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Analysis of the Impact of Sino-US Poultry Trade on China's Chicken Prices

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Abstract: The trade relationship between China and the United States, two of the world's largest economies, is of significant global importance, particularly in the agricultural sector. This sector plays a crucial role in both nations' economies, contributing substantially to their GDPs and employment rates.This paper delves into the intricate dynamics of poultry trade between China and the United States, focusing on its impact on chicken prices in China. Utilizing comprehensive datasets spanning from 2007 to 2022 sourced from the United States Department of Agriculture (USDA) and the National Bureau of Statistics of China, the study employs static economic analysis and regression techniques to explore the factors influencing poultry prices. The findings substantiated the hypothesis posited: a rise in poultry trade volume between the U.S. and China correlates with a decrease in chicken prices in China. Findings reveal a complex relationship between trade dynamics and price movements, providing insights into the broader economic and trade policies shaping agricultural trade between these two economic powerhouses.

Keywords: Poultry trade, China, United States, Chicken prices, Regression analysis.

1. Introduction

As two of the world's largest economies, China and the United States have a trade relationship that commands global attention. This dynamic is particularly evident in the agricultural sector, which plays a vital role in both nations' economies. According to the latest data from the World Bank in 2023, the United States is China's largest trading partner, with the total trade volume reaching US$577.125 billion[1]. Agriculture is notably resilient compared to other industrial sectors, with world agricultural product prices generally remaining more stable. This stability is highlighted by the Organization for Economic Cooperation and Development (OECD), which emphasizes the sector's resilience and the stability of agricultural product prices[2]. Within the agricultural sector, poultry trade stands out as a particularly important component.The article "Meat and Dairy Production" by Ritchie et al. (2019) notes that from 1961 to 2014, global poultry production increased more than twelvefold, with the United States emerging as the largest poultry producer[3]. This substantial growth underscores the importance of poultry within the agricultural trade framework. Further highlighting the dynamics of poultry trade, OECD research from 2023 shows that from 2018 to 2021, China's annual per capita pork consumption was about twice that of chicken consumption[2]. Despite this preference for pork, the price of poultry in China was higher than in the United States. This price

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disparity is influenced by a myriad of factors, including trade policies, production costs, and market demand[4].

This article will focus on the poultry trade between China and the United States. It will explore the reasons behind the higher poultry prices in China through static economic analysis and regression analysis, providing a detailed examination of how trade impacts poultry prices in both countries. This analysis will offer insights into the broader economic and trade policies that shape the agricultural trade landscape between these two economic giants.

2. Overview of China-US Poultry Trade

According to data from the U.S. Department of Agriculture on U.S. poultry exports to China and U.S. poultry imports from China from 2007 to 2022, the trade balance formula reveals that the United States has consistently maintained a trade surplus in poultry trade, while China has experienced a trade deficit. Considering these results, it is crucial to study the factors contributing to the differences in poultry trade between the two countries. Neoclassical theory explains that varying Production Possibility Frontiers (PPFs) and Community Indifference Curves (CICs) among countries result in differing supply and demand dynamics, which drive international trade. This part will verify the consistency of this theoretical principle through data analysis[5].

The "Poultry and Products Annual" report published by the USDA in 2022 indicates that China's chicken production and domestic consumption in 2021 were 14,700 thousand metric tons (MT) and 15,032 thousand MT, respectively, showing that consumption exceeded production. According to the USDA's News Release in 2023, the U.S. produced 59.2 billion pounds of chicken in 2021[6]. Additionally, the statistical database Statista (2023) reports that the per capita consumption of poultry in the United States in 2021 was 113.4 pounds. To determine total chicken consumption in the U.S. for 2021, this information must be combined with the population data for that year provided by FRED:

$$113.4 \text{ pounds} \times 332{,}351{,}000 = 37{,}688{,}603{,}400 \text{pounds}$$

From these calculations, it is evident that China has excess demand for chicken, while the United States has excess supply. Under free trade conditions, the U.S. produces X1 chickens and consumes X2 chickens, resulting in exports of (X1 - X2) chickens. Conversely, China produces X3 chickens and consumes X4 chickens, leading to imports of (X4 - X3) chickens.

In summary, due to the different production endowments and consumption preferences for chicken in the United States and China, the U.S. emerges as an exporter and China as an importer. This is driven by the different productive capacities and consumption costs in each country. Next, this paper will utilize regression analysis to verify the relationship between China and the United States in the poultry trade.

3. Method

This paper utilizes comprehensive datasets from several sources to analyze trade and price dynamics in the poultry market between the United States and China from 2007 to 2022. The primary data source for trade figures is the United States Department of Agriculture (USDA), which provides detailed import and export statistics. These figures enable the calculation of the annual China-US trade balance for poultry, offering a clear picture of the trade dynamics over the 15-year period.

Additionally, the study incorporates data on chicken and pork prices in China, sourced from the National Bureau of Statistics of China. These price data represent national averages over the same period (2007-2022). By including China's pork prices as an exogenous variable in the regression analysis, the study aims to enhance the reliability of the results. The inclusion of this variable helps

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to ensure the independence of the analysis and mitigates potential biases that could arise from using only endogenous variables[7].

To account for inflation and present an accurate reflection of price changes over time, the study adjusts the raw chicken and pork prices using the Chinese Consumer Price Index (CPI) provided by the Federal Reserve Economic Data (FRED). The CPI adjustment uses 2015 as the base year, allowing for consistent and authentic price comparisons across the entire period. The adjustment formula applied is:

$$\text{Real Price} = (\text{Nominal Price} \div \text{CPI}) \times 100$$

4. Result and Analysis

In the empirical analysis section, this study uses the trade balance as the independent variable and the adjusted chicken price as the dependent variable, based on the aforementioned databases and variables. A scatter plot was generated to visually examine the overall trend depicted by the data. The scatter plot reveals that as the trade balance increases, the adjusted chicken price generally tends to decrease. This observation aligns with the initial research hypothesis.

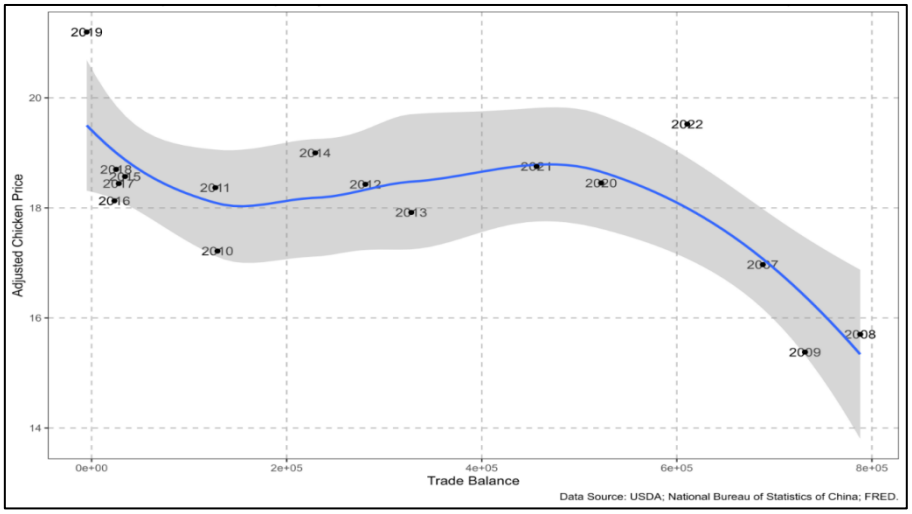

Figure 1: The relationship between the poultry trade balance of the United States & China and the chicken prices in China

Subsequently, a regression analysis was conducted to verify the downward trend observed in the scatter plot. The results of this analysis are presented in the table below. The regression equation derived from this analysis is:

$$\text{Adjusted Chicken Price} = -0.000003\ \text{Trade Balance} + 19.07805$$

From the regression equation, because of the negative coefficient, the adjusted chicken prices decrease as the trade balance grows. In detail, when the trade balance increases by 1 MT, the value of adjusted chicken price decreases by 0.000003 on average. This is consistent with the downward trend in the scatter plot and prediction of this study(see table 1).

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Table 1: The Regression Result of the Trade Balance and the Adjusted Chicken Price

	Dependent variable:
	`Adjusted Chicken Price
`Trade Balance`	-0.000003**
	(0.000001)
Constant	19.078050***
	(0.440834)
Observations	16
R2	0.348242
Adjusted R2	0.301688
Residual Std.Error	1.162202(df =14)
F Statistic	7.480375**(df=1;14)
Note:	*p<0.1;**p<0.05;***p<0.01

To verify the independence and unbiasedness of the regression analysis, the variable of pork prices in China will be introduced as an additional independent variable in the analysis. The regression result table is given as follows. The regression equation can be deduced as:

$$\text{Adjusted Chicken Price}$$

$$= -0.000003\text{Trade Balance} + 17.18328 + 0.115103\text{Adjusted Pork Price}$$

According to the regression analysis, when the Chinese pork price variable is included, the coefficient for the original independent variable, the trade balance, remains unchanged. This stability in the trade balance coefficient suggests that the addition of the pork price variable does not affect the relationship between the trade balance and the adjusted chicken price, thus confirming the robustness of the initial model. Moreover, the regression results show a positive coefficient for the pork price variable, indicating a direct correlation between pork prices and chicken prices. Specifically, the positive coefficient value means that for every unit increase in the pork price, the adjusted chicken price increases by an average of 0.115103. This suggests that higher pork prices in China lead to higher chicken prices, likely due to the substitutive nature of these two protein sources in consumer diets(see table 2).

The inclusion of the pork price variable enhances the credibility of the regression analysis by addressing potential omitted variable bias. By demonstrating that the trade balance's coefficient remains stable and the expected positive correlation between pork and chicken prices holds, the analysis confirms the independence and unbiasedness of the model. This further supports the initial hypothesis that the trade balance negatively influences the adjusted chicken price, as previously depicted in the scatter plot.

Table 2: The Regression Result of the Trade Balance & the Adjusted Pork Price and the Adjusted Chicken Price

	Dependent variable:
	`Adjusted Chicken Price
`Trade Balance`	-0.000003**
	(0.000001)
`Adjusted Pork Price	0.115103**
	(0.046947)
Constant	17.183280***
	(0.860438)

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Table 2: (continued).

Observations	16
R2	0.554324
Adjusted R2	0.485758
Residual Std.Error	0.997334 (df =13)
F Statistic	8.084578**(df =2;13)
Note:	*p<0.1;**p<0.05;***p<0.01

Also, the first regression results table indicates that the p-value associated with the trade balance coefficient is marked by two asterisks, signifying a p-value of less than 0.05. This demonstrates the statistical significance of the trade balance as an independent variable. In the second regression results table, which includes the additional independent variable of pork price, the p-values for the coefficients of both independent variables (trade balance and pork price) are also less than 0.05. This indicates that both variables are statistically significant in the regression model.

5. Discussion

It is often believed that traded products are inflated in price due to factors such as tariffs. However, the theoretical and empirical analysis presented here suggests that this view is incomplete. In the case of China-US poultry trade, increased trade volume has not led to higher chicken prices in China. On the contrary, the data shows that as trade volume increases, chicken prices in China tend to decrease[8]. This observation highlights that different countries have varying resource endowments and production technologies, resulting in different production possibility frontiers (PPFs)[5]. Therefore, the fundamental reason why chicken is more expensive in China than in the United States is due to China's relatively insufficient resource endowment for chicken production. Additionally, neoclassical economic theory explains that transitioning from self-sufficiency to free trade generally leads to a decrease in the relative price of the same product in the importing country.

Moreover, the inclusion of China's pork price as an exogenous variable in the regression analysis reveals a positive coefficient. This indicates that as pork prices in China increase, chicken prices also rise. This positive relationship can be explained using the aggregate demand-aggregate supply (AD-AS) model in economics[9]. When pork prices rise, consumers may shift their demand to chicken as a substitute, leading to an increase in demand for chicken. However, if the supply of chicken does not adjust quickly to this increased demand, the demand curve for chicken shifts to the right, resulting in a higher equilibrium price for chicken.

It is noteworthy that the coefficient of the original independent variable, trade balance, remains unchanged after including the variable for pork price in China. This suggests that fluctuations in Chinese pork prices have little effect on the volume of poultry trade between China and the United States. Many factors influence trade between the two countries, including trade policy, exchange rates, and consumer demand. Therefore, it can be concluded that the price of pork in China, as a substitute for chicken, has minimal impact on the poultry trade between the United States and China.

6. Conclusion

This paper delves into the intricate dynamics of the U.S.-China poultry trade, aiming to shed light on its potential implications for chicken prices in China. The study initiates by grounding its analysis within the framework of Neoclassical theory. By delineating the U.S. as an exporter and China as an importer of chicken, this theoretical foundation offers valuable insights into the dynamics at play. Utilizing rigorous statistical methods including regression analysis and independence tests, the study

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meticulously examines the relationship between poultry trade volume and chicken prices in China. Drawing upon comprehensive datasets sourced from authoritative bodies such as the United States Department of Agriculture (USDA) and the National Bureau of Statistics of China, the analysis endeavors to unravel intricate patterns and correlations embedded within the data.

The findings of the study challenge conventional assumptions about the impact of trade on consumer prices, particularly within the context of tariffs and trade barriers. Contrary to expectations, the research reveals a counterintuitive relationship: an increase in poultry trade volume between the U.S. and China corresponds with a decrease in chicken prices in China. This discovery underscores the complexity of global trade dynamics and highlights the need for nuanced analyses that consider multiple factors.

However, it is crucial to acknowledge the study's limitations, notably the exclusion of data for the year 2023. While the research provides valuable insights, the absence of recent data underscores the necessity for future studies to adopt a broader temporal scope and incorporate a more extensive sample size.

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