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Forecasting of U.S. Total Textiles and Apparel Export to the World in Next 10 Years (2015-2025)

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ABSTRACT

Global textile and apparel value chain is forecast to grow at a CAGR of 5% per year and reach US$2,100bn by 2025. Increased by 8 percent, world exports of textiles and apparel in 2013 reach 766 billion dollars, which is four times higher than the average growth (2 percent) for world exports. Vietnam overtook United States and became the sixth-largest exports of textiles and apparel. However, the Free Trade Agreement greatly supports the U.S. textile and apparel industry, and is expected to impact American employment in this sector since its labor-intensive nature. Based on historical data (1989-2014), this paper will perform a forecasting of U.S. total textiles and apparel export to the world for next 10 years (2015-2025) with two forecasting models: regression model and ARIMA model. The forecasting is then adjusted by taking into account of the trend and authors' future expectations.

Keywords: Forecasting apparel exports, global value chain, regression and ARIMA models

INTRODUCTION

In textiles and apparel supply chain, leading countries such as U.S, EU and Japan focus on highest-value stages, which are designing, branding and marketing. Meanwhile, China, India and other developing countries including Bangladesh, Vietnam, Pakistan and Indonesia concentrated in manufacturing activities. Hong Kong, South Korea and Taiwan sometimes play as a unique role on global textile and apparel supply chain, which connected manufacturers with the end-users.

Global textile and apparel value chain is forecast to grow at a CAGR of 5% per year and reach US$2,100bn by 2025. Global textile and apparel industry will attract investment worth US$350bn over the period of 2012- 2025. Because of this globalized supply chain, tremendous amount of textiles and apparel are imported and exported between countries (Tot, 2014).

Increased by 8 percent, world exports of textiles and apparel in 2013 reach 766 billion dollars, which is four times higher than the average growth (2 percent) for world exports. China continued leading the export of textile

and apparel, with a 35 percent share in world exports in textiles and 39 percent in apparel. The top 5 textile and apparel exporters are China, European Union, India, Turkey and Bangladesh. Vietnam overtook United States and became the sixth-largest exports of textiles and apparel (World Trade Organization, 2014).

However, U.S. Free Trade Agreement has brought great opportunities to U.S. textiles and apparel industry. More than two-third of U.S. textile production is exported to Western Hemisphere nations that are members of the North American Free Trade Agreement (NAFTA), the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR), and the Caribbean Basin Initiative (CBI). And the ongoing Trans-Pacific Partnership (TPP) and free trade agreement with Africa will support the U.S. textile and apparel industry, and is expected to impact American employment in this sector since its labor-intensive nature.

Based on historical data (1989-2014), this paper will perform a forecasting of U.S. total textiles and apparel export to the world for next 10 years (2015-2025) with two forecasting models: regression model and ARIMA model.

LITERATURE REVIEW

U.S. textiles and apparel exports

In 2014, U.S. total textile and apparel exports rose up to $24.3 billion. Also, Unites States is the second largest importer of clothing, accounting for 19 percent of world imports, which supplied about 98 percent of U.S. consumer demand for textiles and apparel. Textiles account for 83 percent of all U.S. textiles and apparel exports in 2013. Exports of these textiles products such as fabrics and yarns are used primarily as intermediate materials for products manufactured overseas and then imported back into the United States for retailing. Top categories of textiles and apparel exports include specialty and industrial fabrics, spun yarns and thread, felts and other non-woven textiles as well as other made-up textile articles, which account for nearly half of U.S. total textile and apparel exports in 2013 (Lu, 2014).

Free Trade Agreement brings more opportunities

66 percent of U.S. Textiles and apparel exports in 2013 went to the Western Hemisphere (North America, Central America, South America, and the Caribbean countries). Mexico and Canada remain the top two largest export markets for U.S. textile and apparel exports in 2013 thanks to the North American Free Trade Agreement (NAFTA) (Lu, 2014).

Other Free Trade Agreement includes the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR), and the Caribbean Basin Initiative (CBI). These free trade agreements provide that certain exports from FTA member countries may enter the U.S. market duty-free only if they are made from textiles yarn or fabric produced in the trade region. This can encourage manufacturers in Mexico and Central America to use yarns and fabrics made-in-USA to manufacture apparel, home furnishings, and other textile products. A U.S. trade surplus of $2.4 billion in yarns and fabrics in 2013 was contributed by exports to these Free Trade Agreement countries (Platzer, 2014).

Two models – regression model and ARIMA were employed to forecast U.S. total textile and apparel exports within the next ten years.

Regression model

Simple linear regression is the least squares estimation with a single explanatory variable, which fits a straight line through the set of observations to makes the sum of squared residuals of the model as small as possible. Regression model is one of the most basic statistic model, which will not be discussed in details. In this paper, the dependent variable Y is the absolute value of U.S. textile and apparel exports and the independent variable X is the year (Wikipedia, 2014).

ARIMA model

Trend and prediction of time series can be computed by using ARIMA model. ARIMA (p,d,q)(P,D,Q) model is complex a linear model, which create explanatory variables from the original demand history by using autocorrelations to identify those lagged demand historical values that best predict future demand. There are three parts (Figure 1) of ARIMA model: Autoregressive (AR) – linear combination of the influence of its own previous p number of values; Integrative (I) – random walk; Moving average (MA) – linear combination of previous q errors.

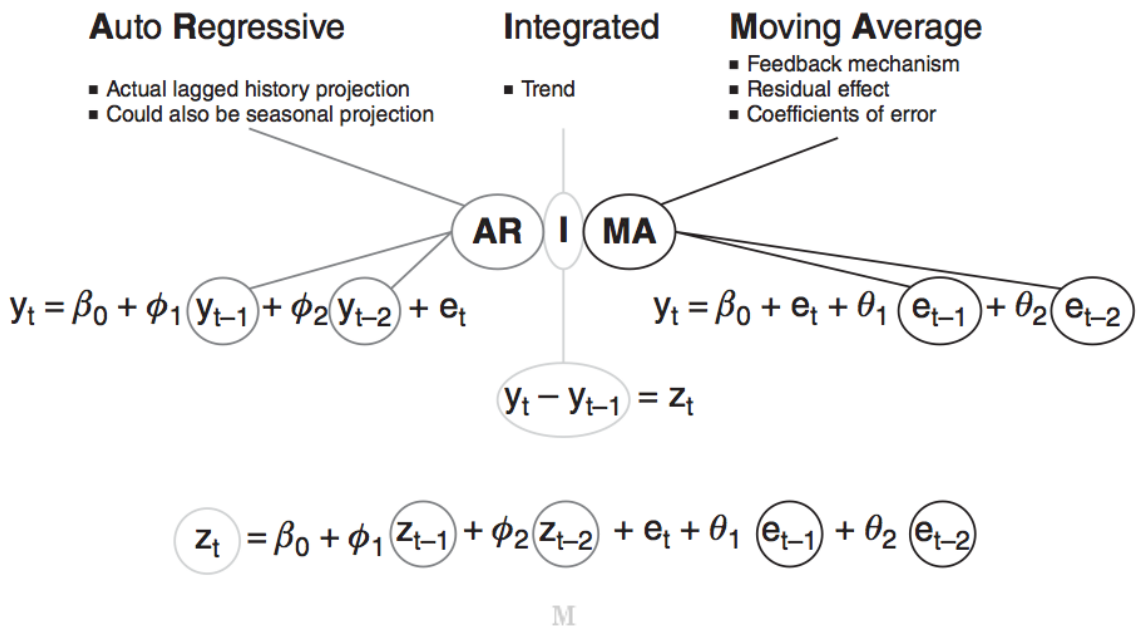

Figure 1. ARIMA (Auto Regressive Integrated Moving Average) model structure,

The first step to use ARIMA model is to identify the type of the model and the values of the parameters. Three plots of the correlations are used to determine model parameter that are autocorrelation (ACF) and partial autocorrelation (PACF) and inverse autocorrelation (IACF) function of the stationary time series. Autocorrelation means the correlation's between time series and the same time series lag. Partial autocorrelations are also correlation coefficients between the basic time series and the same time series lag and we will eliminate the influence of the members between. IACF was used mainly to determine over-differencing and confirm seasonality to support the PACF plot (Chase, 2009).

METHODOLOGY

Data collection

U.S. total textile and apparel world exports data (Table 1) was collected through U.S. Department of Commerce website (2015) website with the unit of dollar. Four categories of U.S. exports to the world data were collected: textile & apparel, total apparel, total yarn and total fabric. In each category, there were 26 historical observations available for analysis.

Table 1. U.S. total textile and apparel world exports data (1989-2014)

Exports/Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
TEXTILES & APPAREL	7.092E+09	8.642E+09	1.003E+10	1.117E+10	1.213E+10	1.355E+10	1.573E+10	1.732E+10	1.961E+10
TOTAL APPAREL	1.913E+09	2.365E+09	3.069E+09	4.004E+09	4.737E+09	5.388E+09	6.418E+09	7.307E+09	8.453E+09
Total Yarn	1.911E+09	2.141E+09	2.233E+09	1.986E+09	1.861E+09	2.179E+09	2.818E+09	2.952E+09	3.083E+09
Total Fabric	2.305E+09	2.903E+09	3.24E+09	3.602E+09	3.893E+09	4.313E+09	4.77E+09	5.097E+09	5.799E+09

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1.971E+10	1.931E+10	2.122E+10	1.896E+10	1.829E+10	1.811E+10	1.887E+10	1.941E+10	1.984E+10	1.931E+10
8.616E+09	8.071E+09	8.414E+09	6.755E+09	5.867E+09	5.401E+09	4.89E+09	4.739E+09	4.6E+09	4.021E+09
2.944E+09	2.805E+09	3.13E+09	2.636E+09	2.65E+09	2.85E+09	3.157E+09	3.271E+09	3.701E+09	3.932E+09
5.905E+09	6.31E+09	7.42E+09	7.345E+09	7.666E+09	7.831E+09	8.588E+09	8.81E+09	8.759E+09	8.375E+09

2008	2009	2010	2011	2012	2013	2014
1.974E+10	1.659E+10	1.975E+10	2.243E+10	2.267E+10	2.367E+10	2.435E+10
4.183E+09	3.945E+09	4.52E+09	5.154E+09	5.539E+09	5.863E+09	6.081E+09
4.259E+09	3.455E+09	4.444E+09	5.623E+09	5.068E+09	5.177E+09	5.249E+09
8.146E+09	6.354E+09	7.637E+09	8.257E+09	8.495E+09	8.865E+09	9.25E+09

Data analysis

All the data was downloaded from the U.S. Department of Commerce website and saved in Microsoft Excel. In terms of regression analysis and forecasting, Excel was used to analyze data and generate the smooth plot. Then SPSS was use to determine ARIMA parameters. At last ARIMA forecasting was performed on R based-statistical software (Wessa, 2013).

The ARIMA model was calibrated using the authors' expectations. By modeling the past behavior of U.S. textile and apparel exports using historical data, the author adjusted the coefficients of the parameter by taking into account the trend and future expectations.

RESULTS AND DISCUSSION

Regression forecasting results

First of all, a figure was created using Excel that illustrates the US total textile and apparel export trend from 1989 to 2014.

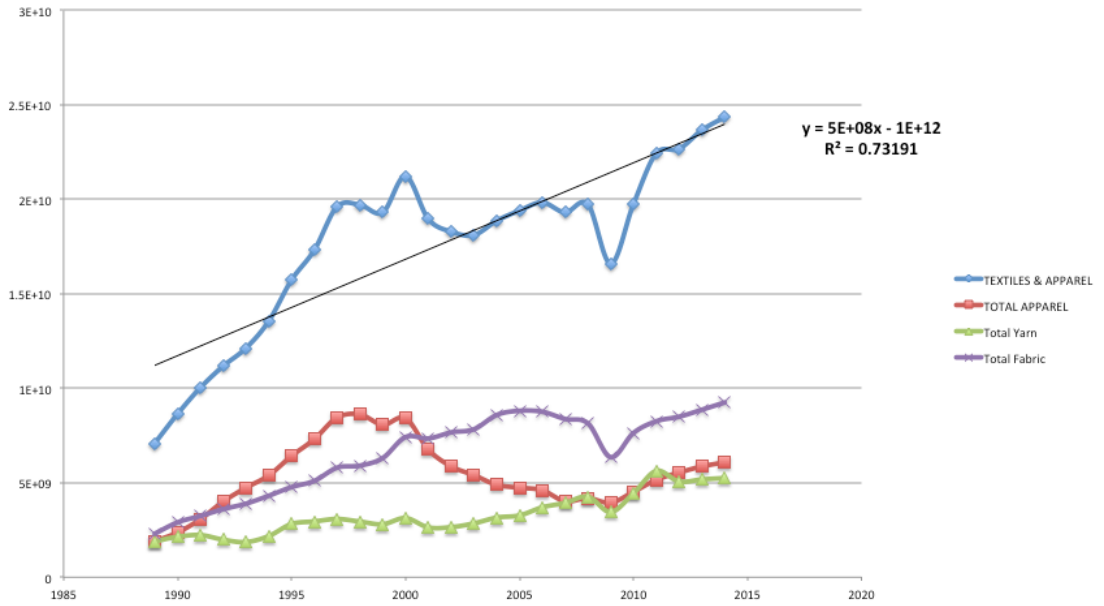

Figure 2. U.S. total textile and apparel world exports trends and regression analysis,

Second, a regression line was calculated based on the previous data (1989-2014), which denotes as following equation:

Y= 5E+08X-1E+12

Where Y is the U.S. total textile and apparel world exports in dollar unit. And X is the year.

R^2= 0.73191 which means there is a relative strong correlation between the year and total exports (dollars). In other words, 73 percent of the variants in U.S. total textile and apparel world exports can be explained by year different.

Last, based on the regression line, the next ten years forecasting was calculated (Table 2).

Table 2. U.S. total textile and apparel world exports regression forecast results (2015-2025)

2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
24488015543	24998522195	25509028847	26019535499	26530042151	27040548803	27551055456	28061562108	28572068760	29082575412	29593082064

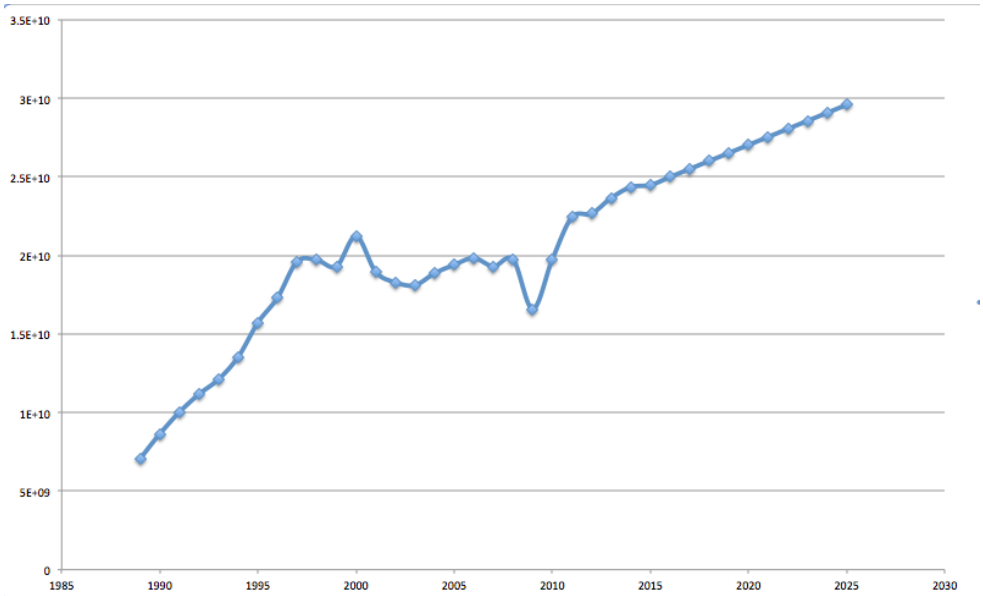

Figure 3. U.S. total textile and apparel world exports trends and regression forecast (1989-2025),

Last, a forecasting figure (Figure 3) was created through excel according to the forecasting point.

ARIMA forecasting results

First of all, after analyzed through SPSS analysis, autocorrelation (ACF) and partial autocorrelation (PACF) confirmed the parameters (p,d,q) of ARIMA. Then in R statistic software, an ARIMA model was built to perform the forecasting. The result was illustrated in tables 3.

Table 3. U.S. total textile and apparel world exports ARIMA forecast results (2015-2025)

Univariate ARIMA Extrapolation Forecast								
time	Y[t]	F[t]	95% LB	95% UB	p-value (H0: Y[t] = F[t])	P(F[t]>Y[t-1])	P(F[t]>Y[t-s])	P(F[t]>Y[24])
23	23.665519984	-	-	-	-	-	-	-
24	24.352871668	-	-	-	-	-	-	-
25	24.488	24.8225	21.8968	27.7482	0.4113	0.6235	0.6235	0.6235
26	24.9985	25.2918	21.0863	29.4973	0.4456	0.646	0.646	0.6692
27	25.509	25.7608	20.5281	30.9936	0.4624	0.6124	0.6124	0.701
28	26.0195	26.2295	20.0937	32.3654	0.4733	0.591	0.591	0.7256
29	26.53	26.698	19.7347	33.6612	0.4812	0.5757	0.5757	0.7454
30	27.0405	27.1661	19.4266	34.9056	0.4873	0.564	0.564	0.7619
31	27.5511	27.6339	19.1551	36.1126	0.4924	0.5545	0.5545	0.7759
32	28.0616	28.1014	18.9114	37.2914	0.4966	0.5467	0.5467	0.788
33	28.5721	28.5686	18.6891	38.4481	0.4997	0.5401	0.5401	0.7985
34	29.0826	29.0355	18.4841	39.5869	0.4965	0.5343	0.5343	0.8078
35	29.5931	29.5021	18.293	40.7112	0.4937	0.5292	0.5292	0.816

**25-35 stands for year 2015-2025.*

By manually setting the regression model results as real export data for 2015-2025, the forecast performance was calculated below (Table 4). The results show that the MAPE is less than 2%, which indicated a very accurate performance.

Last, a forecast figure was created, where the white line stands for the forecasting results of ARIMA. Also the yellow area stands for the 95% confident interval area.

Table 4. ARIMA forecasting performance analysis

Univariate ARIMA Extrapolation Forecast Performance									
time	% S.E.	PE	MAPE	sMAPE	Sq.E	MSE	RMSE	ScaledE	MASE
25	0.0601	-0.0137	0.0137	0.0136	0.1119	0	0	-0.6552	0.6552
26	0.0848	-0.0117	0.0127	0.0126	0.086	0.0989	0.3146	-0.5745	0.6149
27	0.1036	-0.0099	0.0118	0.0117	0.0634	0.0871	0.2951	-0.4932	0.5743
28	0.1194	-0.0081	0.0108	0.0108	0.0441	0.0764	0.2763	-0.4114	0.5336
29	0.1331	-0.0063	0.0099	0.0099	0.0282	0.0667	0.2583	-0.3289	0.4927
30	0.1454	-0.0046	0.0091	0.009	0.0158	0.0582	0.2413	-0.2459	0.4515
31	0.1565	-0.003	0.0082	0.0081	0.0069	0.0509	0.2256	-0.1622	0.4102
32	0.1669	-0.0014	0.0073	0.0073	0.0016	0.0447	0.2115	-0.078	0.3687
33	0.1764	1e-04	0.0065	0.0065	0	0.0398	0.1994	0.0068	0.3285
34	0.1854	0.0016	0.006	0.006	0.0022	0.036	0.1897	0.0922	0.3048
35	0.1938	0.0031	0.0058	0.0058	0.0083	0.0335	0.183	0.1782	0.2933

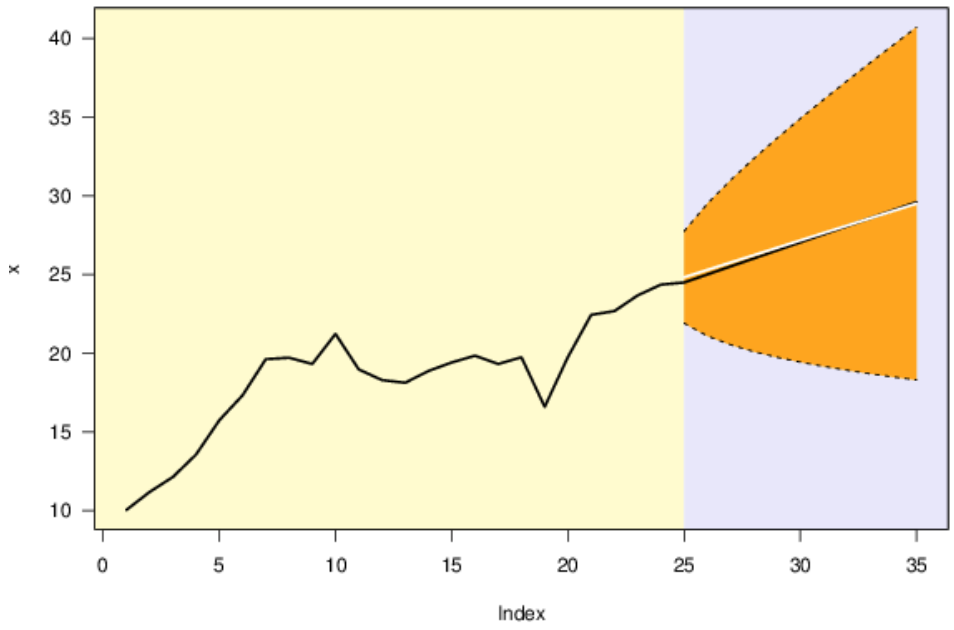

Figure 4. U.S. total textile and apparel world exports trends and ARIMA forecast,

CONCLUSION AND FUTURE STUDY

By using two different forecasting methods, we can see that the two models (regression-black line & ARIMA-white line) almost give the same forecasting results. The U.S. total textile and apparel market is projected to reach 29.5 billion in 2025, which is a 21 percent increase compared to 2014.

Noticing that both politics and industries trying to move certain manufacturing back to U.S. to create more Made-in-US product as well as more jobs, we can have a positive attitude of textile and apparel exports in the next ten years and predict the real exports value lying between the foresting value and 95% upper bound.

However, the forecasting of this paper is only technical forecasting that based on previous data. Many other factors can influence the exports that should be taken into consideration such as the US dollar exchange rate and the on-going Free Trade Agreement negotiations. More accurate forecasting can be done in the future through some computing technological methods such as ANN (artificial neural network).

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