

Pet Food Industry Development Forecast: Trend Analysis and New Perspectives on Strategic Planning

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ABSTRACT

China's pet industry has experienced significant growth; however, disparities in the development of cats and dogs over the past five years, as well as core driving factors, remain to be clarified. Future trends over the next three years require forecasting to clarify market structure. Development paths in core overseas markets like Europe and the US influence the global landscape, and gaps in relevant analysis and forecasting constrain China's industry internationalization. The expansion of China's pet food industry in both production and exports necessitates analyzing the current landscape by integrating global demand trends with China's production capacity advantages. By filtering out short-term policy fluctuations, we can forecast production and export trends over the next three years to identify intrinsic drivers. This industry heavily relies on overseas markets, with policy shifts in Europe and the United States impacting exports. However, it lacks quantitative analysis of policy impacts and corresponding countermeasures, resulting in insufficient risk resilience. Therefore, it is essential to rely on industry white papers and reliable data, leveraging mathematical models to solve problems and provide decision-making support for China's pet industry—particularly the food sector.

KEYWORDS

Moving Average(MA); Autoregressive Model(AR); ARIMA model; Quantitative analysis model

1 Introduction

Driven by rapid economic growth and rising per capita income, evolving modern consumption patterns have fueled the global rise of the pet industry. The establishment of the China Small Animal Protection Association in 1992 marked the awakening of domestic pet protection awareness. The following year, international brands like Royal Canin and Mars entered China, introducing advanced concepts and products while popularizing the idea of "companion pets." This catalyzed the emergence of a vast and rapidly expanding market. Based on industry white papers and supplementary data, analyzing industry trends and demands while formulating strategic recommendations in light of the economic environment has become crucial for supporting the sustainable development of China's pet industry.

The four core issues requiring immediate attention are interconnected: China's pet industry has experienced significant growth in recent years, but it is essential to first systematically analyze the developmental disparities and key drivers across different pet categories over the past five years, and scientifically forecast trends for the next three years to clarify the structural characteristics of the domestic market. As the core markets of the global pet industry, Europe and the United States shape the global landscape through their development trajectories, pet preferences, and evolving food demands. The absence of analysis in this dimension and forecasts for pet food demand over the next three years will constrain China's international industrial expansion. Therefore, after clarifying the domestic market, further research into the global market is essential. Pet food constitutes the core segment of the pet industry. China's pet food sector has seen continuous expansion in both production and export volumes. To analyze its current status, it is essential to integrate global demand trends with domestic competitive advantages. Future production and export trajectories over the next three years should be forecasted by filtering out short-term policy disruptions. This analysis must be grounded in a comprehensive understanding of both domestic and international markets. Furthermore, as this industry is highly dependent on overseas markets, policy changes such as tariff adjustments and trade barriers in Europe and the United States have become critical factors affecting exports. The lack of quantitative analysis on policy impacts and corresponding countermeasures has resulted in inadequate risk management capabilities, necessitating further solutions based on the aforementioned industry analysis.

Existing research has significant shortcomings and is insufficient to support the resolution of the aforementioned issues. At the domestic level, the 2022 industry white paper and the 2023 China Pet Industry Development Report merely describe pet numbers without quantifying the driving factors. The ARIMA model by Zhou Xiaoli et al.^[1] and the MA model by Li Linghui et al.^[2] were applied individually without optimizing for "multiple factors with limited samples" error. At the global level, the multiple regression model by Mari Palta et al.^[3] focused on European and American samples while neglecting emerging markets, failed to establish a spatial relationship between GDP and pet density, and overlooked nonlinear trends. The ARIMA model by Michael Sack Elmaleh et al.^[4] did not account for core factors, limiting its guidance value. At the industry and risk levels, Mäntysaari, Esa A et al.'s linear regression^[5] did not account for non-linear growth.

Most studies failed to exclude policy interference and did not use R^2 to validate the fit. Anna John noted that risk response research tends to be qualitative ^[6], lacking quantification of tariff impacts, and suggested that recommendations lack practical applicability.

Future solutions will address the fragmented analysis, inadequate model adaptation, and disjointed strategies present in existing research. This paper will construct an integrated “domestic-global-industry-risk” framework, employing methods such as Spearman's correlation coefficient to fill gaps. It aims to provide decision support for the healthy development, trend identification, and risk management of China's pet industry, particularly its food sector.

2 Method

2.1 Review of the Domestic Development of China's Pet Industry and Forecast of Future Trends

The establishment of the China Small Animal Protection Association in 1992 and the entry of international pet brands in 1993 mark the industry's inception. Against the backdrop of the growing popularity of the “pet companionship” concept, and based on industry white papers and collected data, pets are categorized into five types including cats and dogs. After compiling and preprocessing the numbers from the past five years, an analysis has been conducted to preliminarily outline the industry's trajectory. Subsequently, the Spearman coefficient method was employed to address shortcomings in quantitative analysis, identifying five core factors. After comparing MA, AR, and ARIMA models, the ARIMA model with the smallest error was selected to forecast future three-year development. The differenced autoregressive moving average model incorporates a differencing component. Differencing eliminates the non-stationarity of the time series, thereby ensuring that the mean and variance remain constant over time. $(1-B)^d$; Self-Regression Component

$(1-\phi_1B-\phi_2B^2-\dots-\phi_pB^p)$ Moving Average Section

$(1+\theta_1B-\theta_2B^2+\dots+\theta_qB^q)$ ARIMA(p,d,q)represented as:

$$(1-\phi_1B-\phi_2B^2-\dots-\phi_pB^p)(1-B)^d y_{ij} = (1+\theta_1B+\theta_2B^2+\dots+\theta_qB^q)\epsilon_{ij} \quad (1)$$

B for the back operator: $By_{ij}=y_{i(t-1)}$. For this forecasting problem, we know the time series is stationary, so we can use the ARIMA(1,0,1) model, expressed as follows:

$$(1-\phi_1B)y_{ij}=(1+\theta_1B)\epsilon_{ij} \quad (2)$$

unfold:

$$y_{ij}-\phi_1 y_{i(t-1)}=\epsilon_{ij}+\theta_1 \epsilon_{i(t-1)} \quad (3)$$

where: y_{ij} is the predicted value for the i -th factor in the j -th year

2.2 Global Pet Industry Mapping and Future Pet Food Demand Projections

For global pet food demand forecasting, we first leverage the strong correlation between GDP and the pet industry. Using a three-dimensional visualization of global GDP distribution, we map pet population density across economically active regions, such as Europe, America, and East Asia. Next, we select four representative countries—China, the United States, France, and Germany—to calculate the Spearman correlation coefficients between pet food demand and cat/dog populations using Spearman's rho. Combining these coefficients with each country's share of global GDP yields weighted coefficients ($j=1,2,3,4$). This forms the basis for constructing a multiple linear regression model for global pet food demand. to project global pet food demand trends over the next three years. This provides data support for China's pet food industry to integrate with global markets and formulate internationalization strategies.

The specific formula is as follows:

$$y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_4 x_{i4} \quad (4)$$

Among them:

$$\beta_2 = \mu_1 * GDP(\text{Percentage share}) \quad (5)$$

Annual global demand for pet food. ($j=1,2,3,4$) Annual demand for pet food in various countries (where i represents the year and j represents four different countries).

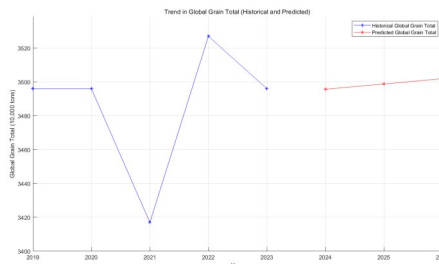


Figure 1 Global Pet Food Demand Forecast

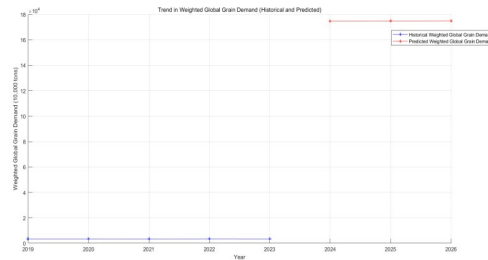


Figure 2 Weighted Analysis of Global Pet Food Demand Forecast

2.3 Dual-Dimensional Forecast of China's Pet Food Industry Trends for the Next Three Years

Leveraging global demand forecasts and analyzing China's domestic market, we focus on the pet food industry. Internationally, we closely track global demand growth trends. Domestically, we build upon the foundation of rising GDP and increasing industry share, filtering out short-term policy disruptions. Employing a quadratic fitting model with time as the independent variable and production value and export value as dependent variables, we validate accuracy through the coefficient of determination. This enables precise forecasting of the next three years' trajectory, clarifies the industry's endogenous growth path, and provides fundamental support for navigating external policy risks. We utilize the general formula of the quadratic fitting function:

$$y=ax^2+bx+c \quad (6)$$

Using time as the independent variable x and China's total pet production value and total export value as the dependent variable y , construct a quadratic fitting function ($y = ax^2 + bx + c$). By minimizing the sum of squared errors, take partial derivatives of a , b , and c and set them to zero to solve for the optimal coefficients, thereby determining the fitting function.

2.4 Impact of Western Economic Policies and Sustainable Development Strategies for China's Pet Food Industry

As the final implementation phase of the research, we focus on the core external variable of external economic policies—such as tariffs in Europe and the United States—given the Chinese pet food industry's high dependence on overseas markets. By constructing an income function (linking prices, tariff rates, and market demand), a cost function (connecting production scale and cost structure), and a profit function, we quantify the impact of tariff fluctuations on the economic benefits of China's pet food industry in overseas markets. Building upon this foundation and integrating prior research, we propose strategies for optimizing product lines and expanding distribution channels from dimensions such as market positioning and product upgrades. These measures assist the industry in navigating policy challenges and achieving stable global development. We have developed a quantitative analysis model for tariff impacts on China's pet food sector. Through the revenue function, we can determine the effects of price, tariff rate, and demand volume on revenue. The revenue function is expressed as:

$$R=P*(1-T)*D \quad (7)$$

The cost function reflects the relationship between cost and output. Since cost increases as output rises, the two exhibit a linear relationship. Therefore, the cost function is expressed as:

$$C=f(P) \quad (8)$$

The profit function enables the assessment of profitability within China's pet food industry while quantifying the impact of factors such as price, tariff rates, and demand volume on profits. The profit function is expressed as:

$$\Pi=R-C \quad (9)$$

Table 1

Parameters	Variable
P	Total production of pet food in China
E	Exports of Chinese pet food to European and American countries
C	Production costs of Chinese pet food
R	Revenue from Chinese pet food
T	Tariff rates imposed by European and American countries on Chinese pet food
D	Demand for Chinese pet food in European and American markets
FC	Fixed costs
VC	Variable costs

In summary, this quantitative analysis model leverages revenue, cost, and profit functions to comprehensively analyze the economic landscape of China's pet food industry, covering dimensions such as market demand, cost structure, and profitability.

3 Experiment

3.1 Data Processing

Experimental Environment. The hardware for this experiment consists of a 64-bit system and an x64 architecture computer equipped with an i7-1360P processor, meeting data computation requirements. MATLAB software supports the entire process of data processing, modeling, and result visualization, covering the full experimental workflow.

Basic Data Processing. The dataset is based on cat and dog data from 2019 to 2023, expanded to include six categories of pet data and supplemented with data from 2010 to 2023, analyzed using MATLAB. Concurrently, we processed the data: multi-dimensional data was consolidated by category and standardized to $[0, 1]$, while small samples with anomalies or missing values were handled using the mean substitution method.

Specialized Data Analysis. We employed Spearman's correlation coefficient to identify five key factors including GDP, calculated the correlation coefficients between food demand and pet ownership in China, France, Germany, and the United States, determined weights based on each country's GDP share, and projected global demand forecasts through multiple regression analysis. For these five key factors, we applied MA, AR, and ARIMA models for forecasting, calculated relative errors and average relative errors for each model, and selected the optimal model through comparison. We correlated global GDP with pet numbers, using MATLAB to plot a 3D graph depicting distribution density. For forecasting China's pet food production and exports, we extracted data from 2019 to 2023, integrated GDP growth rates and industry share data for the same period, and evaluated quadratic fitting models using R^2 . We maintained accuracy by setting the coefficient to the minimum sum of squared errors.

3.2 Predicted Core Metrics for China's Pet Industry Over the Next Three Years Based on Multi-Model Comparison and Optimization

Based on the AR, MA, and ARIMA models, the prediction results were visualized to derive comparative outcomes:

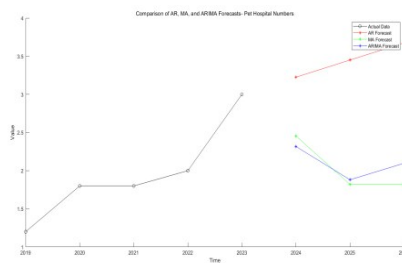


Figure 3 Predicted Number of Pet Hospitals by Three Models

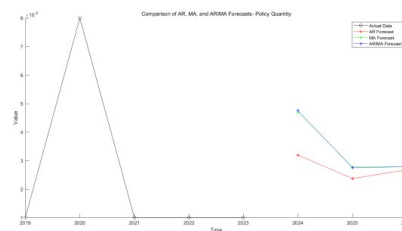


Figure 4 Policy Quantity Forecast Results from Three Models

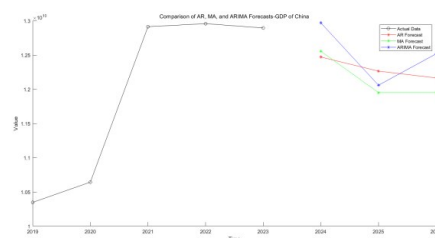


Figure 5 GDP Forecast Results from Three Models

After data processing, the ARIMA model demonstrated the smallest relative error among the AR, MA, and ARIMA models, delivering the most accurate and reliable predictions. Its forecasts for five key factors indicate: select indicators will experience a slight decline in 2025 before rebounding in 2026. GDP will stabilize after a dip, exhibiting short-term volatility alongside long-term growth, highlighting the industry's resilience and potential.

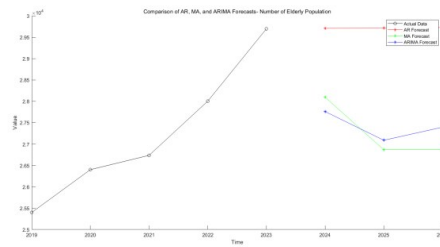


Figure 6 Projected Elderly Population by Three Models

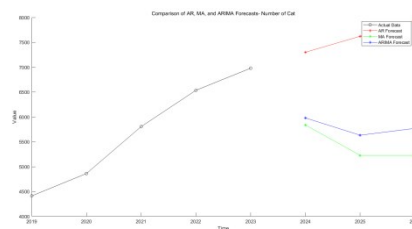


Figure 7 Predicted cat population results from the three models

3.3 Projected Rapid Growth in the Global Pet Food Market Over the Next Three Years Based on Dual-Dimensional Chart Analysis

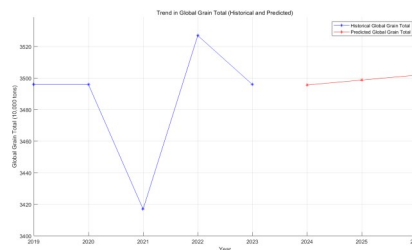


Figure 8 Global Pet Food Demand Forecast

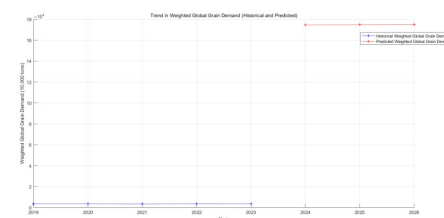


Figure 9 Weighted Analysis of Global Pet Food Demand Forecast

In the unweighted chart, demand for cat and dog products shows a steady annual increase from 2024 to 2026, presenting investment and innovation opportunities. In the weighted chart, demand remains stable from 2019 to 2023, with a significant projected rise starting in 2024. Overall, demand is expected to grow rapidly over the next three years.

3.4 Forecast of Rapid Expansion Trends in China's Pet Food Production and Exports Over the Next Three Years

Overall, production history shows slight fluctuations but a long-term upward trend, while exports initially declined but later resumed growth. During the forecast period, both will expand rapidly, with exports projected to grow at a more

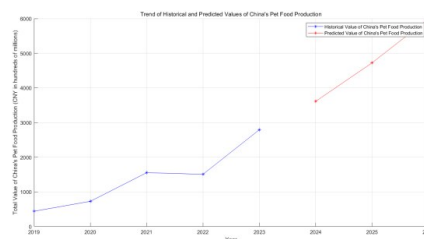


Figure 10 Forecast of China's Pet Food Production Value

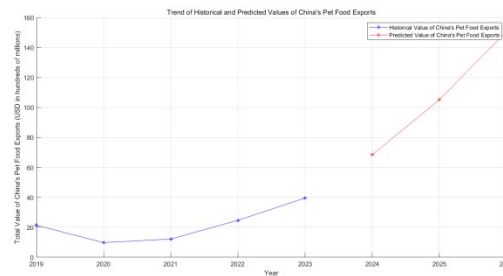


Figure 11 Forecast of China's Pet Food Export Value

vigorous pace.

3.5 Strategic Planning for China's Pet Food Industry to Adapt to Transformation, Internationalization, and Tariff Responses

Historical data analysis reveals that China's pet industry has undergone a diversification trend over the past five years. Rising living standards have expanded consumer perceptions of pets beyond traditional cats and dogs to include niche animals, requiring businesses to optimize product lines to align with this shift.

Regarding global demand forecasting and the internationalization of Chinese products, three-dimensional visualization and multiple linear regression models predict global pet food demand. This rapid growth stems from rising global pet ownership and increased pet owners' focus on pet health, with pet food markets expanding in both developed Western economies and emerging economies. Chinese enterprises must pursue multidimensional internationalization strategies: First, strengthen brand building through international exhibitions and event sponsorships to enhance brand recognition and reputation. Second, expand distribution channels by partnering with international retail chains and leveraging cross-border e-commerce to increase market share and reduce costs.

For forecasting China's production and exports while addressing European and American tariffs, a quadratic fitting function predicts China's pet food production and export scale based on global demand growth and rising GDP. China's GDP growth will stimulate pet consumption, while technological advancements and supply chain improvements enhance international competitiveness. Enterprises should increase production investments and strengthen international logistics partnerships. Europe and the US remain key export markets, where tariff fluctuations directly impact Chinese companies' costs and competitiveness. Imposing high tariffs would diminish the price competitiveness of Chinese products, potentially reducing sales volume and market share.

4 Discussion

This study follows a logical framework of "local trends—global demand—industry forecasting—risk mitigation": First, it analyzes disparities in China's pet industry over the past five years, identifies core factors using Spearman's correlation coefficient, and forecasts local trends via ARIMA models (after comparing errors from MA and AR models). Next, it maps global GDP patterns and employs multiple regression analysis for China, the US, France, and Germany to predict global pet food demand. Subsequently, a quadratic fitting model (with a coefficient of determination near 1) forecasts industrial production and exports. Finally, an economic model quantifies risks and proposes strategies regarding EU-US tariffs.

Strengths include a logically progressive framework, scientifically validated models, intuitive data presentation, and practical focus. Weaknesses involve limited sample coverage in some models, incomplete variable consideration, insufficient policy analysis depth, and room for improvement in data timeliness and supplementation. While offering practical reference value, the study remains open to optimization.

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