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 expoit comparative advantages that arise through specialization. More goods and services can be produced and this in turn leads 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.

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 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.

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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)

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

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 (2012) argue that on an aggregate level, there is 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]

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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.

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.

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.

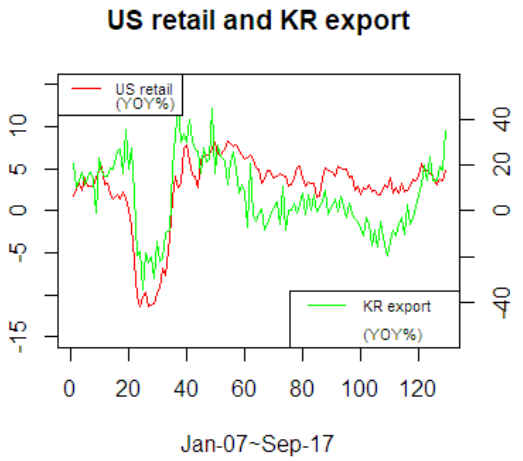
1-2) **Exogenous variable 1: Increasing rate of US retail sales (US retail)**

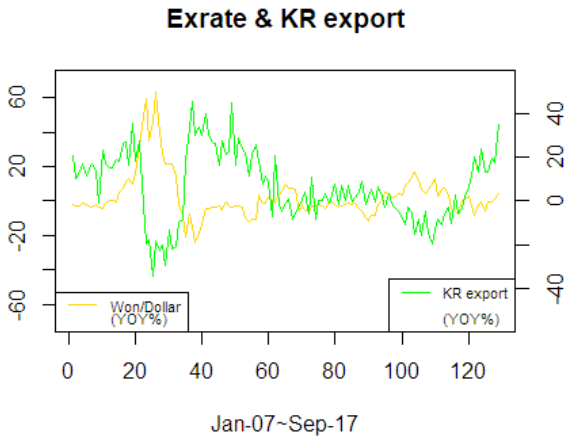
We assumed that there are several macroeconomic factors which have a decisive effect on the fluctuation of KR export. Among them, we selected the retail sector of US under the commonsensical inference that the consumption of US can represent global economy condition. Therefore, we found US retail consumption 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.

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



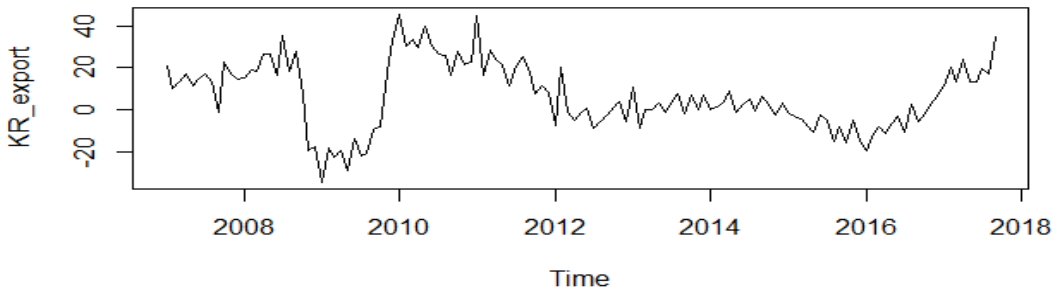


As you can see above, KR export shows very similar shape with US retail. We can say that there is strong relationship between KR export and US retail as we assumed before. And the graph shows the difference of the degree of variation, which means that the fluctuation of KR export seems more variable 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. The unexpected above could be explained in two different ways. Either Exrate does not have that close relationship with KR export as we expected, or there would be a time lag so that the variation of Exrate impact on KR export 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>

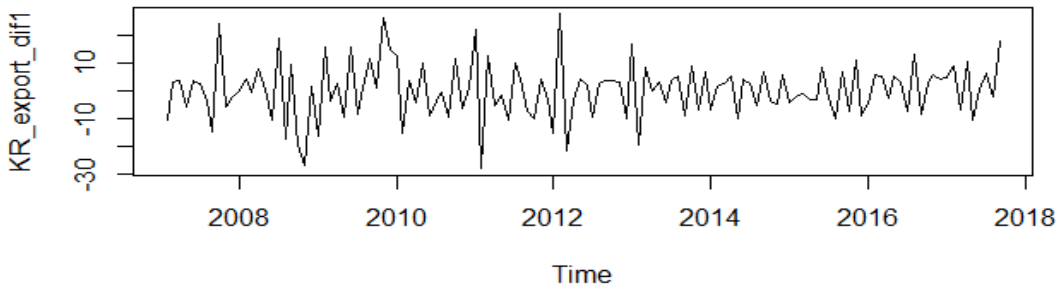
As you can see, the increasing rate of KR export is non-stationary, because the mean and variance are not constant. And we carried out Augmented Dickey-Fuller test by using R.

```
        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_dif1)

        Augmented Dickey-Fuller Test

data:  KR_export_dif1
Dickey-Fuller = -4.4941, Lag order = 5, p-value = 0.01
alternative hypothesis: stationary

경고메시지(들):
In adf.test(KR_export_dif1) : p-value smaller than printed p-value
```

<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
```

<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
```

```
> 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.

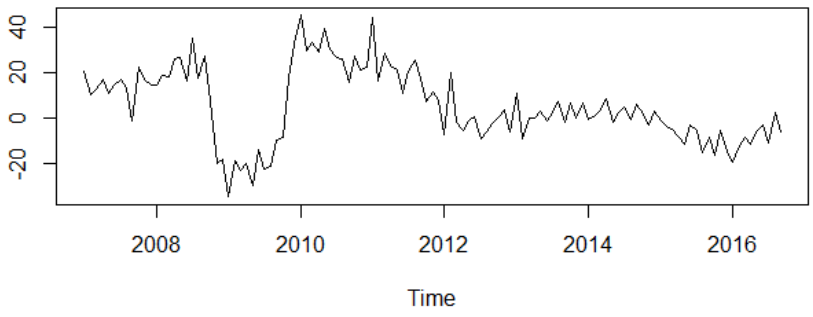
5) Time series analysis

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>

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 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).

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

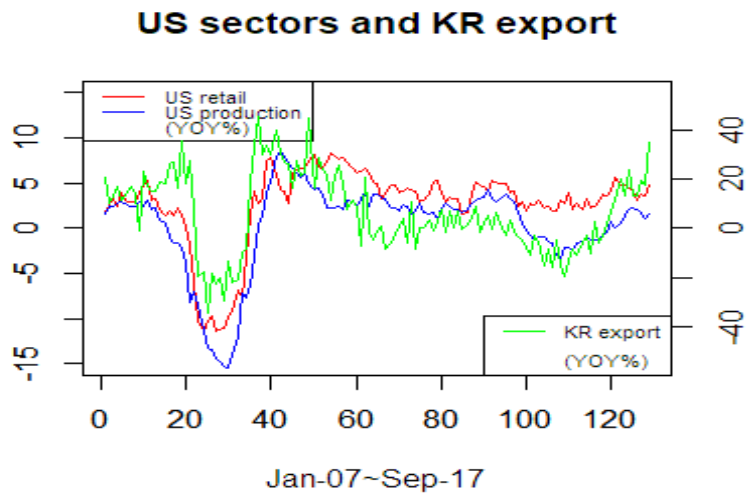
In order to determine prediction power, we calculated MSE and compared them.

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.



US product would come into this description 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.

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

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 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 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 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 the increasing rate of US retails and that of KR export rate. If we can prove it by statistical methods, it would be a great proof of the bullwhip effect.

7. Appendix: References and Data

1) References

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

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2) Data

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