Forecasting the increase rate of Korean export by using Time Series Data

Finding an exogenous variable that helps making a better forecast of Korean export

Final Project

Group 7

Time Series Data Analysis and Forecasting – MGT 4206, fall 2017

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Content

1. Problem motivation

Let us look at the trading system. Trade is the exchange of material or intangible goods between economic subjects from the production to the consumption. Therefore, trade contributes to the market economy. Trading allows countries to ~~take advantage of~~expoit comparative advantages that arise through specialization. More goods and services can be produced and this in turn leads ~~– in theory –~~ to more prosperity for all participating parties.1 This is why for every country it is important to have a good trading system and to be able to export and import goods. Especially in exports, we see a main indicator for economic prosperity and international competitiveness. Countries that have a higher orientation towards exports show a higher increase in incomes, which in turn leads to more prosperity within the country. Additionally, the improvement of the trading balance (export/import ratio) can make the county more attractive for foreign capital. That leads to more foreign direct investment that helps the economy grow.2

Korea counts to the largest economies worldwide and is a major exporter in the world. In 2016, Korea exported goods and services in total value of 483 billion US-Dollars. That makes the country the 7th biggest exporter in the world, which again leads to a huge trading surplus of 93.7 billion, since Korea only imports goods and services in the value of 389 billion USD. The main drivers of Koreas export are integrated circuits, cars, car parts, ships and refined petroleum. After China, the United States of America are the second largest trading partner for Korea with a total export to the US of 66.7 Billion dollars in 2016.3 This makes the US not only important for the exporting industries in Korea, but for the country as a whole.

All this makes it of interest to forecast the future growth rate of export and finding good indicators to making valid predictions.

Furthermore, we can develop our discussion with a business administration point of view applying the theory of so-called “bullwhip”-effect. The Bullwhip effect refers to increasing volatility in the amount of orders going in at supply chain components the further away those components are from the originator. This effect is central in the theory of supply-chain-management and results from dynamic processes in the supply chain. Already small changes in the amount demanded can lead to large fluctuations in the quantity ordered at later stages in the supply chain. Therefore, the producer who stands at the very beginning of the supply chain suffers the biggest changes in orders and the largest fluctuations in the amount of stock.

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~~In terms of export sales the United States are Korea’s biggest trading partner after China. Products in total value of 66.8 billion dollars (13.5% of the total volume) were exported to the US in 2016. Therefore~~As mentioned before, Korea’s prosperity is highly dependent on America’s consumption behavior (consumption will be denoted as retail revenue in this paper). The “bullwhip”-effect in the supply chain from American customers to Korean producers may lead to major fluctuations in the total amount

1 Hill & Hult (2017). Global Business Today (9e), McGraw-Hill.

2 Balassa, Bela (1978). World Bank Reprint Series: Number Sixty-eight. *Exports and Economic Growth: Further Evidence*. p. 180-189.

3 The Observatory of Economic Complexity (OEC). *South Korea. Visualizations*. Obtained from: https://atlas.media.mit.edu/en/profile/country/kor/ (12.21.2017)

exported from Korea and could lead to economic wide inconsistency.4 It is of interest to examine this topic so that measures can be taken accordingly.

2. Literature review

1) Exports with Exogenous variables

Arize (1995) has found that the exchange-rate uncertainty, which the researcher examined in the form of volatility, has a negative effect on the exports in the case of the United States. Arize further suggests that studies should include the exchange-rate uncertainty, because the export equation becomes structurally unstable when the volatility is excluded.5

Also, Ca' Zorzi and Schnatz (2007) tried to test different kinds of exogenous variables. They addressed the unit labor cost in the total economy, but argued that those include non-tradable goods that are affecting the export sector only indirectly. The paper further addresses producer prices, but those don't include service prices which are important in the international trade, especially in the increasing globalized world. The GDP deflator includes such service prices, however, GDP is subject to taxes which are not fully comparable between countries. In the end, they conclude that the assessment for the explanation and forecasting of future developments in exports needs a range of different measures.6

Further, Kwan-Ho Shin (2007) has insisted that the most significant macroeconomic factor which affects Korean exports is global business condition rather than the exchange rate of Korean Won. After Asian financial crisis, the influence of exchange rate to Korean exports has decreased. In spite of macroeconomic knowledge that increase of exchange rate brings about expansion of exports, the relationship between exports and the exchange rate became weaker.7

2) Previous research about the bullwhip effect

Cachon et al. (2007) could not find conclusive evidence for the existence of the bullwhip effect in aggregate empirical data.8 Also Chen and Lee (~~9032842~~2012) argue that on an aggregate level, there is

4 Lee, Hau L.; Padmanabhan, V.; Whang, Seungjin (1997). MANAGEMENT SCIENCE. *Information Distortion in a Supply Chain: The Bullwhip Effect*. P. 546-558.

5 Arize, Augustine C. (1995). Southern Economic Journal. *The Effects of Exchange Rate Volatility on U.S. Exports: An Empirical Investigation*. Vol. 62, No. 1 (Jul., 1995) pp. 34-43.

6 Ca' zorzi, Michele; Schnatz, Bernd (2007). European Central Bank. *Explaining and Forecasting Euro Area Exports. Which Competitiveness Indicator Performs Best?* Working Paper Series. No. 833 / November 2007.

7 Kwan-Ho Shin (2007). PRISM. *수출에 영향을 미치는 주요 요인 분석*. 산업통상자원부 발간 자료

8 Cachon, Gérard P.; Randall, Taylor; Schmidt, Glen M. (2007). Manufacturing & Service Operations Mangagemnt. *In Search of the Bullwhip Effect*. Vol. 9, No. 4, Fall 2007, p. 457–479.

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no clear evidence for the bullwhip effect, but at the individual product level, there might be specific evidence. This is due to the fact, that financial planning and capital investment decisions are being made on a aggregate level and not on an individual product level. This might lead to overlooking the severity of the bullwhip effect. [9]

Though, Udenio, Fransoo and Peels (2014) suggest, that the bullwhip effect might not only be a most significant on a product level, but also at an aggregate level. Slow reaction speeds and underestimation of the supply pipeline might cause such shocks also on the aggregate level. [10] Furthermore,

Pastore, Alfieri and Zotteri (2017) found out that fast moving products are effected more by the bullwhip effect than slow moving products. The dealers try to decouple supply and demand, especially if they are given incentives to forward-buy.[11]

3. Statement of research objectives

Our goal is to test the relationship between the fluctuation of the US retail revenue and the fluctuation of Korean export and we will try to find an explanation for the relationship. In the process, we want to find an exogenous variable that helps making a better forecast of Korean export. Additionally, we can take the concept of the bullwhip effect as a tool for explanation of the relationship. Afterwards, we want to forecast the increase of the Korean export rate and make a prediction.

4. Description of data and applied methodology

1) Description of data

1-1) **Target variable: Exports growth rate of South Korea (KR export)**

This paper wants to show the fluctuation of South Korea's exports which makes critical impacts on economy of South Korea. Since the exports are taking a large possession of GDP of South Korea, we can predict the business outlook of Korean economy by forecasting exports growth of South Korea. We've converted the amount of Korean exports into the year-on-year increase rate in order to measure the variation of Korean exports. We've collected 129 monthly data from January 2007 to September 2017 from the Ministry of Commerce of Korea. Then we will call it KR export below.

1-2) **Exogenous variable 1: Increasing rate of US retail sales (US retail)**

We assumed that there are several macro-economic factors which have a decisive effect on the fluctuation of KR export. Among them, we selected the retail sector of US under the commonsensical inference that the consumption of US can represent global economy condition. Therefore, we found ~~out~~ US retail consumption data from The Conference Board, and also converted it into year-on-year rate for corresponding period. Then we will call it US retail below.

[9] Chen, Li; Lee, Hau L. (2012). Operations Research. Bullwhip Effect Measurement and Its Implications. 60(4): p. 771-784

[10] Udenio, Maximiliano; Fransoo, Jan C.; Peels, Robert (2014). Int. J. Production Economics. Destocking, the bullwhip effect, and the credit crisis: Empirical modeling of supply chain dynamics. 160 (2015) p.34-46.

[11] Pastore, Erica; Alfieri, Arianna; Zotteri, Giulio (2017). International Journal of Production Economics. An empirical investigation on the antecedents of the bullwhip effect: Evidence from the spare parts industry. p. 1-13.

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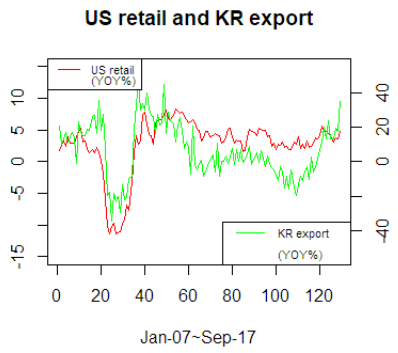
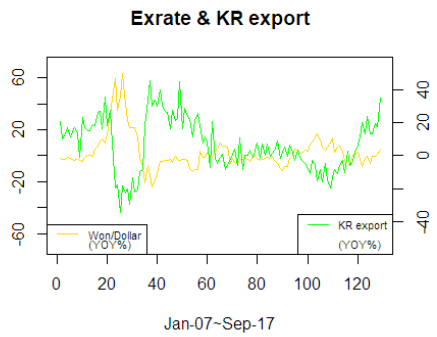
1-3) **Exogenous variable 2: Increasing rate of Won-Dollar Exchange rate (Exrate)**

The exchange rate of Korean Won also has a close relationship with KR export. It is an elementary knowledge of macroeconomics that competitiveness in exports significantly dependent on the exchange rate. As exchange rate of Korean Won against other currencies increases (depreciation of Korean Won), exports of Korea would become better. Since Korean goods have price competitiveness in comparison with foreign goods. Therefore, we will take the Won-Dollar exchange rate as the indicator representing the worth of Won. Won-Dollar exchange rate also got transformed into year-on-year increase rate to show the fluctuation of that variable. The data is from BOK, then we will call it Exrate below.

2) Plotting with assumptions





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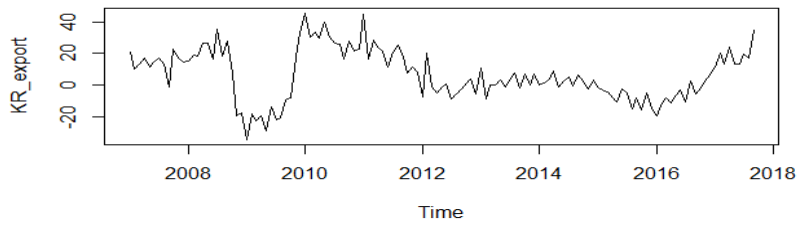
As you can see above, KR export shows very similar shape with US retail. We can say that there is strong relationship between KR export and US retail as we assumed before. And the graph shows the difference of the degree of variation, which means that the fluctuation of KR export seems more variable compared to the fluctuation of US retail.

Meanwhile, the fluctuation of KR export and Exrate shows a little difference in that shape although there should be a strong relationship between KR export and Exrate theoretically. ~~An~~ The unexpected above~~,~~ could be explained in two different ways. Either Exrate does not have that close relationship with KR export ~~that~~ as we expected, or there would be a time lag so that the variation of Exrate impact on KR export ~~at~~ has a time difference.

3) Stationary check

Prior to conducting any analysis, the dataset representing KR export has been plotted using R and is shown below.



<Figure, Plot of The increasing rate of KR export>

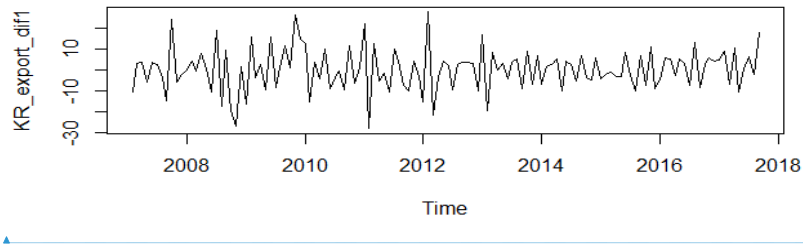
As you can see, the increasing rate of KR export is non-stationary, because the mean and variance are not constant. And we carried out Augmented Dickey-Fuller test by using R.

```
        Augmented Dickey-Fuller Test

data:  KR_export
Dickey-Fuller = -2.6849, Lag order = 5, p-value = 0.2918
alternative hypothesis: stationary
```

<Figure, The result of Augmented Dicky-Fuller test>

The null hypothesis is non-stationary and the p-value is 0.2918 which is higher than 0.05 alpha level. So, the model is non-stationary at 0.05 alpha level. As a result, we need differencing to conduct analysis.



<Figure, Plot of the KR export after taking 1st order difference>

We took the 1st order difference by using R. And as you can see, the plot seemed to be stationary.

We could also do an Augmented Dicky-Fuller test and the result is following.

```
> adf.test(KR_export_difl)

        Augmented Dickey-Fuller Test

data:  KR_export_difl
Dickey-Fuller = -4.4941, Lag order = 5, p-value = 0.01
alternative hypothesis: stationary

경고메시지(들):
In adf.test(KR_export_difl) : p-value smaller than printed p-value
```

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<Figure, The result of Augmented Dicky-Fuller test>

The p-value is smaller than 0.05 alpha level. So, we can reject null hypothesis which is non-stationary. Therefore we can say the data is stationary.

4) Granger causality

Prior to carrying out Granger causality test, we found that the US retail and Exchange rate are non-stationary data. So, we took 1st order difference to make stationary. And the results are stationary.

```
> grangertest(KR_export1~US_retail1,order = 1) # significant US retail -> KR export
Granger causality test

Model 1: KR_export1 ~ Lags(KR_export1, 1:1) + Lags(US_retail1, 1:1)
Model 2: KR_export1 ~ Lags(KR_export1, 1:1)
  Res.Df Df      F    Pr(>F)
1    124
2    125 -1 37.628 1.057e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> grangertest(US_retail1~KR_export1,order=1) # not significant KR export -> US retail
Granger causality test

Model 1: US_retail1 ~ Lags(US_retail1, 1:1) + Lags(KR_export1, 1:1)
Model 2: US_retail1 ~ Lags(US_retail1, 1:1)
  Res.Df Df      F Pr(>F)
1    124
2    125 -1 0.7019 0.4037
```

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<Figure, The result of Granger causality test in R>

Then, we carried out Granger causality test between KR export and US retail using R. When we set time lag 1, US retail is granger causality, because the P-value is lower than 0.05 alpha level. But the opposite is not significant at 0.05 alpha level. In addition, we carried out the test in different time lags, 2 and 3. The result are same. So, we can say US retail is useful in forecasting KR export.

```
> grangertest(KR_export1~Won_Dollar1,order=1)
Granger causality test

Model 1: KR_export1 ~ Lags(KR_export1, 1:1) + Lags(Won_Dollar1, 1:1)
Model 2: KR_export1 ~ Lags(KR_export1, 1:1)
  Res.Df Df      F Pr(>F)
1    124
2    125 -1 1.5664 0.2131
```

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```
> grangertest(KR_export1~Won_Dollar1,order=3)
Granger causality test

Model 1: KR_export1 ~ Lags(KR_export1, 1:3) + Lags(Won_Dollar1, 1:3)
Model 2: KR_export1 ~ Lags(KR_export1, 1:3)
  Res.Df Df     F    Pr(>F)
1    118
2    121 -3 7.819 8.353e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

<Figure, The result of Granger causality test in R>

We also carried out Granger causality test between KR export and export rate using R. When we set time lag 1, there are no Granger causality relationships because all P-values are higher than 0.05. What is remarkable is that the P-value is lower than 0.05 alpha level when we set time lag 3. In this case, exchange rate is granger causality and it means that there is a time lag in the response of exports to the exchange rate.

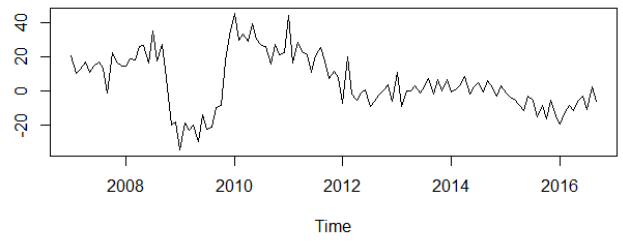
5) Time series analysis

In order to determine the model prediction power(fit), we divided the data as follows to be used for estimation and prediction.

January 2007 – September 2016 (117 data) : in-sample data

October 2016 – September 2017 (12 data) : out-of-sample data

5-1) Model A : ARIMA model



<Figure, The increasing rate of KR export of in sample data>

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As can be seen, the data is non-stationary. Originally, if the data is non-stationary, it can be hard to analyze the time series data. But if we use ARIMA model, non-stationary data is not that much of a problem. And R program provides auto.arima function that automatically calculates and gives us the best (p, d, q). So, we can easily find ~~that~~ those values. The result is following:

```
> aKR_export = auto.arima(KR_export, seasonal = F)
> summary(aKR_export)
Series: KR_export
ARIMA(1,1,0)

Coefficients:
          ar1
      -0.4299
s.e.   0.0840

sigma^2 estimated as 85.6:  log likelihood=-422.28
AIC=848.56   AICc=848.67   BIC=854.07

Training set error measures:
                     ME    RMSE      MAE MPE MAPE      MASE         ACF1
Training set -0.2870348 9.1727 6.797475 Inf  Inf 0.3675446 -0.001748091
```

<Figure, The result of auto.arima function in R to make ARIMA model>

So, we have found best (p, d, q), which is (1, 1, 0). And we can find the d is 1 which means R took first order differences to make the data stationary.

5-2) Model B : ARIMAX with US retail

```
> xKR_export = auto.arima(KR_export,seasonal = F, xreg = US_retail)
> summary(xKR_export)
Series: KR_export
Regression with ARIMA(2,1,3) errors

Coefficients:
          ar1      ar2     ma1      ma2      ma3    xreg
      -1.7385  -0.8215  1.0451  -0.2949  -0.3932  3.0340
s.e.   0.2263   0.2340  0.2768   0.1711   0.2132  0.3647

sigma^2 estimated as 62.93:  log likelihood=-402.44
AIC=818.89   AICc=819.93   BIC=838.16

Training set error measures:
                     ME     RMSE      MAE MPE MAPE      MASE        ACF1
Training set -0.5367914 7.692057 5.834296 Inf  Inf 0.3154648 0.002687595
```

<Figure, The result of auto.arima function in R to make ARIMAX model>

We can also make ARIMAX model by using auto.arima model. In this case, the exogeneous variable is US retail. And the best (p, d, q) of the result is (2, 1, 3).

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5-3) Model C : ARIMAX with Exchange Rate

```
> xKR_export1 = auto.arima(KR_export,seasonal = F, xreg = Exch_rate)
> summary(xKR_export1)
Series: KR_export
Regression with ARIMA(2,1,1) errors

Coefficients:
          ar1      ar2     ma1     xreg
      -1.3995  -0.4883  0.9664  -0.2682
s.e.   0.0841   0.0812  0.0432   0.1212

sigma^2 estimated as 79.78:  log likelihood=-417
AIC=844   AICc=844.54   BIC=857.77

Training set error measures:
                    ME     RMSE      MAE MPE MAPE      MASE        ACF1
Training set -0.3058476 8.738937 6.535617 Inf  Inf 0.3533858 0.004889399
```

<Figure, The result of auto.arima function in R to make ARIMAX model>

We can also make another ARIMAX model by using auto.arima model. In this case, the exogeneous variable is Exchange rate. And the best (p, d, q) of the result is (2, 1, 1).

5. Analysis results

1) Comparing the prediction power of the models

We can get the future Estimated value. So, we got the 12 extimated values. The result is following:

Time	201610	201611	201612	201701	201702	201703	201704	201705	201706	201707	201708	201709
Out-of-Sample	-10.1	3.7	-2.4	-1.9	1.7	-5.3	3.6	-2.6	-1.2	7	23.5	28.5
Model A	-2.3	-3.89	-3.21	-3.5	-3.38	-3.43	-3.41	-3.42	-3.41	-3.42	-3.41	-3.41
Model B	-0.21	-4.06	-1.51	-2.63	-2.74	-1.62	-3.47	-1.17	-3.65	-1.23	-3.4	-1.61
Model C	-2.53	-3.46	-4.35	-3.09	-4.82	-3.38	-4.88	-3.77	-4.84	-4.12	-4.82	-4.38

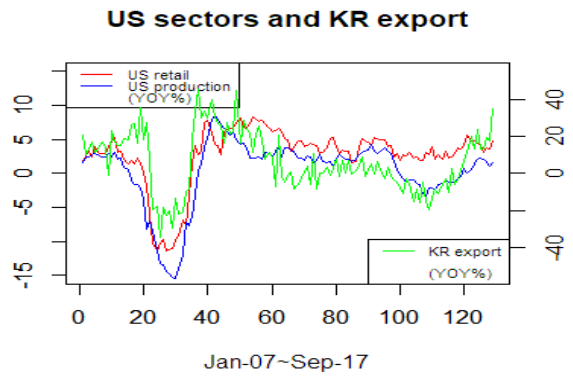
In order to determine prediction power, we calculated MSE and compared them.

Mean Squrare of Prediction Error (MSE) Comparison by Model					
Model A		Model B		Model C	
SSE = 2056.637	MSE = 2056.647/12 = 171.38725	SSE = 1948.598	MSE = 1948.598/12 = **162.383167**	SSE = 2253.286	MSE = 2253.286/12 = 187.7738333

As can be seen, MSE of Model B is the smallest value. So, we can tell that the Model B that includes US retail variable has the highest prediction power among them.

2) Bullwhip effect

The result above can partially show the existence of the Bullwhip effect mentioned before. In supply chain from customers of US to exporters of Korea, the fluctuation of demand increases as the process goes further. The further from orginating signal(US consumption), the greater the variation of the wave pattern. That's why many consumer products have quite consistent consumption at retail but this signal becomes more unpredictable when it comes to forcast exports of Korea.



~~and Korean economy's features.~~

~~Here,~~ US product ~~wsh~~ould come into this description ~~appear~~ as the connection link between US retail and KR export. Korea's principal export items are all concentrated on capital goods and intermediate goods. Thus the variation of exports amount is especially dependent on industrial demand. Also the industrial prodution is affected by consumption of consumers commonly. This path has been confirmed in accordance with the result of Granger causality test which showed significant p-value US retail to US production and US production to KR export. As seen above, the volatility of each sector increases through this series of process. ~~in the process of explain bullwhip effect.~~

~~The path of supply chain (US retail -> US product -> KR export) can also be proposed.~~

To sum up, because of the exsistence of this bullwhip effect, exports of Korea is fairly dependent on consumption of US. It is because small fluctuations in US retail sector can create large unpredictability in KR export. Then we can say that it eventually means Korean economy is considerably vulnerable to global bussiness condition(represented by US). We need to consider some macroeconomic factors which indicates the condition of global economy when trying to forcast Korean economy.

3) Forecasting

As we saw before, Model B which includes US retail have the highest prediction power. Therefore, we would forecast some future values of the growth rate of KR export using ARIMAX with US retail model. In this case, we would also include all period data to make ARIMAX model, not only in sample data. Using R, we could make a model and forecast some future values. The result is following:

Estimated Future Values

201710	201711	201712	201801	201802	201803	201804	201805	201806	201807	201808	201809
22.37	**30.493**	**24.139**	**28.607**	**26.002**	**26.893**	**27.468**	**25.743**	**28.267**	**25.296**	**28.389**	**25.453**

<Table, Estimated future values of the growth rate of KR export>

6. Expected original contribution and limitation

~~Maybe It might be difficult to make clear statements for the whole economy because different industries are part of the analysis. → maybe analyzing only one industry (highly seasonal industries tend to smooth demand volatility whereas non-seasonal industries tend to amplify).~~

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1) Contribution

As we have seen, we have looked at which exogenous variables is useful in predicting the growth rate of Korean exports. We looked at the ARIMA ~~model~~ and ARIMAX model and we compared the predictive power of each model by comparing MSE. As a result, Model B with US retail had the lowest MSE with 162.383167. This means that model B has the highest predictive power. In general, the exchange rate is considered as a more direct effect on exports. However, it was rather surprising that it was not.

We have estimated a year of export growth through model B, and it is forecasted that all of the growth rates will be positive until next September. This means Korea's exports will be great next year, and this is~~it is a~~ very positive in terms of Korea's heavy reliance on exports. So the government, businesses and households should have a better plan for next year within these predictions.

Meanwhile, China's influence on Korea and Korea's trade with other countries has increased. So, the U.S.'s influence on Korean exports has decreased relatively. We wonder if Model B's predictive power is still higher than other models as time goes on. So, it would be good to continue studying this topic and see what the U.S. is doing.

2) Limitation

As you know, the bullwhip effect refers to increasing swings in inventory in response to shifts in customer demand as one moves further up the supply chain. But the analysis of the models just show a stronger relationship between the increasing rate of US retails revenues and that of KR export rate than other exogenous variables. In other word, this statistically doesn't ~~show~~ prove the small fluctuations of the increasing rate of US retails revenues results in the large fluctuation of that of KR export rate. So, we just showed the graphs of ~~and compared variances of two things,~~ the increasing rate of US retails and that of KR export rate. If we can prove it by statistical methods, ~~However, the variance is that of total period, not part of the period. If we could show the variances of part period and compaere them,~~ it would be a great ~~show~~ proof of the~~about~~ bullwhip effect.

7. Appendix-: References and Data

1) References

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~~8. Sources for data~~

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서식 있음: 글꼴: 9 pt
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9. Appendix

2) Data

date	US_retail_sales(Billion $)	US_retail	Index of industrial product (Seasonally Adjusted)	US_product	KR_export	Export KR to US (million $)	KR_export_to_US	KR_C	
07-Jan	363.52	1.723751959	109	1.5	20.8	3,636	11.5	4.439252336	-2.431059507
07-Feb	364.09	2.637179867	110.1	2.4	10.3	3,704	17.7	4.667444574	-3.007363922
07-Mar	367.414	3.256647912	110.3	2.4	13.2	4,060	5.1	4.651162791	-3.169865692
07-Apr	366.28	2.427006636	111.1	2.8	17	3,845	8.7	4.988399072	-1.309372349
07-May	370.867	4.023011074	111.2	3	11.1	3,993	13.6	4.849884527	-1.897964578
07-Jun	368.08	2.886340893	111.2	2.6	14.5	3,846	1.6	4.953917051	-2.619235837
07-Jul	369.5	2.899854353	111.1	2.5	17.2	3,795	5.6	5.902777778	-3.753337172
07-Aug	371.019	2.913895161	111.3	2.4	13.6	3,516	-1	6.004618938	-2.392593362
07-Sep	372.936	3.968196442	111.7	2.9	-1.1	3,213	-16.1	5.747126437	-3.28665786
07-Oct	375.217	4.692827527	111.2	2.5	22.9	4,224	27.8	4.756511891	-4.420270629
07-Nov	378.481	5.365415024	111.8	3.1	17	4,081	1.3	4.49943757	-0.882337117
07-Dec	375.256	3.015894803	111.8	2.1	14.8	3,854	2.3	4.586129754	0.683016027
08-Jan	375.28	3.235035211	111.5	2.3	14.9	3,656	0.6	5.14541387	0.292195718
08-Feb	371.734	2.099480898	111.1	0.9	18.9	3,359	-9.3	5.016722408	-0.286700292
08-Mar	372.656	1.426728432	110.8	0.5	18.4	4,087	0.7	4.777777778	5.261199979
08-Apr	373.086	1.858141313	110	-1	26.4	4,235	10.2	4.198895028	7.713380244
08-May	375.851	1.343877994	109.4	-1.6	26.9	3,870	-3.1	3.964757709	11.02069412
08-Jun	376.378	2.254401217	109.3	-1.7	16.4	4,215	9.6	3.293084523	13.22112783
08-Jul	374.837	1.444384303	108.7	-2.2	35.6	4,147	9.3	2.841530055	10.0891983
08-Aug	372.112	0.294594077	107.1	-3.8	18.1	3,549	1	2.614379085	16.05030374
08-Sep	366.377	-1.758746809	102.5	-8.2	27.6	3,834	19.3	2.717391304	31.88548325
08-Oct	352.768	-5.982937873	103.4	-7	7.8	4,435	5	2.162162162	43.34332667
08-Nov	339.776	-10.22640502	102.2	-8.6	-19.5	3,498	-14.3	1.291711518	59.47456983
08-Dec	332.307	-11.44525337	99.2	-11.3	-17.9	3,491	-9.4	-0.320855615	34.56011965
09-Jan	336.918	-10.22223407	96.8	-13.2	-34.5	2,628	-28.1	-1.382978723	46.1595508
09-Feb	335.698	-9.694028526	96.2	-13.4	-18.5	2,744	-18.3	-1.486199575	63.30333848

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09-Mar	329.947	-11.46070371	94.7	-14.5	-22.5	2,936	-28.2	-1.272534464	39.67284293
09-Apr	331.313	-11.19661419	93.8	-14.7	-19.9	3,270	-22.8	-0.742311771	27.96090361
09-May	334.315	-11.05118784	92.8	-15.2	-29.4	2,943	-24	-0.63559322	21.85330809
09-Jun	339.535	-9.788829315	92.4	-15.5	-13.6	3,279	-22.2	0.743889479	21.78672148
09-Jul	340.229	-9.232813196	93.4	-14.1	-22.1	3,287	-20.7	1.168969182	21.41198557
09-Aug	346.657	-6.840682375	94.4	-11.9	-20.9	3,144	-11.4	1.486199575	14.68913583
09-Sep	338.427	-7.628753988	95.1	-7.2	-9.4	3,387	-11.7	1.481481481	-2.390322714
09-Oct	341.578	-3.172056422	95.4	-7.7	-8.5	3,190	-28.1	2.116402116	-8.389170766
09-Nov	344.579	1.413578358	95.8	-6.3	17.9	3,486	-0.4	2.975557917	-20.85091899
09-Dec	346.215	4.185286497	96.1	-3.1	32.8	3,358	-3.8	4.291845494	-7.534436902
10-Jan	346.252	2.770407043	97.2	0.4	45.4	3,058	16.3	5.070118662	-15.79080893
10-Feb	346.835	3.317565193	97.5	1.4	30.1	3,406	24.1	5.603448276	-24.35930877
10-Mar	354.564	7.460895235	98.2	3.7	33.8	4,073	38.7	5.907626208	-18.20350624
10-Apr	357.095	7.781765279	98.6	5.1	29.6	4,339	32.7	6.08974359	-13.61262666
10-May	354.267	5.968024169	100.1	7.9	39.8	4,158	41.3	6.609808102	-4.214635701
10-Jun	353.811	4.204573903	100.3	8.5	30.5	4,466	36.2	6.012658228	-4.058244044
10-Jul	354.457	4.181889257	100.8	7.9	26.7	4,541	38.2	6.092436975	-3.747711089
10-Aug	356.505	2.840848447	101.2	7.2	26	4,051	28.9	5.648535565	-3.999679705
10-Sep	359.326	6.17533471	101.5	6.7	16.2	4,149	22.5	5.213764338	-3.212800272
10-Oct	363.736	6.486951736	101.2	6.1	27.6	4,778	49.8	4.352331606	-4.853506955
10-Nov	367.33	6.602549778	101.3	5.7	21.4	4,448	27.6	4.231166151	-0.245119119
10-Dec	369.294	6.666088991	102.1	6.2	22.6	4,350	29.6	4.526748971	-2.558708625
11-Jan	372.047	7.449776463	102	4.9	44.7	4,143	35.5	5.338809035	-3.46890467
11-Feb	374.97	8.11192642	101.6	4.2	16.4	3,812	11.9	4.795918367	-2.698392172
11-Mar	378.472	6.742929344	102.6	4.5	28.8	4,643	14	4.462474645	-3.071280216
11-Apr	380.796	6.637169381	102.2	3.7	23.5	5,094	17.4	3.726082578	-3.333784454
11-May	380.402	7.377204199	102.4	2.3	21.7	5,172	24.4	3.6	-10.23913496
11-Jun	383.072	8.270234673	102.6	2.3	11.1	4,969	11.3	3.68159204	-12.64880344
11-Jul	382.93	8.032850247	103.1	2.3	21.1	4,651	2.4	3.564356436	-10.85651475
11-Aug	383.822	7.662445127	103.7	2.5	25.5	4,322	6.7	4.059405941	-11.02260405
11-Sep	387.402	7.81351753	103.6	2.1	18	4,795	15.6	3.96432111	3.315062486
11-Oct	390.299	7.302824026	104.3	3.1	7.6	4,605	-3.6	4.468718967	-1.350810931
11-Nov	391.571	6.599243187	104.2	2.9	11.5	5,402	21.4	3.96039604	-1.439841359
11-Dec	391.744	6.079167276	104.7	2.5	8.2	4,600	5.7	3.641732283	1.511212936
12-Jan	395.317	6.254586114	105.4	3.3	-7.3	4,123	-0.5	2.631578947	0.169423514
12-Feb	400.042	6.686401579	105.7	4	20.4	5,619	47.4	3.11587147	-0.886014265
12-Mar	401.859	6.179321059	105.1	2.4	-1.5	5,935	27.8	3.009708738	3.314488921
12-Apr	400.077	5.063341001	106	3.7	-5	5,307	4.2	3.203883495	5.474145977
12-May	399.37	4.986303963	106.2	3.7	-1	4,727	-8.6	2.799227799	9.377751008
12-Jun	395.782	3.317914126	106.2	3.5	0.9	4,977	0.2	2.495201536	7.282349084

12-Jul	397.347	3.76491787	106.5	3.3	-8.7	4,692	0.9	2.676864245	7.237029309
12-Aug	401.904	4.711037929	106	2.2	-6	4,222	-2.3	1.902949572	6.369814858
12-Sep	405.658	4.712417592	106	2.3	-2.4	4,814	0.4	2.287893232	-5.653410297
12-Oct	405.877	3.991298978	106.3	1.9	-1	4,439	-3.6	1.901140684	-1.738660421
12-Nov	407.386	4.038858853	106.9	2.6	3.9	5,114	-5.3	2.476190476	-5.266150549
12-Dec	409.343	4.492474677	107.2	2.4	-6	4,555	-1	2.659069326	-7.0703125
13-Jan	412.125	4.251777687	107.1	1.6	10.9	4,961	20.3	2.849002849	-3.062269106
13-Feb	416.603	4.139815319	107.7	1.9	-8.6	5,003	-11	2.549575071	-3.195816386
13-Mar	413.848	2.98338472	108	2.8	0	4,979	-16.1	2.262016965	-1.919597546
13-Apr	412.655	3.1438948	107.9	1.8	0.1	5,347	0.8	2.445907808	-2.544135215
13-May	414.182	3.708841425	107.9	1.6	3.1	5,744	21.5	2.535211268	-4.291100097
13-Jun	415.777	5.052023589	108.1	1.8	-1	5,293	6.3	2.808988764	-0.296839532
13-Jul	418.222	5.253594465	107.5	0.9	2.6	5,154	9.8	2.51396648	-0.632407571
13-Aug	417.503	3.88127513	108.3	2.2	7.6	4,973	17.8	3.081232493	-2.172380365
13-Sep	417.565	2.935231155	108.9	2.7	-1.7	4,734	-1.7	2.982292637	-3.310990148
13-Oct	419.693	3.403986922	108.8	2.4	7.2	5,465	23.1	3.451492537	-2.7504011
13-Nov	421.033	3.349894204	109.1	2.1	0.2	5,248	2.6	3.345724907	-2.276190036
13-Dec	423.005	3.337543332	109.4	2.1	6.9	5,152	13.1	3.330249769	-1.424501425
14-Jan	418.8	1.619654231	108.9	1.7	-0.2	4,856	-2.1	3.601108033	-1.698884246
14-Feb	424.117	1.803635596	110	2.1	1.4	4,664	-6.8	3.591160221	-1.422107304
14-Mar	429.72	3.835224527	111	2.8	3.7	5,814	16.8	4.055299539	-4.197786376
14-Apr	433.675	5.093843525	111.2	3.1	8.9	6,376	19.2	3.764921947	-6.169980932
14-May	434.334	4.865493913	111.5	3.3	-1.5	6,059	5.5	3.571428571	-0.697264761
14-Jun	435.094	4.646000139	111.9	3.5	2.4	6,087	15	3.187613843	-11.40105079
14-Jul	435.688	4.176250891	112	4.2	5.2	6,103	18.4	3.36058129	-8.509501981
14-Aug	439.554	5.281638695	111.9	3.3	-0.4	5,318	6.9	3.442028086	-8.657267691
14-Sep	438.687	5.058374145	112.2	3	6.3	5,665	19.7	3.438914027	-1.805238915
14-Oct	440.396	4.932891423	112.3	3.2	2.3	6,799	24.4	3.065825068	0.692905963
14-Nov	442.106	5.005070861	113.1	3.7	-2.7	6,305	20.1	2.877697842	4.672588113
14-Dec	439.323	3.857637617	112.9	3.2	3.1	6,239	21.1	3.043867502	4.155216526
15-Jan	435.929	4.090019102	112.1	2.9	-1	5,562	14.5	2.941176471	2.16264188
15-Feb	434.153	2.366328159	111.9	1.7	-3.4	5,021	7.7	3.111111111	2.894613583
15-Mar	442.225	2.910034441	111.5	0.5	-4.6	6,795	16.9	2.834366696	4.212652045
15-Apr	442.183	1.961837782	111.1	-0.1	-8	6,205	-2.7	3.008849558	3.778971307
15-May	446.238	2.740747904	110.7	-0.7	-11	5,624	-7.2	2.829354553	8.631083664
15-Jun	446.238	2.561285607	110.4	-1.3	-2.7	6,504	6.9	2.736098853	10.24906108
15-Jul	449.403	3.147894824	110.9	-1	-5.2	6,185	1.3	2.636203866	13.82983898
15-Aug	449.592	2.283678456	110.9	-0.9	-15.2	5,059	-4.9	2.977232025	16.62310765
15-Sep	449.496	2.463943541	110.6	-1.4	-8.5	5,464	-3.5	3.587051619	12.32409382
15-Oct	448.616	1.866501966	110.4	-1.7	-16	6,011	-11.6	4.111986002	6.740941859

15-Nov	450.509	1.900675404	109.7	-3	-5	5,520	-12.5	4.108391608	4.545249379
15-Dec	452.756	3.057659171	109.2	-3.3	-14.3	5,882	-5.7	3.735881842	6.673338489
16-Jan	448.171	2.808255473	109.8	-2.1	-19.3	5,041	-9.4	3.29004329	9.647037308
16-Feb	451.209	3.928568961	109.6	-2.1	-13.4	5,223	4	2.931034483	12.59104151
16-Mar	451.274	2.046243428	108.8	-2.4	-8.2	6,545	-3.7	2.928509905	3.064443443
16-Apr	454.231	2.72466377	109.2	-1.7	-11.1	5,824	-6.1	2.920962199	6.238343902
16-May	455.753	2.132270224	109.1	-1.4	-6.1	5,669	0.8	3.525365434	7.534741021
16-Jun	460.563	3.210170358	109.4	-0.9	-2.9	6,053	-6.9	3.951890034	3.254146123
16-Jul	459.744	2.30105273	109.5	-1.3	-10.5	5,291	-14.5	4.280821918	-4.256410256
16-Aug	460.198	2.359027741	109.5	-1.3	2.6	4,819	-4.8	4.081632653	-5.725158562
16-Sep	463.045	3.014264866	109.3	-1.2	-6	5,132	-6.1	3.209459459	-7.086813465
16-Oct	465.368	3.734151256	109.5	-0.8	-3.2	5,402	-10.1	2.68907563	0.385931059
16-Nov	466.974	3.654754955	109.3	-0.4	2.3	5,723	3.7	2.938706969	0.949831621
16-Dec	470.996	4.028660029	110.1	0.8	6.3	5,741	-2.4	3.182579564	3.002132196
17-Jan	473.464	5.643604785	109.8	0	11.1	4,944	-1.9	3.772003353	-3.085647569
17-Feb	472.513	4.721537026	110.1	0.5	20.2	5,313	1.7	3.936348409	-8.571197542
17-Mar	472.991	4.81237563	110.3	1.4	13.1	6,201	-5.3	4.351464435	-2.195015304
17-Apr	474.547	4.472614154	111.5	2.1	23.8	6,036	3.6	4.424040067	-0.122882472
17-May	474.76	4.170460754	111.5	2.2	13.1	5,521	-2.6	3.986710963	-6.058571788
17-Jun	474.488	3.023473444	111.7	2.1	13.4	5,982	-1.2	3.553719008	-0.66851884
17-Jul	476.752	3.699450129	111.5	1.8	19.5	5,661	7	3.201970443	-0.107123728
17-Aug	476.513	3.545213147	110.7	1.1	17.3	5,953	23.5	3.022875817	1.166128454
17-Sep	485.419	4.831927782	111.1	1.6	35	6,597	28.5	3.600654664	4.004358485

Date	US retail sales (Billion $,SA)	US retail sales (YOY %)	Index of industrial product (YOY%)	KR Exports growth rate (YOY%)	Won/Dollar (YOY%)
Jan-07	363.52	1.72	1.5	20.8	-2.43
Feb-07	364.09	2.64	2.4	10.3	-3.01
Mar-07	367.414	3.26	2.4	13.2	-3.17
Apr-07	366.28	2.43	2.8	17	-1.31
May-07	370.867	4.02	3.0	11.1	-1.90
Jun-07	368.08	2.89	2.6	14.5	-2.62
Jul-07	369.5	2.90	2.5	17.2	-3.75
Aug-07	371.019	2.91	2.4	13.6	-2.39
Sep-07	372.936	3.97	2.9	-1.1	-3.29
Oct-07	375.217	4.69	2.5	22.9	-4.42

Nov-07	378.481	5.37	3.1	17	-0.88
Dec-07	375.256	3.02	2.1	14.8	0.68
Jan-08	375.28	3.24	2.3	14.9	0.29
Feb-08	371.734	2.10	0.9	18.9	-0.29
Mar-08	372.656	1.43	0.5	18.4	5.26
Apr-08	373.086	1.86	-1.0	26.4	7.71
May-08	375.851	1.34	-1.6	26.9	11.02
Jun-08	376.378	2.25	-1.7	16.4	13.22
Jul-08	374.837	1.44	-2.2	35.6	10.09
Aug-08	372.112	0.29	-3.8	18.1	16.05
Sep-08	366.377	-1.76	-8.2	27.6	31.89
Oct-08	352.768	-5.98	-7.0	7.8	43.34
Nov-08	339.776	-10.23	-8.6	-19.5	59.47
Dec-08	332.307	-11.45	-11.3	-17.9	34.56
Jan-09	336.918	-10.22	-13.2	-34.50	46.16
Feb-09	335.698	-9.69	-13.4	-18.50	63.30
Mar-09	329.947	-11.46	-14.5	-22.50	39.67
Apr-09	331.313	-11.20	-14.7	-19.90	27.96
May-09	334.315	-11.05	-15.2	-29.40	21.85
Jun-09	339.535	-9.79	-15.5	-13.60	21.79
Jul-09	340.229	-9.23	-14.1	-22.10	21.41
Aug-09	346.657	-6.84	-11.9	-20.90	14.69
Sep-09	338.427	-7.63	-7.2	-9.40	-2.39
Oct-09	341.578	-3.17	-7.7	-8.50	-8.39
Nov-09	344.579	1.41	-6.3	17.90	-20.85
Dec-09	346.215	4.19	-3.1	32.80	-7.53
Jan-10	346.252	2.77	0.4	45.40	-15.79
Feb-10	346.835	3.32	1.4	30.10	-24.36
Mar-10	354.564	7.46	3.7	33.80	-18.20
Apr-10	357.095	7.78	5.1	29.60	-13.61
May-10	354.267	5.97	7.9	39.80	-4.21
Jun-10	353.811	4.20	8.5	30.50	-4.06
Jul-10	354.457	4.18	7.9	26.70	-3.75
Aug-10	356.505	2.84	7.2	26.00	-4.00
Sep-10	359.326	6.18	6.7	16.20	-3.21
Oct-10	363.736	6.49	6.1	27.60	-4.85
Nov-10	367.33	6.60	5.7	21.40	-0.25
Dec-10	369.294	6.67	6.2	22.60	-2.56
Jan-11	372.047	7.45	4.9	44.70	-3.47
Feb-11	374.97	8.11	4.2	16.40	-2.70

Mar-11	378.472	6.74	4.5	28.80	-3.07
Apr-11	380.796	6.64	3.7	23.50	-3.33
May-11	380.402	7.38	2.3	21.70	-10.24
Jun-11	383.072	8.27	2.3	11.10	-12.65
Jul-11	382.93	8.03	2.3	21.10	-10.86
Aug-11	383.822	7.66	2.5	25.50	-11.02
Sep-11	387.402	7.81	2.1	18.00	3.32
Oct-11	390.299	7.30	3.1	7.60	-1.35
Nov-11	391.571	6.60	2.9	11.50	-1.44
Dec-11	391.744	6.08	2.5	8.20	1.51
Jan-12	395.317	6.25	3.3	-7.30	0.17
Feb-12	400.042	6.69	4.0	20.40	-0.89
Mar-12	401.859	6.18	2.4	-1.50	3.31
Apr-12	400.077	5.06	3.7	-5.00	5.47
May-12	399.37	4.99	3.7	-1.00	9.38
Jun-12	395.782	3.32	3.5	0.90	7.28
Jul-12	397.347	3.76	3.3	-8.70	7.24
Aug-12	401.904	4.71	2.2	-6.00	6.37
Sep-12	405.658	4.71	2.3	-2.40	-5.65
Oct-12	405.877	3.99	1.9	1.00	-1.74
Nov-12	407.386	4.04	2.6	3.90	-5.27
Dec-12	409.343	4.49	2.4	-6.00	-7.07
Jan-13	412.125	4.25	1.6	10.90	-3.06
Feb-13	416.603	4.14	1.9	-8.60	-3.20
Mar-13	413.848	2.98	2.8	0.00	-1.92
Apr-13	412.655	3.14	1.8	0.10	-2.54
May-13	414.182	3.71	1.6	3.10	-4.29
Jun-13	415.777	5.05	1.8	-1.00	-0.30
Jul-13	418.222	5.25	0.9	2.60	-0.63
Aug-13	417.503	3.88	2.2	7.60	-2.17
Sep-13	417.565	2.94	2.7	-1.70	-3.31
Oct-13	419.693	3.40	2.4	7.20	-2.75
Nov-13	421.033	3.35	2.1	0.20	-2.28
Dec-13	423.005	3.34	2.1	6.90	-1.42
Jan-14	418.8	1.62	1.7	-0.20	-1.70
Feb-14	424.117	1.80	2.1	1.40	-1.42
Mar-14	429.72	3.84	2.8	3.70	-4.20
Apr-14	433.675	5.09	3.1	8.90	-6.17
May-14	434.334	4.87	3.3	-1.50	-9.70
Jun-14	435.094	4.65	3.5	2.40	-11.40

Jul-14	435.688	4.18	4.2	5.20	-8.51
Aug-14	439.554	5.28	3.3	-0.40	-8.66
Sep-14	438.687	5.06	3.0	6.30	-1.81
Oct-14	440.396	4.93	3.2	2.30	0.69
Nov-14	442.106	5.01	3.7	-2.70	4.67
Dec-14	439.323	3.86	3.2	3.10	4.16
Jan-15	435.929	4.09	2.9	-1.00	2.16
Feb-15	434.153	2.37	1.7	-3.40	2.89
Mar-15	442.225	2.91	0.5	-4.60	4.21
Apr-15	442.183	1.96	-0.1	-8.00	3.78
May-15	446.238	2.74	-0.7	-11.00	8.63
Jun-15	446.238	2.56	-1.3	-2.70	10.25
Jul-15	449.403	3.15	-1.0	-5.20	13.83
Aug-15	449.592	2.28	-0.9	-15.20	16.62
Sep-15	449.496	2.46	-1.4	-8.50	12.32
Oct-15	448.616	1.87	-1.7	-16.00	6.74
Nov-15	450.509	1.90	-3.0	-5.00	4.55
Dec-15	452.756	3.06	-3.3	-14.30	6.67
Jan-16	448.171	2.81	-2.1	-19.30	9.65
Feb-16	451.209	3.93	-2.1	-13.40	12.59
Mar-16	451.274	2.05	-2.4	-8.20	3.06
Apr-16	454.231	2.72	-1.7	-11.10	6.24
May-16	455.753	2.13	-1.4	-6.10	7.53
Jun-16	460.563	3.21	-0.9	-2.90	3.25
Jul-16	459.744	2.30	-1.3	-10.50	-4.26
Aug-16	460.198	2.36	-1.3	2.60	-5.73
Sep-16	463.045	3.01	-1.2	-6.00	-7.09
Oct-16	465.368	3.73	-0.8	-3.20	0.39
Nov-16	466.974	3.65	-0.4	2.30	0.95
Dec-16	470.996	4.03	0.8	6.30	3.00
Jan-17	473.464	5.64	0.0	11.10	-3.09
Feb-17	472.513	4.72	0.5	20.20	-8.57
Mar-17	472.991	4.81	1.4	13.10	-2.20
Apr-17	474.547	4.47	2.1	23.80	-0.12
May-17	474.76	4.17	2.2	13.10	-6.06
Jun-17	474.488	3.02	2.1	13.40	-0.67
Jul-17	476.752	3.70	1.8	19.50	-0.11
Aug-17	476.513	3.55	1.1	17.30	1.17
Sep-17	485.419	4.83	1.6	35.00	4.00

Source :	The Conference Board & Bureau of the Census	The Conference Board & Bureau of the Census	BOK	BOK	BOK