Forecasting the import and export values in Turkish livestock sector with ATA analysis

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ABSTRACT

Unlike traditional time-series methods, the ATA analysis method developed in recent years dynamically adjusts the smoothing parameters according to the sample size. This study aimed to estimate the export and import values of live animals and livestock products for the next five years (2024-2028) using the ATA method, based on the values from the previous years (2014-2023) in Türkiye. The study material consisted of export and import values (in dollars) of the "live animals," "meat/meat products," "milk/milk products + eggs" and "fish and other seafood" categories in Türkiye between 2014 and 2023. The Turkish Statistical Institute's records, divided into the aforementioned categories and presented in four annual quarters, provided the study data. The ATA method, which is a simple, highly accurate, and automatic forecasting method, was used for data modeling. According to the study findings, it was estimated that the import values of "live animals," "meat/meat products," "milk/milk products + eggs," and "fish and other seafood" may be a total of approximately $1.4 billion, $172 million, $157 million, and $300 million, respectively, whereas the export value of the same products may reach $113 million, $1.3 billion, $866 million, and $2 billion, respectively, in 2028. In conclusion, the ATA analysis method can be used to reveal a perspective in the coming years in terms of foreign trade in the livestock sector, but it should be updated constantly. It has been concluded that such studies can guide policymakers in the country in developing necessary strategies in foreign trade for the future.

Introduction

The livestock sector has an important role in people's healthy and balanced nutrition, meeting their basic biological needs, economic and social development, and increasing their level of welfare (19). The World Health Organization (WHO) recommends that animal proteins should account for at least 40% of a healthy person's daily protein intake per kilogram of body weight (16). Reports indicate that the average animal protein ratio is 64% in the USA, 58% in the EU, 39% globally, 36% in Turkey, and 23% in Africa (5, 11).

Türkiye is among the countries most suitable for animal husbandry because of the existence of pasture areas and fertile lands. The share of agriculture, forestry, and animal husbandry in the country's total GDP is approximately 6.5% (7). The number of cattle and sheep in Türkiye has generally increased by 15–35%, respectively, over the last decade, and this has also been reflected in production (6, 10). However, we should aim to increase the milk and carcass productivity per animal to the level of developed countries. For this purpose, it is crucial to select the appropriate breeds for the production

area, provide the breeds with appropriate care and feeding conditions, create markets, and raise the awareness of producers. Low levels of productivity per unit animal prevent sustainability in production and reduce profitability. Problems in livestock production cause difficulties in meeting the demand for livestock products, a decrease in exports of animals and livestock products, and a decrease in income. The inability to meet the total market demand due to low productivity per animal and the gradual increase in production costs in the domestic market will make imports attractive in the country and increase the foreign trade deficit. In recent years, factors such as climate change, drought in crop production that provides raw materials for animal husbandry, irregular rainfall regimes in some regions, and increases in exchange rates have caused both an increase in input costs in the sector and a decrease in competitiveness in international markets. However, Türkiye, like other developed countries, should decrease its imports of live animals and livestock products while increasing its exports. Increasing export values, as long as they meet domestic demand, can ensure economic growth for countries. Conversely, if import values exceed exports, it can lead to a foreign trade deficit and a contraction of the economy.

Given this information, the time-series analyses employed in the current study play a crucial role in forecasting the future, planning for the country's needs, and making informed investment decisions. Time-series analyses are a set of econometric analyses that enable the analysis of past and present data to reveal future data (6, 10). In contrast to traditional methods, the updated ATA method, a time-series analysis, dynamically adjusts the smoothing parameters according to the sample size and streamlines the initialization process by fine-tuning the parameters. However, the literature review found no studies using the ATA method in animal husbandry in Türkiye, despite its application in various fields (4, 15). Therefore, we conducted this study to estimate the export and import values of live animals and livestock products for the next five years (2024-2028) using the ATA method, a time series analysis, and the values from the previous years (2014-2023) in Türkiye.

Materials and Methods

The study material consisted of export and import values (in dollars) of the "live animals," "meat/meat products," "milk/milk products + eggs," and "fish and other seafood" categories in Türkiye between 2014 and 2023. We obtained the export and import values (in dollars) for the "live animals," "meat/meat products," "milk/milk products + eggs," and "fish and other seafood" categories from the records of the Turkish Statistical Institute (18) and grouped them into 4 annual quarters (1st quarter: January, February, March; 2nd quarter: April, May, June; 3rd quarter: July, August, September; 4th quarter: October, November, December) in Türkiye between 2014 and 2023. We modeled the official export and import values (in $) as time-series data, and obtained monthly forecasts for the next five years (2024-2028) by examining past behavior. We used the ATA method, a simple, highly accurate, and automatic forecasting method, in the modelling phase. The ATA method represents an innovative approach to forecasting that draws inspiration from exponential smoothing models. What distinguishes ATA is its adaptive nature, where smoothing parameters dynamically adjust based on the sample size. Unlike conventional methods, ATA fine-tunes parameters within a discrete space, simplifying the initialization process. Through simultaneous optimization and initialization, ATA minimizes the influence of initial values by rapidly converging toward zero weights, thereby ensuring robust forecasting outcomes. ATA's versatility across all-time series settings translates to superior forecasting performance, thanks to its inherent flexibility [1, 2, 3, 4]. The following paragraphs will explain the intricacies of the ATA method, including its formula and application nuances.

For a time series $\{y_1, \dots y_n\}$ ATA method can be given in additive form as below:

$$l_t = \left(\frac{p}{t}\right) y_t + \left(\frac{t-p}{t}\right)(l_{t-1} + \emptyset b_{t-1}),$$

$$b_t = \left(\frac{q}{t}\right)(l_t - l_{t-1}) + \left(\frac{t-q}{t}\right)(\emptyset b_{t-1}),$$

where p is the smoothing parameter for level, q is the smoothing parameter for trend, $\emptyset$ is the dampening parameter and $l_t = y_t$ for $t \leq p$, $b_t = y_t - y_{t-1}$ for $t \leq q$, $b_1 = 0$, $p \in \{1,2,\dots,n\}$, $q \in \{0,1,2,\dots,p\}$, $\emptyset \in (0,1]$. Then, the h step ahead forecasts can be obtained by:

$$\hat{y}_{t+h|t} = l_t + (\emptyset + \emptyset^2 + \cdots + \emptyset^h) b_t.$$

The method require three parameters we will distinguish between them by using the notation $ATA_{add}(p, q, \emptyset)$ for the additive form.

Notice that when $q = 0$ both forms of ATA are reduced to the simple form $ATA(p, 0, \emptyset)$ which can be written as:

$$l_t = \left(\frac{p}{t}\right) y_t + \left(\frac{t-p}{t}\right) l_{t-1},$$

where $p \in \{1,2,\dots,n\}$ and $l_t = y_t$ for $t \leq p$. Forecasts then can be obtained by $\hat{y}_{t+h|t} = l_t$.

When $q \neq 0$ and $\emptyset = 1$ the additive form of ATA are reduced to the trended versions $ATA_{add}(p, q, 1)$ which is given below respectively:

$$l_t = \left(\frac{p}{t}\right) y_t + \left(\frac{t-p}{t}\right)(l_{t-1} + b_{t-1}),$$

$$b_t = \left(\frac{q}{t}\right)(l_t - l_{t-1}) + \left(\frac{t-q}{t}\right)(b_{t-1}),$$

$$\hat{y}_{t+h|t} = l_t + h b_t ,$$

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To sum up, ATA can be given in 3 forms, namely the additive damped form $ATA_{add}(p,q,\emptyset)$ (equations (1.1)-(1.3)), simple form $ATA(p,0,\emptyset)$ (equation (2.1)), additive trend form $ATA_{add}(p,q,1)$ (equations ((3.1)-(3.3)) (20).

In this study, we implemented the holdout version of the ATA method. The holdout sample method allows for the fitting of models at one epoch, distinct from the epoch of assessment. The method divides the in-sample data into a training set and a validation set, also known as the holdout set, and optimizes the parameters using the training set. We then compute multi-step forecasts for the holdout sample period and evaluate the models based on the accuracy of these out-of-sample forecasts. We select and refit the model that best fits the holdout sample using all available data to obtain the final forecasting model. The ATA forecasting package facilitates the use of the holdout sample method for model selection, allowing independent control over the time range used for model fitting and evaluation. You can use automatic model selection to select the model that provides the most accurate out-of-sample forecasts for the holdout sample.

Results

Tables 1-4 and the time series graphs in Figures 1 and 2 provide the export and import values of live animals and livestock products used in the study for the years 2014–2023.

The import values of live animals and livestock products (meat/meat products, milk products + eggs, fish, and other seafood) showed a fluctuating (up-and-down) course in Türkiye between 2014 and 2023. An upward trend in live animal imports began again in 2023. The annual total import values of milk/milk products and eggs reached their peak in 2014, whereas the annual total import values of meat/meat products reached their peak in 2023. Imports of meat/meat products showed a decreasing trend in the last quarter of 2023, while imports of live animals, milk/milk products + eggs, fish, and other seafood showed an increasing trend. In general, during the examined period (2014-2023), total annual imports of live animals, meat/meat products, fish, and other seafood increased by 755%, 67.4%, and 34.8%, respectively, while imports of milk/milk products and eggs decreased by 24.1%.

The export values of live animals and livestock products (meat/meat products, milk/milk products + eggs, fish, and other seafood) in Türkiye between 2014 and 2023 showed a fluctuating trend, similar to the import values. In addition, the annual total export values of live animals, meat/meat products, milk/milk products + eggs, and fish and other seafood in 2023 increased by 142.2%, 14.5%, 1.7%, and 150.7%, respectively, compared to the total annual export values of 2014 (Table 1-4; Figure 1-2).

Table 1. Türkiye's live animal export and import values (000 $).

Live Animals	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2014	1.614	17.127	2.647	8.002	2.454	11.502	2.191	11.377	26.720	139.891
2015	3.037	10.782	2.011	17.101	3.263	31.426	3.180	51.247	34.473	322.768
2016	2.850	39.800	1.559	43.394	2.252	79.569	2.644	60.320	27.914	603.822
2017	2.475	57.821	2.940	124.986	2.182	78.051	3.961	143.162	34.673	1.212.194
2018	4.205	138.555	5.139	156.183	5.260	211.554	4.719	129.700	57.966	1.767.909
2019	6.012	58.538	6.288	50.316	9.509	99.714	6.395	60.576	84.612	700.574
2020	6.310	43.884	3.299	18.742	8.148	21.853	10.045	63.233	83.406	446.859
2021	6.876	41.585	9.031	17.253	8.606	42.193	10.862	20.554	106.121	310.235
2022	14.464	15.299	5.836	9.564	9.211	13.499	13.491	28.646	129.006	180.905
2023	7.122	55.503	5.178	70.360	3.859	128.717	5.414	156.184	64.719	1.195.977

Table 2. Türkiye's meat and meat products export and import values (000 $).

Meat and Meat Prod.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2014	72.968	18.954	77.459	23.215	76.055	12.710	70.955	17.423	892.311	216.908
2015	57.031	4.866	35.884	8.862	42.933	15.560	37.678	20.053	520.578	148.023
2016	31.290	3.553	37.361	9.095	36.851	9.714	45.671	11.240	453.518	100.808
2017	45.722	9.274	49.727	4.505	61.096	6.408	62.626	33.012	657.512	159.597
2018	50.743	28.284	55.255	34.200	61.488	23.192	69.257	22.860	710.230	325.609
2019	53.950	9.985	63.241	8.896	62.177	4.255	60.439	6.658	719.421	89.384
2020	57.123	7.116	53.949	5.667	50.403	5.111	55.060	7.435	649.605	75.989
2021	54.978	4.543	81.512	5.769	89.838	8.313	105.310	7.618	994.912	78.726
2022	102.888	9.587	118.309	14.747	106.993	14.302	108.759	9.752	1.310.847	145.164
2023	76.348	10.329	81.598	17.115	89.070	50.194	93.698	43.372	1.022.142	363.031

Table 3. Türkiye's milk, milk products and eggs export and import values (000 $).

Milk, Milk Prod. and Egg	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2014	76.134	14.440	67.351	19.995	58.856	18.792	60.638	25.223	788.941	235.350
2015	57.843	12.892	45.038	13.292	43.080	11.230	47.506	18.737	580.402	168.452
2016	46.631	13.335	51.918	12.498	56.318	10.030	62.023	12.449	650.671	144.934
2017	64.228	6.578	57.063	10.259	63.833	14.659	62.759	19.609	743.649	153.313
2018	66.723	17.336	63.304	15.599	63.320	8.501	73.742	11.322	801.265	158.273
2019	70.940	9.110	59.089	12.211	50.956	11.278	54.467	18.842	706.353	154.324
2020	51.289	9.188	45.841	10.837	51.614	12.816	61.075	9.500	629.458	127.023
2021	59.479	9.747	81.138	8.567	70.175	8.688	83.397	11.937	882.565	116.820
2022	97.746	9.969	90.095	10.923	74.929	8.394	72.767	17.569	1.006.608	140.564
2023	63.122	12.495	66.802	13.138	62.736	11.802	74.867	22.160	802.579	178.783

Table 4. Türkiye's fish and other seafood export and import values (000 $).

Fish and Other Seafood	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2014	58.507	15.071	55.872	15.277	53.742	20.350	59.566	21.718	683.061	217.246
2015	60.533	20.151	57.956	18.873	52.346	21.489	61.400	27.171	696.706	263.050
2016	66.546	19.560	64.451	11.751	61.302	12.784	70.820	19.048	789.357	189.426
2017	68.074	15.332	68.227	16.016	68.993	18.930	79.826	28.744	855.358	237.065
2018	78.182	19.122	83.854	15.713	73.908	13.224	81.503	18.211	952.340	198.812
2019	92.273	12.054	81.742	13.743	80.986	17.520	84.137	23.081	1.017.413	199.194
2020	85.761	15.482	70.907	10.390	89.166	11.906	108.568	16.844	1.063.203	163.866
2021	104.102	17.158	115.077	12.966	114.052	18.275	125.107	25.774	1.375.012	222.519
2022	130.797	20.930	136.555	25.220	147.098	27.457	137.356	34.468	1.655.420	324.224
2023	142.410	25.878	144.691	21.857	147.931	21.973	135.835	27.930	1.712.599	292.917

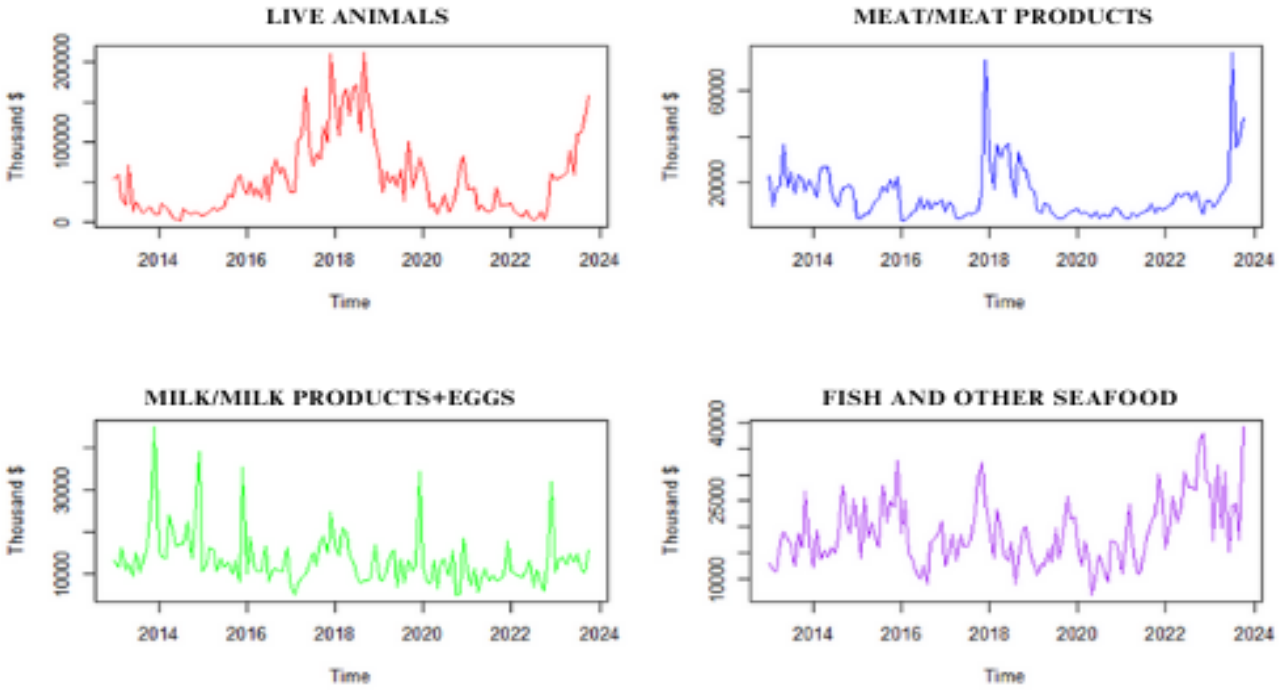

Figure 1. Graph of import values of live animals, meat/meat products, milk/milk products+eggs, fish and other seafood (2014-2023)

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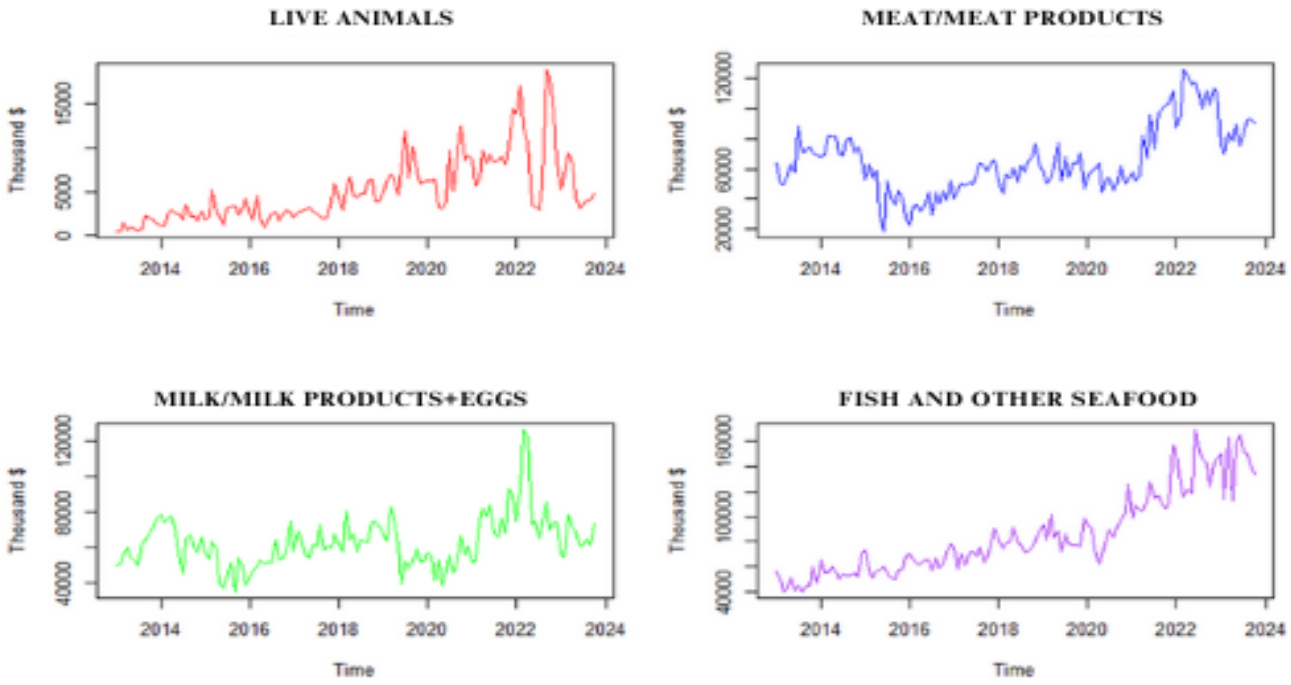

Figure 2. Graph of export values of live animals, meat/meat products, milk/milk products+eggs, fish and other seafood (2014-2023)

This study applied data sets of the ATA method to prospectively estimate the export and import values of live animals and livestock products. In the present study, the simple ATA model (Model 1), expressed as ATA (p,0,∅), and the linear trend model (Model 2), expressed as 〚 ATA_add^ (p,1,1), were used, and trend behavior was modeled additively. We utilized import and export data from eight distinct previous periods (2014-2023) pertaining to live animals and livestock products in these two ATA models (2), which excel at modeling the data set. Table 5 presents the accuracy measures of the models for the trained data.

Table 6 provides the sMAPE accuracy measure values of the test data.

Upon examination of the tables, we observed a consistent behavior between the accuracy measures of the trained data and the accuracy measures of the test data. This shows that there are no problems such as overfitting, and thus it is a good forecasting model (Tables 5, 6).

We obtained the forecasting values for the next 5 years (2024-2028) using the entire data set, which includes monthly (in 4 quarters) import and export data between 2014 and 2023, and estimated the model parameters at the holdout stage. We applied the forecasting combination, a method that significantly enhances model performance, to the forecast values derived from these two ATA models (3). To put it another way, we obtained the final values by taking the simple average of the 5-year forecasting values from both methods, as shown in Figure 3-4 and Table 7-10.

The present study, which analyzed data from the past 10 years in Türkiye and forecasted data for the next 5 years, estimated that live animal import values would reach approximately $1.4 billion in 2028, while export values would rise to $113 million. The study estimated a gradual increase in the foreign trade deficit in live animals over the next 5 years, with a potential difference of approximately $1.3 billion favoring imports over exports (Table 7).

We estimated that the import values of meat and meat products in Türkiye between 2024 and 2028 would show a decreasing trend in the next 5 years, potentially dropping to approximately $172 million in 2028. The export value of these products would reach approximately $1.3 billion, an increase of approximately 4.9%. (Table 8).

It was estimated that the import value of milk/milk products and eggs would be around $156-160 million in the next 5 years in Türkiye. The export values in this product group may exceed imports and reach levels of $820-866 million (Table 9).

Research indicates that in the next 5 years, export values in fish and other seafood, similar to the milk/milk products + egg group, will surpass imports. The total export data of fish and other seafood may increase to $2 billion and import data to approximately $300 million in 2028. We forecasted that there would be no foreign trade deficit in fish and other seafood, with export figures remaining above import figures for the next 5 years (Table 10).

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Table 5. Accuracy measures of trained data

	Data	Accuracy Measures	Model 1	Model 2
Import	**Live animals**	**MSE**	692,190,805	703,863,919
	Meat/meat products		144,884,775	155,754,727
	Milk/milk products+egg		20,788,670	22,218,132
	Fish and other seafood		32,070,514	45,302,164
Export	**Live animals**		5,435,202	7,041,579
	Meat/meat products		119,523,659	124,459,006
	Milk/milk products+egg		179,468,848	152,995,612
	Fish and other seafood		121,887,742	122,205,122
Import	**Live animals**	**MAE**	19,673	20,353
	Meat/meat products		7,693	7,733
	Milk/milk products+egg		3,647	3,762
	Fish and other seafood		4,437	5,662
Export	**Live animals**		1,604	1,876
	Meat/meat products		8,560	8,688
	Milk/milk products+egg		10,074	9,092
	Fish and other seafood		8,083	8,110
Import	**Live animals**	**sMAPE**	52.73	53.85
	Meat/meat products		50.66	54.59
	Milk/milk products+egg		27.83	28.64
	Fish and other seafood		23.50	29.29
Export	**Live animals**		32.24	39.72
	Meat/meat products		14.36	14.63
	Milk/milk products+egg		16.03	14.35
	Fish and other seafood		9.80	9.90
Import	**Live animals**	**MASE**	0.49	0.50
	Meat/meat products		0.69	0.70
	Milk/milk products+egg		0.62	0.63
	Fish and other seafood		0.61	0.78
Export	**Live animals**		0.67	0.78
	Meat/meat products		0.38	0.39
	Milk/milk products+egg		0.54	0.49
	Fish and other seafood		0.51	0.51

Table 6. sMAPE accuracy measure values of test data

Models	**Import**		**Export**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Live animals	81.2	82.6	37.8	42.6
Meat/meat products	50.4	99.9	33.1	34.9
Milk/milk products+egg	20.8	22.4	24.3	14.1
Fish and other seafood	31.4	21.7	29.5	19.6

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Table 7. Estimated values of live animals export and import in Türkiye (000 $).

Live Animals	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2024	7.914	100.273	6.948	101.673	8.017	104.136	8.712	114.615	94.776	1.262.090
2025	8.301	103.230	7.335	104.523	8.404	106.986	9.099	117.465	99.415	1.296.611
2026	8.688	106.080	7.721	107.373	8.791	109.836	9.485	120.315	104.055	1.330.811
2027	9.074	108.930	8.108	110.223	9.177	112.686	9.872	123.165	108.695	1.365.012
2028	9.461	111.780	8.495	113.073	9.564	115.536	10.259	126.015	113.335	1.399.212

Table 8. Estimated values of meat and meat products export and import in Türkiye (000 $).

Meat/Meat Prod.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2024	92.910	13.271	99.114	15.193	104.378	16.094	107.398	18.783	1.211.401	190.025
2025	94.245	12.865	100.311	14.817	105.634	15.718	108.687	18.406	1.226.630	185.417
2026	95.373	12.488	101.508	14.440	106.890	15.341	109.976	18.030	1.241.239	180.897
2027	96.500	12.111	102.704	14.063	108.147	14.964	111.265	17.653	1.255.848	176.377
2028	97.628	11.735	103.901	13.687	109.403	14.588	112.554	17.277	1.270.457	171.858

Table 9. Estimated values of milk, milk products and eggs export and import in Türkiye (000 $).

Milk/milk Prod.+egg	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2024	70.215	11.663	67.388	12.885	64.824	11.881	71.093	17.117	820.561	160.641
2025	71.206	11.601	68.320	12.805	65.722	11.807	72.075	17.010	831.970	159.669
2026	72.183	11.529	69.253	12.724	66.621	11.732	73.057	16.902	843.337	158.662
2027	73.159	11.456	70.185	12.644	67.519	11.658	74.039	16.795	854.704	157.655
2028	74.136	11.383	71.118	12.563	68.417	11.583	75.020	16.687	866.071	156.648

Table 10. Estimated values of fish and other seafood export and import in Türkiye (000 $).

Fish and Other Seafood	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2024	151.113	21.799	149.370	19.780	148.754	22.157	154.700	27.796	1.811.815	274.596
2025	155.956	22.342	153.974	20.296	153.357	22.673	159.304	28.312	1.867.769	280.868
2026	160.559	22.858	158.577	20.812	157.960	23.189	163.907	28.828	1.923.007	287.059
2027	165.162	23.374	163.180	21.328	162.563	23.705	168.510	29.343	1.978.244	293.250
2028	169.765	23.890	167.783	21.844	167.166	24.221	173.113	29.859	2.033.482	299.441

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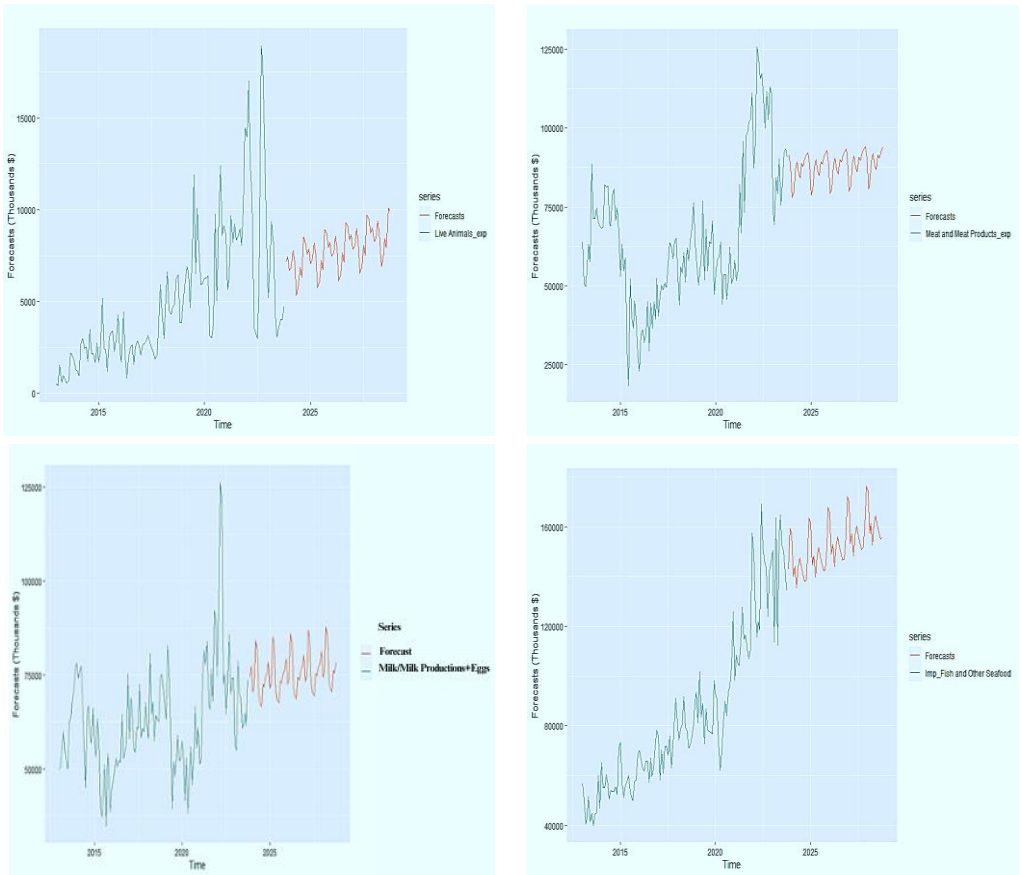

Figure 3. Estimated export values of live animals, meat/meat products, milk/milk products+eggs, fish and other seafood (2024-2028)

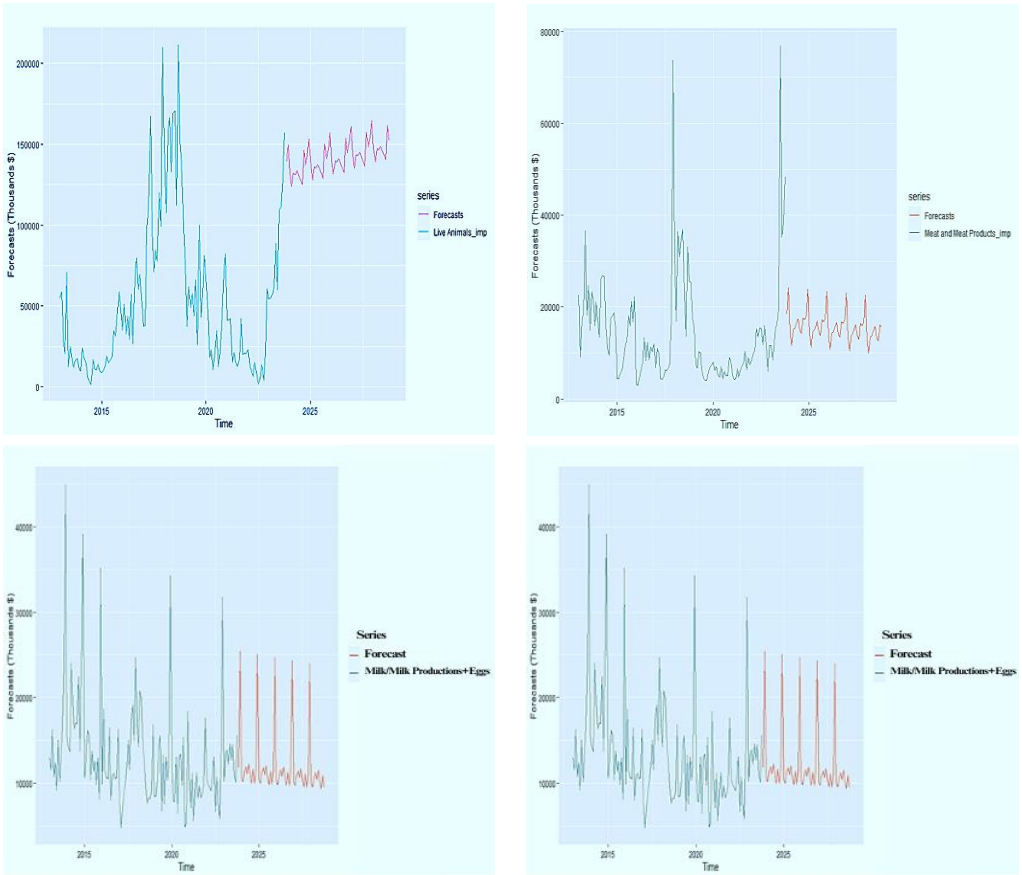

Figure 4. Estimated import values of live animals, meat/meat products, milk/milk products+eggs, fish and other seafood (2024-2028)

Discussion and Conclusion

Foreign trade has significant impacts on country economies through exports and imports. Exports generally have a positive effect (fund inflow) on country economies, whereas imports generally have a negative effect (foreign dependency, fund outflow, deterioration of the balance of payments, and increase in the foreign trade deficit) (1). However, with the right policy approaches, imports can also have positive effects on issues such as raw material supply, intermediate goods input, increasing productivity through technology transfer, and controlling inflation. In countries such as Türkiye, where there is a large population that earns their living from rural areas, the export and import amounts in the fields of agriculture and livestock significantly affect the country's economy. To be cautious and develop policies, all foreign trade relations that are experienced in this sector and are likely to be experienced in the future should be well known by sector representatives and country managers, especially producers.

Few studies have estimated the potential level of foreign trade in the agriculture-livestock sector using methods other than ATA analysis in previous years (6). However, we have not found any study that uses ATA analysis to make forward-looking forecasts of Turkey's foreign trade (exports and imports) in the livestock sector. Therefore, this study estimated possible import and export values for live animals and various livestock products in the next 5 years (2024-2028) using the ATA analysis method. Based on the current study's findings, we anticipate an increase in live animal imports over the next 5 years, while we anticipate a decrease in meat import values. It was observed that live animal imports, in particular, showed a decreasing trend after aggressive increases in every five-year period, as in the previous years, and it was estimated that they would increase in the next five years. The reasons for the general increase in live animal imports in the past decade can be listed as the population growth in the country, the increase in input costs in the domestic market, the restriction of animal movements within the country due to animal diseases and deaths (9, 13), and the emergence of inflation due to the lack of food supply as a result of inadequate meat supply (3). Estimates suggest that similar factors could sustain the imports of live animals, meat, and meat products in the upcoming years. However, the government's live animal import policies may result in a limited increase or even a slight decrease in the import of meat and meat products. We can interpret the import of cultured breeds as breeding animals to boost productivity, and this trend is likely to persist in the future, given the low productivity of local breeds. On the other hand, although no major change is expected in the exports of live animals and meat/meat products, it is anticipated that there will be a slight increase. Less appealing to the palate of ovine meat than bovine meat in Türkiye (14), preference for meat products produced in Türkiye by other countries, especially where Turkish citizens are present, good levels of poultry production in the country, and higher profits that producers can make per unit product in foreign sales (due to the depreciation of TL against the dollar) can be considered among the reasons for exports of meat and meat products despite the fact that there is a presence of demand for meat in the country. Reasons such as restrictions due to country policies, not being preferred by some countries due to the risk of transmission of diseases, high cost of animal transportation (transportation, protection, control, and quarantine costs, etc.), and live weight loss in animals due to transportation (17) may be effective in the emergence of the expectation that major changes will not occur.

Estimates suggest that milk/milk products and egg exports will not undergo major changes in the coming years, with export values not surpassing recent values, and only minor changes occurring. The reasons for this situation include the lack of a simultaneous increase in producer sales prices despite the recent increase in production costs in dairy cattle farming in the country (8), the decrease in the presence of dairy cattle in this process, and the occurrence of productivity losses (due to malnutrition). Furthermore, it's possible that raw milk, milk products, and eggs are susceptible to spoilage. Despite Türkiye's self-sufficiency in milk and milk products, the country likely imports these products in limited quantities to maintain product diversity (such as cheddar, mozzarella cheese, cream, and milk powder), with projections indicating continued imports in the near future.

Due to their abundance in Türkiye, which is surrounded by seas on three sides, export values of fish and other seafood are expected to exceed import values again. Despite the abundance of fish and other seafood in Türkiye, the primary reason for imports could be to offer a diverse range of products, such as Norwegian salmon.

As a result, the current study has shed light on the livestock sector's foreign trade outlook for the coming years. To prevent or reduce the foreign trade deficit in Türkiye, the country must lower the costs of producer inputs, enabling producers to produce more profitably, boost domestic production, transition to exports after satisfying domestic demand, and ultimately boost the country's foreign exchange income. This requires the implementation of correct and consistent policies for producer support. However, politicians must conduct a cost-benefit analysis and evaluate import decisions, taking into account the country's interests, to mitigate potential negative effects from imports. These include the emergence of diseases not found in the country, the

decline in local races, the shift away from production, and the export of the country's economic resources.

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Conflict of Interest
The authors declared that there is no conflict of interest.

Author Contributions
MK, EA, designed the research, supervision, writing, and editing. CİZ, SD, investigation, collecting the data. SS, writing, and review. MAA, HTS, analysis, writing.

Data Availability Statement
The data and materials of this study are available from the corresponding author.

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