International Journal of Asian Social Science
ISSN(e): 2224-4441
ISSN(p): 2226-5139
DOI: 10.55493/5007.v13i10.4887
Vol. 13, No. 10, 282-292.

URL: www.aessweb.com

The influence of codex guidelines on international trade: An analysis focused on Kimchi

Peter Wui[1+]
KyungPhil Kim[2]
GangCheol Seo[3]

[1,3]*School of Business and Management, University of Arkansas Pine Bluff, USA.*
[1]*Email: wuiy@uapb.edu*
[3]*Email: softvalue31@gamil.com*
[2]*Korea Rural Economic Institute, South Korea.*
[2]*Email: kkphil@krei.re.kr*


(+ Corresponding author)

Article History
Received: 27 July 2023
Revised: 9 September 2023
Accepted: 15 September 2023
Published: 4 October 2023

Keywords
Codex standards
Export and import dynamics
Food safety
International food trade
Kimchi trade.

ABSTRACT

The global food trade, with an estimated value of approximately USD 2,395 billion in 2022, encounters various obstacles pertaining to consumer health and the preservation of species. To mitigate these, governments enact legislation and regulations, potentially hindering international food trade. The FAO and WHO established the Codex Alimentarius Committee in 1963 with the goal of harmonizing international food standards, guidelines, and moral behavior for consumer health and fair trade. This paper analyzes the economic impact of Codex certification on Kimchi trade in Korea. Before Codex, various non-standardized versions of kimchi were marketed globally. The implementation codex standards serve to mitigate these disparities by establishing a standardized global norm. The examination of multivariate import and export demand functions investigates the impact of the codex on the trade dynamics of kimchi. The findings indicate a notable rise in kimchi exports to Japan and an increase in imports from China, resulting in benefits for multiple nations. The analysis employs regression models with variables like export prices, GDP per capita, financial crisis dummies, and Codex accreditation. Findings show Codex significantly increases Korean Kimchi exports by 7,096 metric tonnes annually and Chinese Kimchi imports by 99,628 metric tonnes yearly. This highlights Codex's potential to foster international trade and enhance consumer trust. In conclusion, Codex standards offer a robust framework for safe international trade while ensuring consumer safety and promoting market growth. The study provides insights into the economic implications of Codex standards for global food trade.

Contribution/ Originality: This research contributes by analyzing the effects of Codex regulations on imports and exports of Korean kimchi to the Republic of Korea, Japan, the United States, and China. The study evaluates the impact of Codex standards on export and import volumes across the aforementioned nations using multivariate export and import demand functions.

1. INTRODUCTION

The food trade is a massive industry, with an anticipated value ranging from USD 2,395 to 3,045 billion by the year 2022 (Fortune Business Insights, 2023). A predominant focus of national governments is to ensure that imported food does not compromise consumer health or endanger their animal and plant species. To mitigate such risks, import nations have implemented mandatory legislation and regulations. These protective measures,

especially in the food, animal, and plant control sectors, can potentially result in obstacles to international food trade (Buzby, 2003).

The Codex Alimentarius Committee, or simply Codex[1], was conceived by the Food and Agriculture Organization (FAO) and World Health Organization (WHO) in 1963 with the primary aim of synchronizing international food standards, guidelines, and ethical business practices with the dual purpose of safeguarding consumer health and maintaining equity in food commerce (Food and Agriculture Organization of the United Nations & World Trade Organization, 2017). In July 2001, Codex officially recognized the standards for Kimchi. Originating in Korea, the country celebrated the Codex certification as a major milestone in the process of globalizing Kimchi, which will increase the product's competitiveness and export opportunities. Before it was officially recognized by the Codex, a wide variety of Kimchi preparations were sold under the names "kimuchi" in Japan and "paocai" in China. Codex certificate eliminates discrimination and establishes a uniform global standard. Although the country of origin of certified product may have an advantage in terms of production technology and quality for export markets, this advantage is available to all countries that follow the same standards. Codex is important because it encourages not only high-quality and safe food but also international competition for equivalent goods.

The primary objective of this paper is to examine the economic consequences of Codex certification on Kimchi through the lens of its exports and imports in its native country, Korea. Subsequently, it will explore the ramifications of Codex standards on Korea's export and import endeavors concerning Kimchi. Ultimately, the impact of these analyses will be examined.

2. LITERATURE REVIEW

The literature regarding the impact of Codex food safety standards on international trade is expansive and informative. A seminal study conducted by the World Bank, undertaken by Wilson and Otsuki (2001), evaluated the effects of the uniform application of a Codex food safety standard on 15 importing and 31 exporting countries. Their findings indicated a potential increase in grain and nut trade of over $6 billion, an increase of more than 50 percent when juxtaposed with the diverse standards enforced in 1998.

However, research by Otsuki, Wilson, and Sewadeh (2001) found that developing nations, which typically have less stringent food safety standards, may face greater challenges under a strict standard. This was analyzed using a gravity econometric model incorporating a Codex standard.

Supplementing these foundational studies, Swinnen, Vandemoortele, and Deconinck (2015) added to these introductory studies by demonstrating how Codex standards promote openness and dependability in the global food trade. Their study conveyed that developing countries could gain considerable benefits from adopting these standards, provided they have the institutional capacity to do so.

Anders and Caswell (2009) underscored the significance of Codex standards as a reference point in resolving trade disputes within the World Trade Organization. Hence, this substantial contribution greatly facilitates global commerce. The authors emphasized that the implementation of these standards resulted in a decrease in transaction costs, particularly for developing nations, thereby fostering trade.

Ferro, Otsuki, and Wilson (2015) conducted a study on the impact of food safety standards on trade intensity and observed that, in many cases, the effect was negligible, with little or no significant influence on export volumes. The authors put forth the proposition that after a company adjusts its production processes to conform to the demands of foreign market, the adherence to those standards does not significantly impact the level of exports to that particular market. They proposed that once a company adapted its production processes to align with the

[1] The term "Codex Alimentarius" is derived from Latin, where "codex" means "book" and "alimentarius" refers to "food."

foreign market's requirements, those standards had little bearing on the intensity of exports to that market. Interestingly, their analysis also revealed that more stringent requirements tended to disproportionately restrict exports from developing countries, potentially creating challenges for their participation in international trade.

Fiankor, Haase, and Brümmer (2021) affirmed that stringent importer standards had a constraining effect on trade. Nevertheless, their research showed that the elasticity of trade costs varied based on the level of trade intensity between two countries. They found, more specifically, that the proportion of exports to the total imports into the importing country tended to reduce the magnitude of the trade cost elasticity.

Therefore, the adoption of Codex standards can present certain hurdles, particularly for developing nations with less stringent food safety norms. Nonetheless, the potential for encouraging a more equitable, reliable, and efficient global food trade is vast. The successful implementation of these standards, supported by appropriate strengthening capacity initiatives, can empower countries to maximize the advantages of Codex accreditation.

3. DATA DESCRIPTION

Table 1 presents the summary statistics for Kimchi exports, imports, prices, and real Gross Domestic Products (GDP) per capita for Korea, Japan, and China. All monetary values are adjusted for inflation using the 2010 base Korea CPI index.

The mean average prices of exports and imports from 1991 to 2022 were $4/kg and $1.15/kg, respectively, adjusted to 2010 prices. The price of cabbage in Korea, which is a key ingredient in Kimchi processing, was ₩6,423/10 kg, equivalent to $0.57/kg. On average, export prices were 3.5 times higher than import prices from China. The average quantities of exports and imports were 24,404 and 131,107 tonnes, representing a ratio of 4.5: 1, with imports being significantly higher.

Table 1. Summary of Kimchi exports and imports, prices, and real GDP per capita.

Variables	Mean	Standard deviation	Minimum	25%	Median	75%	Maximum
China real GDP per capita*	$3,867	$3,066	$739	$1,065	$2,655	$6,781	$9,753
Japan real GDP per capita*	$37,510	$4,588	$29,624	$35,001	$37,756	$38,757	$49,301
USA real GDP per capita*	$47,988	$5,093	$38,974	$44,874	$48,592	$51,136	$56,924
Korea real GDP per capita*	$21,857	$4,919	$11,677	$17,728	$22,552	$26,224	$29,492
Kimchi export (Ton)**	24,404	9,543	6,183	21,318	25,616	29,317	42,544
Kimchi import (Ton)**	131,107	117,462	-	75	163,042	226,363	306,049
Export price ($/kg)**	$4.00	$1.29	$2.75	$3.13	$3.41	$4.52	$6.92
Import price($/kg)**	$1.15	$1.25	$0.37	$0.47	$0.53	$0.67	$4.11
Kimchi domestic price (won/10kg)**	₩6,423	₩2,197	₩1,906	₩5,240	₩6,117	₩7,911	₩10,619

Source: * World Bank (2023)and ** Ministry of Agriculture Food and Rural Affairs of Republic of Korea & Korea Agro-Fisheries & Food Trade Corporation (2023).
1. All monetary values, including dollars and Korean won, have been adjusted for inflation using the 2010 base Korea CPI index.

Figure 1 presents the trend of Kimchi exports and imports in Korea since 1991. Prior to the emergence of the COVID-19 pandemic, Kimchi exports exhibited a generally increasing trend. Initially, exports showed a growth trajectory but experienced a decline, returning to levels observed before the implementation of CODEX (shown by a red vertical line in 2001). Subsequently, there was a gradual recovery, and exports started to increase again

approximately 14 years after the adoption of CODEX regulations in 2015. CODEX may have had a modest positive impact on Kimchi exports, although the effect does not appear to be substantial[2].

In contrast, imports from China witnessed a significant surge, surpassing the rate of increase in exports overall. Despite experiencing import shocks during the global financial crisis in 2009 and the COVID-19 pandemic in 2020, Figure 1 indicates that the influence of CODEX on imports from China was considerably greater than its impact on exports from Korea. This discrepancy may be attributed to the lower production costs associated with Kimchi production in China[3].

Overall, Figure 1 provides an overview of the dynamics between Kimchi exports and imports in Korea, highlighting the impact of CODEX regulations on both aspects of the trade.

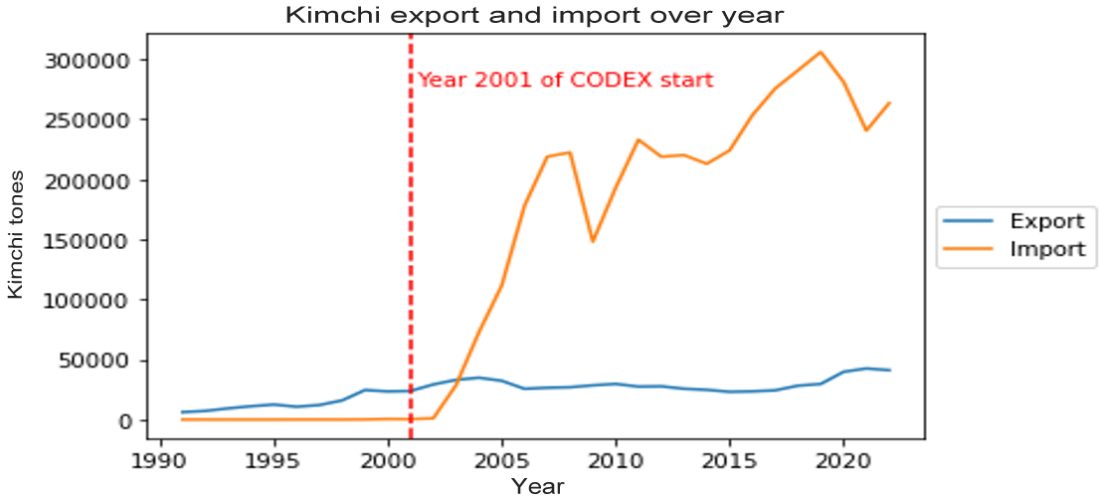

Figure 1. Kimchi exports and imports of Korea over time.

Figure 2 exhibits the prices of Kimchi exports and imports. The general trend is declining, as prior to CODEX, there was a substantial decline in Kimchi prices as the years continuously progressed. CODEX implementation slowed the trajectory of the decline, balancing it out to an almost linear and neutral horizontal line. Initially, the Kimchi prices started off quite high at $6/kg of exports and $4/kg of imports, then dropped to $3/kg of exports and $0.50/kg of imports. There is a specific "dip" around 1997, most likely due to the 'Asia Economic Crisis of 1997'. Figure 2 illustrates the prices of Kimchi exports and imports over time. The overall trend shows a decline in prices, with a notable decrease observed before the implementation of CODEX. Prior to CODEX, Kimchi prices experienced a substantial decline as the years progressed. However, after the implementation of CODEX, the decline in prices slowed down, resulting in a more stabilized and nearly linear trend.

At the beginning of the time period, the Kimchi export prices were relatively high, averaging $6/kg, while import prices stood at around $4/kg. Over time, both export and import prices gradually decreased. By the end of the period, export prices had dropped to approximately $3/kg and import prices had declined to $0.50/kg.

[2] In 2022, the largest share of kimchi exports was directed to Japan, accounting for 47% of the total. The United States followed with 22%, while Hong Kong, the Netherlands, and Australia received 6%, 5%, and 5% respectively. Taiwan, the United Kingdom, Canada, Singapore, and Malaysia represented 4%, 4%, 3%, 2%, and 2% respectively of the total kimchi exports(Ministry of Agriculture Food and Rural Affairs of Republic of Korea & Korea Agro-Fisheries & Food Trade Corporation, 2023).

[3] China accounts for 100% of kimchi imports in Korea (Ministry of Agriculture Food and Rural Affairs of Republic of Korea & Korea Agro-Fisheries & Food Trade Corporation, 2023).

It is worth mentioning that there was a specific "dip" observed around 1997 in the price trend. The 'Asia Economic Crisis of 1997', had a profound effect on the regional economy, including the Kimchi market, and is thus largely responsible for the decline in sales.

Overall, Figure 2 provides insights into the fluctuation and changes in Kimchi export and import prices over time, highlighting the impact of the CODEX implementation and external factors such as economic crises on the Kimchi market.

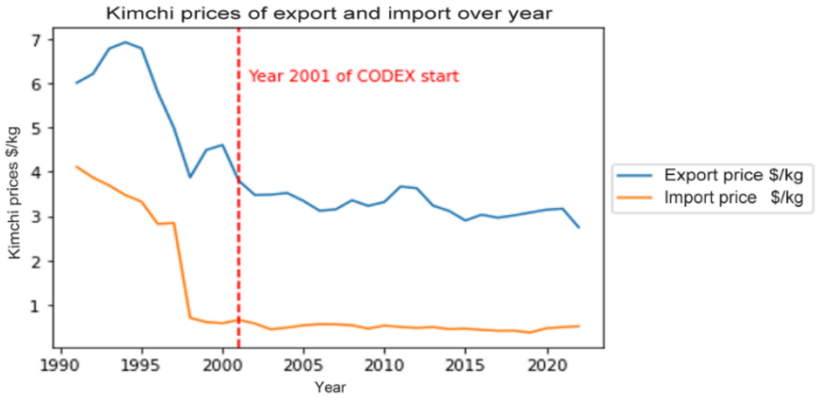

Figure 2. Kimchi export and import prices over time.

Figure 3 displays the wholesale prices of Korean cabbage in won per 10kg over time. Cabbage serves as the primary ingredient in Kimchi products. The overall trend in cabbage prices shows an increasing pattern, but with significant fluctuations. The observed variations can be ascribed to a multitude of factors, encompassing climate change, occurrences of droughts, heavy rains, and extreme temperatures.

However, after the implementation of CODEX, a notable shift can be observed in the cabbage price dynamics. The prices show higher variances with an overall increasing trend. This change can be linked to the substantial increase in imports from China, which in turn impacted the domestic production of cabbage in Korea. The influx of imported cabbage led to a decrease in the domestic supply, resulting in higher cabbage prices and increased price deviations.

The higher variance in cabbage prices after the CODEX implementation reflects the market dynamics influenced by the sharp rise in imports from China. This change in the cabbage market dynamics signifies the complex interplay between domestic production and international trade, ultimately affecting the price trends observed in Figure 3.

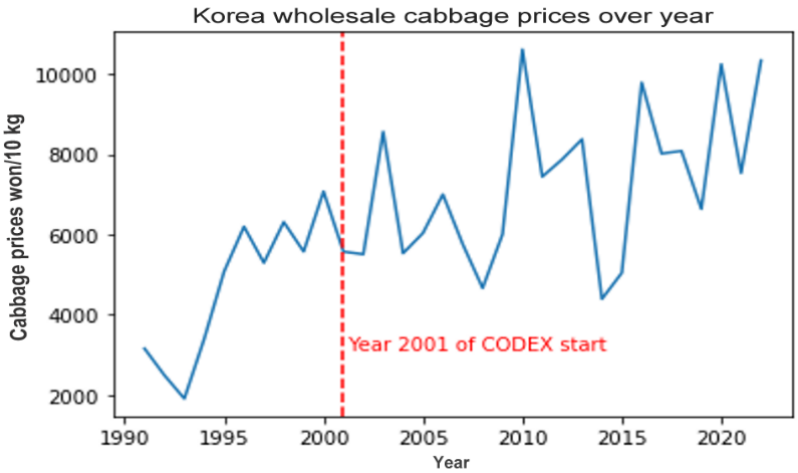

Figure 3. Cabbage prices in Korea over time.

Figure 4 provides a visual representation of the best-fitted demand curves for Kimchi exports and imports in Korea using real data from 1991 to 2022. The export demand curve is predicted using a quadratic function of prices, while the import demand curve is fitted with an inverse function of prices. These functional forms serve as the basis for estimating multi-variable regression demand functions. By analyzing these demand curves, we can gain insights into the relationship between prices and the quantity of Kimchi exports and imports in Korea.

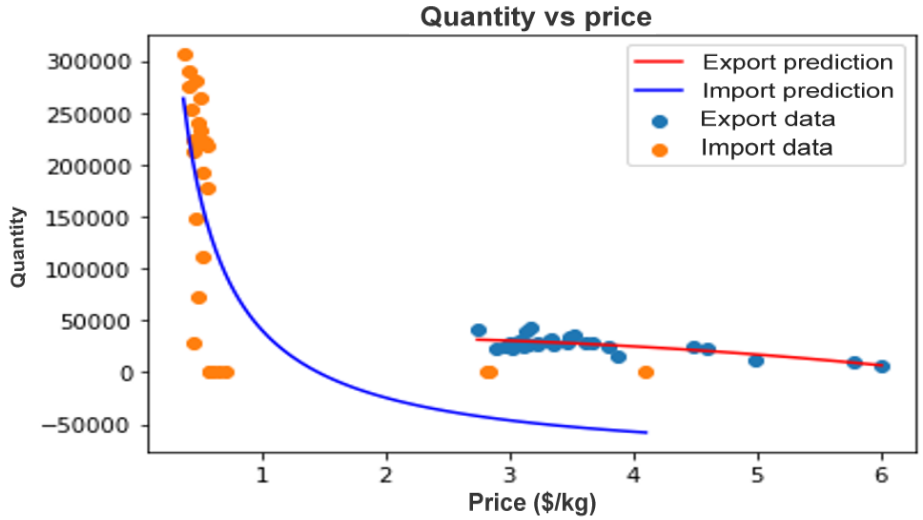

Figure 4. Kimchi exports/imports and its prices, along with the predicted demand curve.

Figure 5 displays the relationship between export and import quantities and their respective countries incomes. The import quantities are plotted against Korean income, while the export quantities are plotted against the weighted aggregated income of Japan (47%) and the USA (22%). The relationships between quantities and incomes follow a quadratic functional form. The imports exhibit an increasing rate of growth as income rises, whereas the exports demonstrate a diminishing rate of growth. These relationships will be utilized to predict demand functions incorporating price variables.

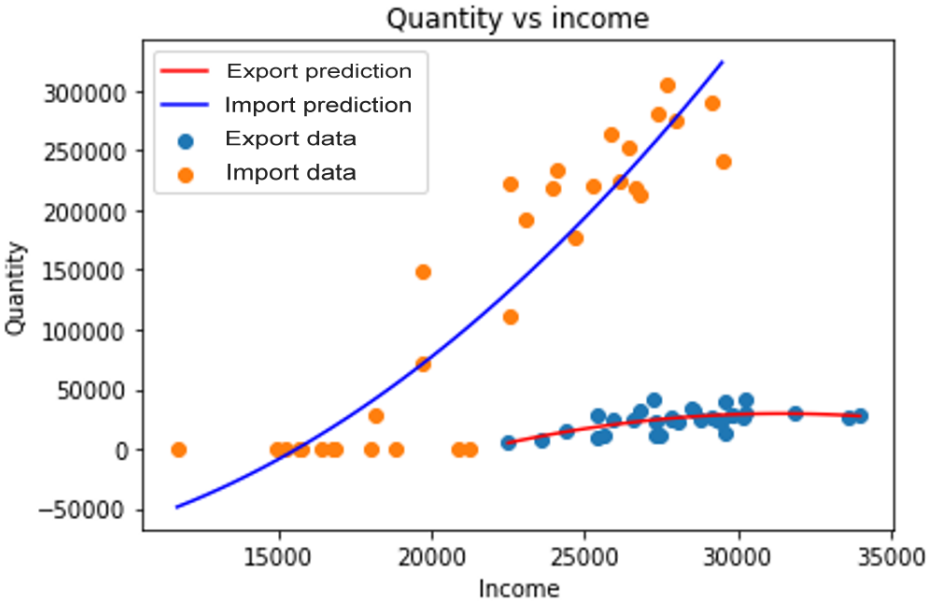

Figure 5. Relationship between export and import quantities and their corresponding country incomes.

4. INFLUENCE OF CODEX STANDARDS ON KOREAN KIMCHI EXPORTS

This analysis centers on examining the impact of Codex standards on the exportation of Korean Kimchi, with a particular emphasis on export activity to Japan and the USA. Kimchi exports from Korea experienced a steady growth trend until 2004, reaching a peak of 34,827 tonnes. However, subsequent years saw a decline in exports due to various factors.

Several factors contributed to the challenges faced by Korean Kimchi in the international market. First, there were concerns about food safety due to parasite infestations in Chinese Kimchi, which affected the reputation of Korean Kimchi. Second, Korean exporters faced stiff competition with Chinese Kimchi in the Japanese market, posing a significant challenge to their market share. Lastly, the global economic recession following the 2008 financial crisis further exacerbated the situation by dampening export volumes.

In 2011, Japan accounted for a significant portion of Korean Kimchi exports, representing 83% of the total. The USA, Hong Kong, and Taiwan accounted for smaller shares of 2.7%, 2.3%, and 2.2%, respectively. However, over the years, the Japanese market share has declined, reaching 47% in 2021. On the other hand, the USA's market share has shown a sharp increase, reaching 22% in the same year. This shift in market shares has made Japan and the USA the key focus of this analysis, as they collectively represent around 70% of the export share in 2022.

The real price of Kimchi exports has shown a decreasing trend, falling from $6.92 per kilogramme in 1994 to $2.75 per kilogramme in 2022. This decrease in price can be attributed to various factors, including increased competition and changes in consumer preferences.

The rise in real GDP per capita in the USA has had a positive impact on Kimchi exports to the country. On the other hand, the Japanese real GDP per capita has remained relatively stable around an average income of $37,510 from 1991 through 2022. This economic factor helps explain the decline in export share to Japan from 83% in 2011 to 47% in 2022. Combining the income impacts from both Japan and the USA, we observe a staggering and slow increase in Kimchi exports.

The analysis of Korean Kimchi exports considers the evolving market dynamics and shifting consumer preferences in key export destinations. To understand the impact of Codex standards on Korean Kimchi exports, a multivariate regression model is employed. The model incorporates various variables such as export price, real GDP per capita of Japan and USA, dummy variables for the financial crisis of 2009 and the COVID-19 pandemic, and a dummy variable for Codex standard accreditation. The regression equation is formulated as follows:

$$Exp_t = \beta_0 + \beta_1 p_t + \beta_2 p_t^2 + \beta_3 y_{Jt} + \beta_4 y_{Jt}^2 + \beta_5 y_{USt} + \beta_6 y_{USt}^2 + \beta_7 d_{2009t} + \beta_8 d_{COVIDt} + \beta_9 codex_t + \varepsilon_t \quad Exp_t = \beta_0 + \beta_1 p_t + \beta_2 y_t + \beta_3 y_t^2 + \beta_4 codex_t + \varepsilon_t, \text{ t=1991-2022.} \quad (1)$$

In this Equation 1, Exp_t represents Korea's Kimchi exports in year t, measured in metric tonnes (MT). The variables used in the equation are defined as follows:

- p_t Indicates the real export prices of Kimchi in year t, measured in $/kg.
- y_{Jt} Represents the real GDP per capita of Japan in year t, measured in $1000.
- y_{USt} Represents the real GDP per capita of the USA in year t, measured in $1000.
- d_{2009t} Symbolizes a dummy variable for a financial crisis in 2009.
- d_{COVIDt} Symbolizes a dummy variable for the COVID pandemic in the years 2020 through 2022.
- $codex_t$ Represents a dummy variable of codex standard accreditation for Kimchi in the post-2001 period.
- The coefficients $\beta_{i,i=0-9}$ represent the marginal export contributions of each respective variable.
- The error term ε_t captures any unexplained variation in the export quantities.

By estimating the values of these coefficients, we can assess the impact of export prices, GDP per capita, dummy variables, and codex standards on Korean Kimchi exports over the specified period.

To address multicollinearity, which can lead to unreliable and inefficient parameters, a conditional number test was conducted[4]. The test revealed that only one variable, the export price p_t, and three dummy variables were $d_{2009t}, d_{COVIDt}, codex_t$ were included in the estimation. This selection helps mitigate the issue of multicollinearity.

The Ordinary Least Squares (OLS) OLS estimation result of the Equation 1 is as follows.

$$Exp_t = 30{,}460 - 3{,}042.9p_t + 767.6d_{2009t} + 12{,}760d_{COVIDt} + 7{,}096.7codex_t \quad (2)$$

$$(-4.52)^{**} \quad (-2.60)^{**} \quad (0.18) \quad (5.01)^{**} \quad (2.22)^{*}$$

$$adj\text{-}R^2 = 0.82, \ F=36.24.$$

The coefficients in parentheses represent the t-statistics for each coefficient. The asterisks (*) in the estimation results indicate statistical significance at the 5% level, while the double asterisks (**) indicate significance at the 1% level. When all other variables are held constant, the estimation results show that the Codex standard has a significant positive impact on Korean Kimchi exports, increasing them by 7,096 tonnes per year. The decrease in export prices by $1 is associated with an increase in exports of approximately 3,043 tons. The net impact of the financial crisis in 2009 is not statistically significant, indicating that any effects of the crisis on exports have already been captured through decreased export prices. Interestingly, the COVID-19 pandemic has led to an increase in Kimchi exports from Korea. This can be attributed to the closure of Chinese factories and the heightened demand for Korean Kimchi compared to China.

In order to predict Korean Kimchi export projections until 2030 through Equation 2, it is essential to initially forecast the Kimchi export price. This is achieved by employing a first-order autoregression equation for the export price, yielding the Korean Kimchi export price estimation as depicted by Equation 3:

$$p_t = 0.232 + 0.9196 * p_{t-1} \quad (3)$$

Figure 6 depicts the projected Korean Kimchi exports considering both scenarios: with and without Codex standards. The absence of Codex standards may result in a more significant decline in exports compared to current levels. Additionally, it is noteworthy that the forecasted Kimchi exports are anticipated to decrease further after the impact of COVID, primarily due to the reopening of the China factory. Furthermore, the increased competition from low-cost Chinese-made Kimchi exports adds to the challenges faced by Korean Kimchi exports in the forecasted period.

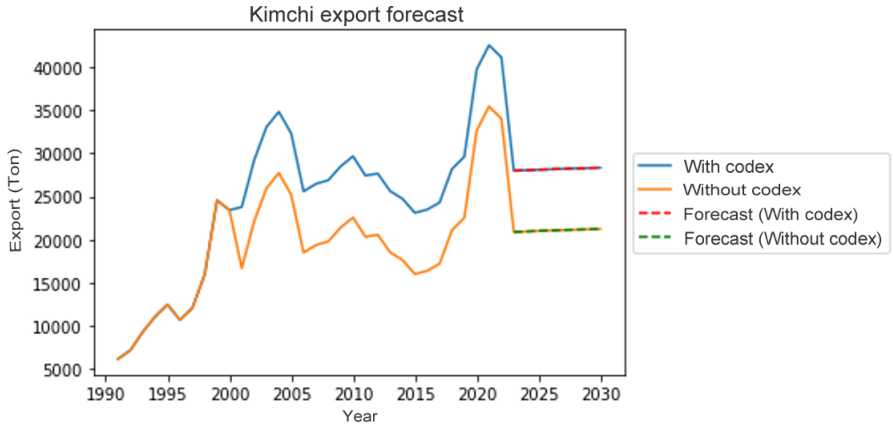

Figure 6. Forecast of Korean Kimchi exports until 2030[5].

[4] Out of the 256 possible regressions obtained by considering all combinations of 8 variables, excluding the "codex" variable, only 44 regressions were selected. Among these selected regressions, the final model was determined by choosing the one with the maximum number of variables included for further examination.

[5] The parallel rise in Kimchi exports with Codex compared to those without Codex is attributed to the estimated parameter value (7,096.7 tons) of the Codex dummy variable in Equation 2.

5. INFLUENCE OF CODEX STANDARDS ON KIMCHI IMPORTS TO KOREA

The imports of Kimchi to Korea are entirely sourced from China. The import trend began in 1996 and experienced a substantial surge from 2000 onward. Over the years, the real import price witnessed a significant reduction, declining from $4.11/kg in 1991 to $0.37/kg in 2019, representing a notable 91% decrease. In contrast, the import volume demonstrated astonishing growth, escalating from 3 tonnes in 1991 to 306 thousand tonnes in 2019, marking an exceptional 102,015% increase.

The remarkable increase in imports can largely be attributed to the substantial price difference observed between domestic Kimchi prices and import prices. In 2019, there was a notable 5.7 times difference between the higher domestic Kimchi price ($2.12/kg) and the lower import price ($0.37/kg). It is intriguing to note that even the discovery of parasites in Chinese Kimchi did not impede the upward trajectory of imports, except for the temporary setback during the 2008 economic crisis. Another significant factor influencing the variations in imports is the rising Korean income.

Based on the regression analysis of Korea's Kimchi imports, which incorporates import prices, domestic prices, Korean income, the financial crisis in 2009, COVID-19, and Codex standards, the relationship can be represented as follows:

$$Imp_t = \beta_0 + \beta_1/p_{Ct} + \beta_2 p_{Kt} + \beta_3 y_{Kt} + \beta_4 y_{Kt}^2 + \beta_5 d_{2009t} + \beta_6 d_{COVIDt} + \beta_7 codex_t + \varepsilon_t Exp_t = \beta_0 + \beta_1 p_t + \beta_2 y_t + \beta_3 y_t^2 + \beta_4 codex_t + \varepsilon_t, \text{ t=1991-2022.} \quad (4)$$

In this Equation 4, Imp_t represents Korea's Kimchi imports in year t, measured in metric tonnes (MT). The variables used in the equation are defined as follows:

- p_{Ct} Indicates the real import prices of Kimchi in year in year t, measured in $/kg. To address the trend observed in Figure 4[6], the inverse values of the real import prices are used as $1/p_{Ct}$.
- p_{Kt} Indicates the real domestic prices of cabbage, which is a crucial substitute for Kimchi, in year t, measured in ₩/10kg.
- y_{Kt} Represents the real GDP per capita of Korea in year t, measured in $1000.
- The coefficients $\beta_{i\ (i=0-7)}$ represent the marginal export contributions of each respective variable.

The OLS regression results indicate that multicollinearity is present among the six explanatory variables, excluding the codex dummy variable, which is the main variable of this study. The selected variables include the inverse price of imports and three dummy variables.

The estimated regression equation for imports is:

$$Imp_t = -40460.3 + 59139.9\frac{1}{p_{Ct}} - 39328.9\, d_{2009t} + 82247.1\, d_{COVIDt} + 99628.3 codex_t$$
$$(-1.27) \qquad (1.84)^* \qquad (-0.53) \qquad (1.82)^* \qquad (1.89)^*$$
$$Adj R^2 = 0.62, F = 13.64 \quad (5)$$

The t-statistics of each coefficient are shown in parentheses. The * symbol denotes statistical significance at the 10% level.

The influence of Codex standards on Chinese Kimchi imports to Korea is found to be significant, resulting in a substantial increase of 99,628 tonnes per year. This impact is approximately 14 times higher than the effect of Codex standards on Korean Kimchi exports. The impact of the inverse import price suggests that when the price of imports is lower, even a slight reduction in price can lead to a rapid increase in imports. This indicates that lower prices make imported Kimchi more attractive to the Korean market, resulting in higher import quantities. Interestingly, the COVID-19 pandemic increased imports by up to 82,247 tonnes. But the financial crisis in 2009 did not have a significant impact on the change in Kimchi imports. This is likely because the effects of the financial

[6]Figure 4 illustrates the Kimchi import demand curve, which exhibits an almost L-shaped pattern.

crisis were already reflected in the changes in import prices, and therefore, their direct impact on import quantities was limited.

The forecasting of Kimchi imports in Korea was conducted by estimating a first autoregression equation of import prices until 2030 as follows.

$$p_{Ct} = 0.042 + 0.864 * p_{Ct-1} \quad (6)$$

Based on the forecasted import prices derived from Equation 6, Figure 7 illustrates the projected imports with and without CODEX standards. The inclusion of CODEX standards has a significant impact on the imports to Korea, leading to a substantial difference between the two scenarios. Figure 7 depicts the forecast of Korea's kimchi imports until 2030.

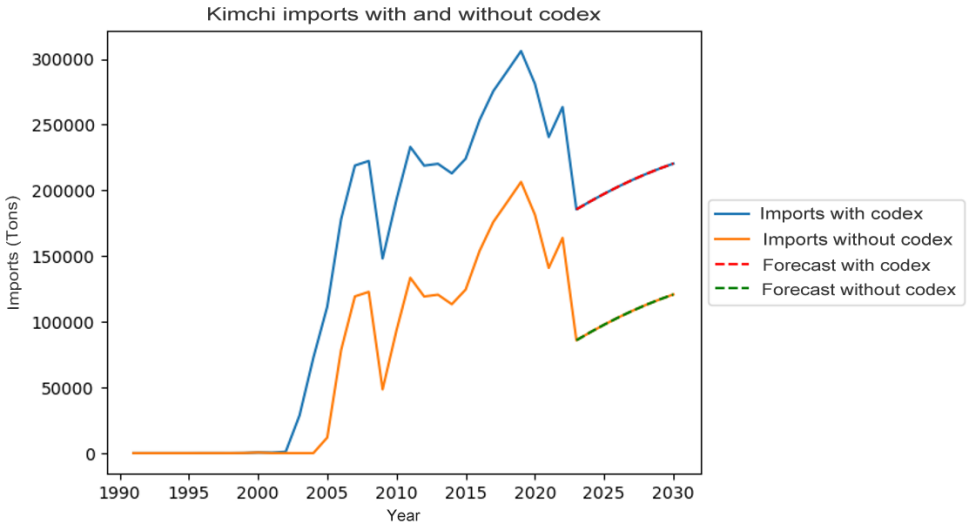

Figure 7. Forecast of Korea kimchi imports until 2030[7].

6. CONCLUSION

Korean kimchi trade has been revolutionized by the implementation of Codex standards, which have increased exports to Japan, the United States, and other developed countries and encouraged imports from China. While the initial impression might suggest a large disparity between the import influx by the CODEX standard (99,628 tonnes) and the expansion in exports (7,097 tonnes) by a factor of 14, it is important to consider the overall economic impact. The annual escalation in exports under CODEX, amounting to $24.3 million in 2022, results in a marginal net loss of $27.1 million when considering the estimated annual increase in imports, valued at $51.4 million in 2022. However, it should be noted that Korean consumers can benefit from the improved quality and safety of Kimchi resulting from the implementation of Codex standards.

The implications of this study's findings for policy, trade, and food safety are significant. Firstly, the Codex standards, as exemplified by the case of Korean Kimchi, have a demonstrable potential to significantly stimulate international trade. Increased exports and imports have been witnessed in the wake of the adoption of these standards, underscoring their critical role in harmonizing global food trade practices.

Secondly, the impact of these standards reaches beyond the originating country, affecting trade dynamics in other countries as well. In the case of Kimchi, while Korea saw a surge in its exports, China also experienced a boost in its exports to Korea. This highlights how international standards can create new trade opportunities for a range of nations, fostering a more globally connected and beneficial trade environment.

[7]The parallel rise in Kimchi imports with Codex compared to those without Codex is attributed to the estimated parameter value (99,628.3 tons) of the Codex dummy variable in Equation 5.

Finally, these standards have proven their importance in cultivating consumer trust. By ensuring the safety and quality of food products, they make a significant contribution to consumer confidence, which in turn can drive demand and market growth. Therefore, the Codex standards are not just trade measures but also important tools for consumer protection and public health.

In conclusion, countries can gain a necessary framework for expanding their safe international trade, consumer benefit, and global market integration through the adoption and reinforcement of global food standards such as the Codex.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: The corresponding author may provide study data upon reasonable request.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Anders, S. M., & Caswell, J. A. (2009). Standards as barriers versus standards as catalysts: Assessing the impact of HACCP implementation on US seafood imports. *American Journal of Agricultural Economics*, *91*(2), 310-321. https://doi.org/10.1111/j.1467-8276.2008.01239.x

Buzby, J. C. (2003). *International trade and food safety: Economic theory and case studies*. Agricultural Economic Report No. 828. Economic Research Service, USDA, November 2003.

Ferro, E., Otsuki, T., & Wilson, J. (2015). The effect of product standards on agricultural exports. *Food Policy*, *50*(C), 68-79. https://doi.org/10.1016/j.foodpol.2014.10.016

Fiankor, D. D. D., Haase, O. K., & Brümmer, B. (2021). The heterogeneous effects of standards on agricultural trade flows. *Journal of Agricultural Economics*, *72*(1), 25-46. https://doi.org/10.1111/1477-9552.12405

Food and Agriculture Organization of the United Nations & World Trade Organization. (2017). *Trade and food standards*. United Nations: Food and Agriculture Organization.

Fortune Business Insights. (2023). *Market research report, food service market size*. Share & COVID-19 Impact Analysis and Regional Forecast, 2023-2030. Report ID: FBI106277.

Ministry of Agriculture Food and Rural Affairs of Republic of Korea & Korea Agro-Fisheries & Food Trade Corporation. (2023). *Agriculture and forestry export & import statistics, 2022*. Korea: Food and Rural Affairs of Republic of Korea & Korea Agro-Fisheries & Food Trade Corporation.

Otsuki, T., Wilson, J. S., & Sewadeh, M. (2001). Saving two in a billion: Quantifying the trade effect of European food safety standards on African exports. *Food Policy*, *26*(5), 495-514.

Swinnen, J., Vandemoortele, T., & Deconinck, K. (2015). *Quality standards, value chains, and international development: Economic and political theory*. Cambridge: Cambridge University Press.

Wilson, J., & Otsuki, T. (2001). *Global trade and food safety: Winners and losers in a fragmented system. The world bank*. Retrieved from http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-2689

World Bank. (2023). *World development indicators*. NW Washington, USA: The World Bank. https://datatopics.worldbank.org/world-development-indicators.