primary livestock feeds, namely corn and soybeans. The data was collected monthly for the years spanning from 2010 to 2020. The countries analyzed as major trade partners included China, South Korea, Mexico, and Japan. These variables were selected based on the rationale that they represent both the primary domestic input costs and the foreign macroeconomic conditions for the industry.

To accurately reflect the biological realities of the agricultural sector, a four-month lag was applied specifically to the crop prices in a secondary model. This was chosen because an increase in the price of corn or soybeans does not immediately change the price of a slaughtered cow. Instead, this lag serves as a time compensation for the months required to harvest crops, process them into feed, and allow the cattle to consume the feed and grow to a marketable slaughter weight. The data for these variables was obtained from two highly credible government sources:

the U.S. Bureau of Labor Statistics (BLS) and the Federal Reserve Economic Data (FRED) database. Two separate linear regressions were run to ensure clarity—one focusing on immediate macroeconomic factors (the Standard Model) and another focusing on the delayed impact of production costs (the Lagged Model).

Results and Discussion

Four values are critical from the regression result to determine its validity: the adjusted r-squared, the number of observations, the coefficient, and the t-stat. The closer to 1 the adjusted r-squared is, the more accurate the regression model is at explaining the variance. For this research, the adjusted r-squared was approximately 0.915, meaning that the data had a very strong correlation and the model successfully explained over 91% of the movement in beef exports.

The Standard Model, which looks at broader economic factors without time lags, shows that the coefficient for the overall U.S. Dollar Index (NBDI) is negative. This firmly validates the economic hypothesis that a stronger dollar generally inhibits exports by making American products relatively more expensive for foreign buyers. However, when looking at specific bilateral trade relationships, a remarkably different trend emerged. The exchange rates for the Chinese Yuan (CNY), Korean Won (KRW), and Mexican Peso (MXN) all showed a positive correlation with meat prices and export volumes. This means that even as the U.S. dollar became more expensive relative to their local currencies, the demand for American beef in these

countries actually increased. This indicates that China, South Korea, and Mexico possess a highly inelastic demand for U.S. beef; consumers in these nations view the product as a premium necessity and are willing to absorb price hikes regardless of currency fluctuations.

The data for the Japanese market, however, provided a stark contrast. In the regression models, the t-stat for Japan was found to be less than the absolute value of 1.96. In statistical terms, this means that the relationship is statistically insignificant. The Japanese market does not rely on the American beef supply chain in the same predictable manner that other East Asian nations do. This lack of correlation is likely because Japan is the home of high-end Wagyu beef production. This robust domestic luxury market satisfies a massive segment of local demand and can even be exported back to the United States at premium prices, effectively insulating Japan's market logic from standard U.S. supply fluctuations.

When analyzing the Lagged Model regarding agricultural crops, the results contradicted traditional cost-push inflation expectations. Even with the four-month biological lag applied to corn and soybeans, there was no strong discovered relationship between these immediate feed costs and the final export price of the beef. This shows that the modern livestock industry is highly resilient to short-term changes in grain prices. It is highly probable that advanced supply management, long-term feed contracting, and large-scale operational hedging allow the U.S. meat industry to absorb these costs internally rather than passing them on to the international market immediately. None of the other agricultural variables tested proved to be reliable enough to alter this overall conclusion.

Limitations

In conducting this research project, some limitations were encountered involving the specific timeframe selected and the availability of certain variables. The research intentionally focused on the period from 2010 to 2020 to avoid the extreme economic volatility and statistical "noise" generated by the 2008 global financial crisis. While this boundary provided highly accurate and consistent results for the main decade of study, it intrinsically means the model does not fully account for the massive, unprecedented shocks caused by the COVID-19 pandemic.

Furthermore, it excludes the radical shifts in global trade that occurred from 2020 to 2022 due to severe supply chain collapses and escalating Sino-American trade wars.

Additionally, due to database limitations, some nuanced variables such as specific sanitary tariffs, regional transportation freight costs, and the localized impacts of avian or swine flus (which affect substitute meat prices) had to be excluded. These limitations mean that the results are most reliable for understanding stable, normalized economic periods. They might not perfectly predict the radical changes seen in recent years, where supermarket inventories and consumer habits in East Asia changed completely overnight. Future research would greatly benefit from utilizing a larger database that includes the 2021-2025 period to assess if the resilient demand trends observed in China and South Korea still hold true in a fundamentally altered post-pandemic world.

Conclusion

After assessing the comprehensive results from the regression models, it can be concluded that international macroeconomic factors—specifically foreign exchange rates—are the dominant forces driving U.S. beef exports. While domestic production costs and feed prices are undeniably important for the daily survival of American farmers, they do not appear to be the primary drivers of world beef prices in the way that currency values are. The remarkable market resilience of China, South Korea, and Mexico proves that these are the most vital destinations for American livestock, as demand remains incredibly high even when the U.S. dollar is strong. Conversely, the lack of statistical significance in the Japanese data serves as a vital reminder that strong domestic production in a foreign country can create entirely independent market behaviors.

Ultimately, this research aligns with historical literature asserting that foreign demand supersedes domestic costs. It helps explain why federal agricultural export strategies must be tailored to specific geographic locations rather than relying on a one-size-fits-all approach. By deeply understanding these macroeconomic correlations, policymakers and the American livestock industry can better prepare for future currency shifts, ensuring that U.S. beef remains a competitive and highly demanded staple on dinner tables around the globe.

References

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