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Determining Shipping Cycle by Supply/Demand Ratio and Markov Regime Switching

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Summary of Presentation

- Nature of Shipping Market Fluctuation (including Shipping Cycle)
- Applying Markov Regime Switching
- Characteristics of Detected Regimes
- Summary

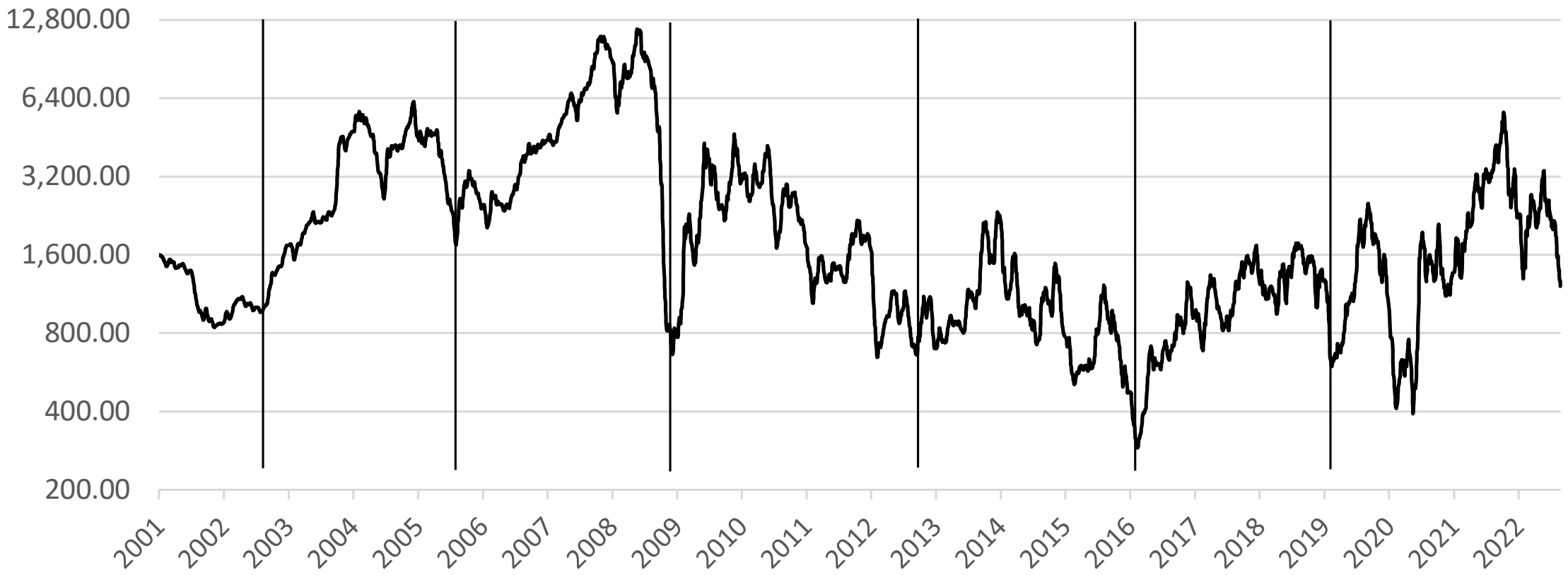
Impact of Market Fluctuation

- In the shipping market, different cycles of fluctuation have different use cases.

- Among these cycles, a cycle having a length of three to five years is one of most important from the viewpoint of investment in vessels.

- This cycle is usually called a "Shipping Cycle."

Recent Shipping Cycles



- A shipping cycle usually begins at a market bottom, lasts three to five years, then ends at another market bottom.

Focusing Deviation from Supply/Demand

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As for investigating the fluctuation, focusing on deviation from the level decided by supply and demand rather than the charter rate itself has some benefits.

- Supply and demand are believed to decide charter rates in the long run.
- There are a lot of forecasts and analyses for both supply (fleet capacity) and demand (cargo trade volume).
- However, even when supply and demand forecasts are on target, there is usually a deviation between expected and actual charter rates.
- If the deviations have regularity, combining that regularity with supply and demand data would give better forecasts.

Characteristics of Fluctuation

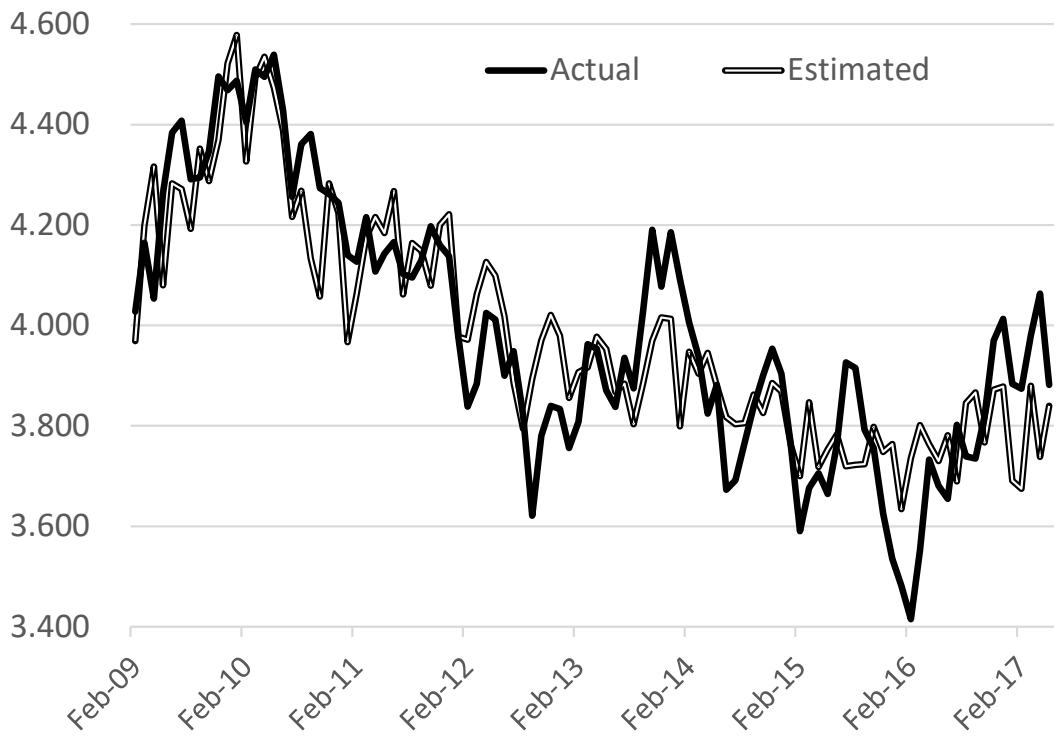
From the viewpoint of deviation from supply/demand level, fluctuations can be categorized as below:

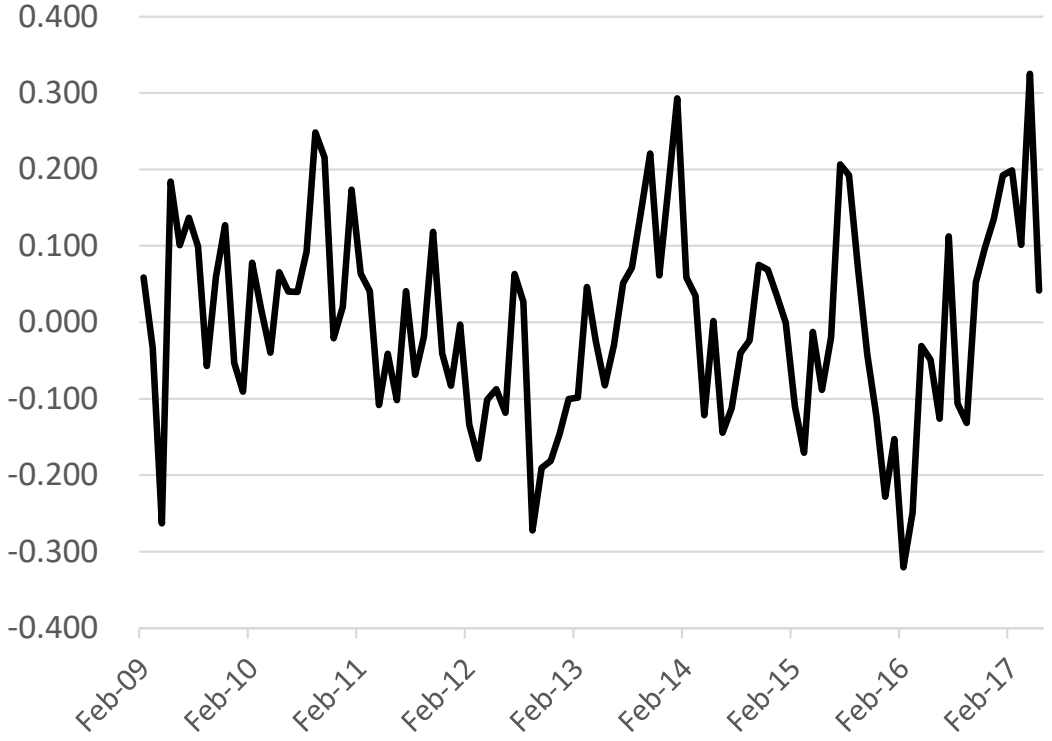
- Irregular fluctuations
  - Deviation decreases over periods
- Periodic and cyclical fluctuations
  - Can be defined by autocorrelation
- Periodic and non-cyclical fluctuations
  - Can be defined by model changes

Irregular Fluctuation

According to Hayashi (2020)

- Charter rates and supply/demand ratio move together (they are cointegrated).
- Irregular fluctuation decreases 50% every month.

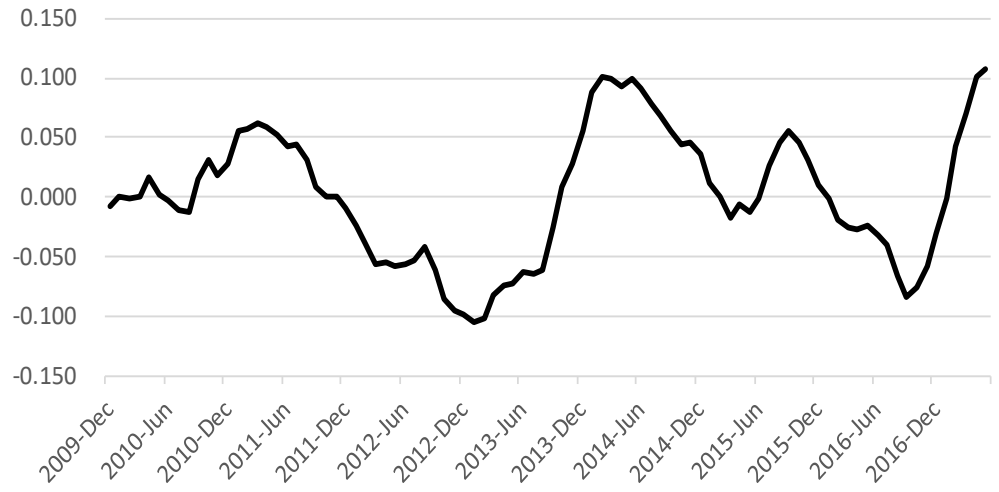


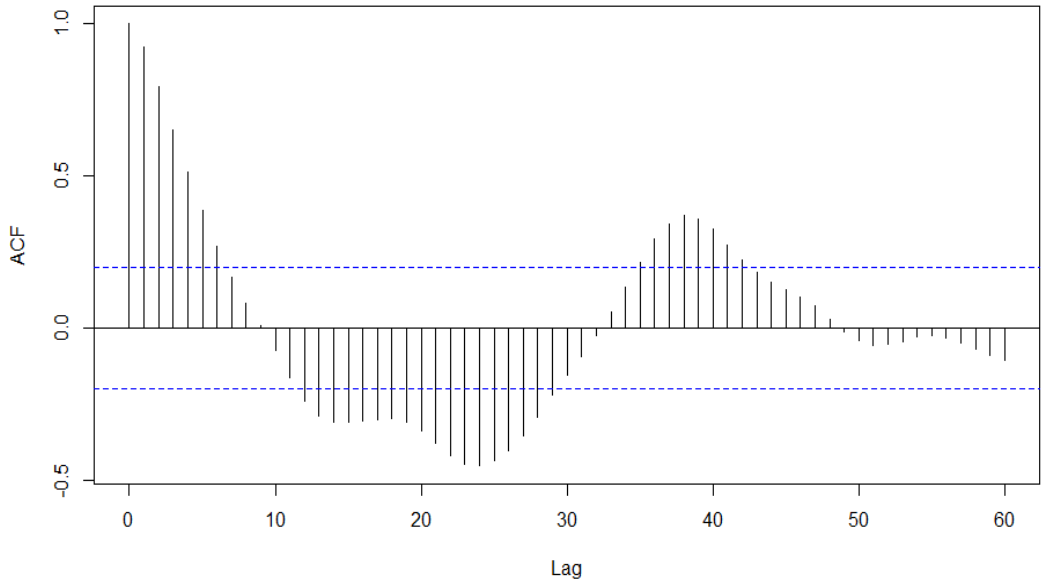


Periodic and Cyclical Fluctuations

According to Hayashi (2019)

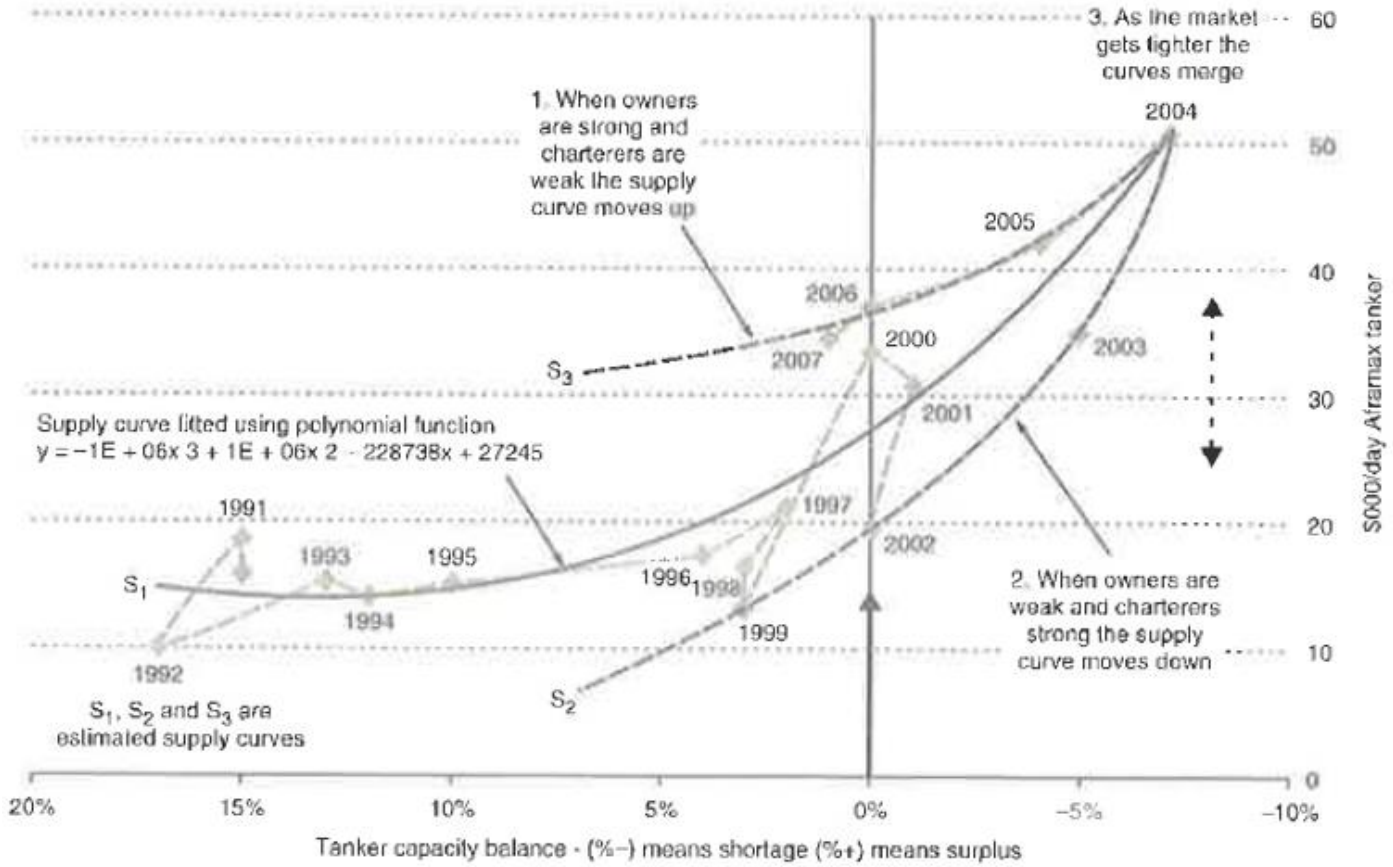
- A collerogram can detect the autocorrelation of deviation from the supply/demand ratio.
- The size of influence is up to ±25%, and the length of the cycle is 38 months.
- The length coincides with the shipping cycle, but influence is not large enough.





Periodic and Non-Cyclical Fluctuations

- Stopford (2015) plots charter rates and supply-demand ratios of Aframax tankers with multiple fitting curves.
- This means that the relationship changes discontinuously every few years.



Purpose of This Study

- Assuming a model to calculate charter rates from supply/demand ratio,
- Try to detect changes of the model in the target periods
- By applying a statistical method

Markov Regime Switching

This study employs the Markov Regime Switching Model (hereafter referred to as MSwM).

MSwM is used to detect switching among models (regimes) by unobservable variables within a time-series.

MSwM is introduced in econometrics by Hamilton (1989). The model gives a good representation of the business cycle and has been widely used in economics and finance.

Detecting Model Change Using MSwM

This study assumes the below regression model, as discussed in Hayashi (2020).

$$\text{charter rate} = \alpha \times \text{supply-demand ratio} + \beta$$

MSwM is then applied to detect changes (e.g., values of regression coefficient α and intercection β) and the timing of changes.

Data Used in This Study

- Charter rate: Baltic Panamax 4T/C average

- Supply: Panamax fleet capacity (in DWT)
- Demand: Export volume of major Panamax cargoes and countries

- 12-month moving average is applied to remove seasonal and short-term random fluctuations

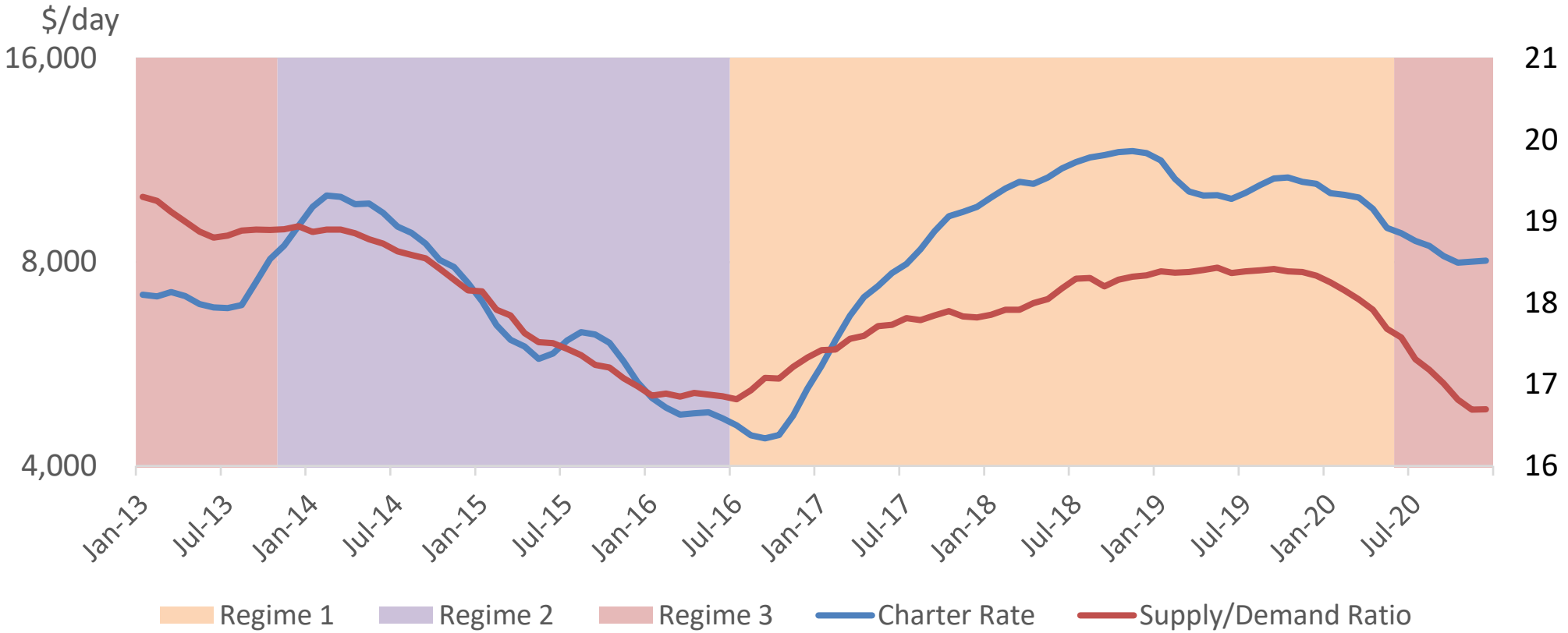
Examined Periods

- Two periods are examined.
  - (1) January 2013 to December 2020
  - (2) January 2001 to December 2008

- Both periods contain two shipping cycles recognized in the shipping industry.

- External influence factors are different.
  - Period (1) has no significant external influencer on charter rates.
  - Period (2) is affected by the Capesize market; when the Capesize market is high, the Panamax market is also high regardless of its own supply/demand ratio.

Detected Regimes in Period (1)



	Beginning/End of Regimes	Regression Coefficient	Intersection	Coefficients of Determination
Regime 1	2016/07～2020/05(47 mos.)	0.27	−0.84	0.87
Regime 2	2013/11～2016/06(32 mos.)	0.14	1.33	0.95
Regime 3	～2013/10、2020/06～(17 mos.)	0.03	4.39	0.55

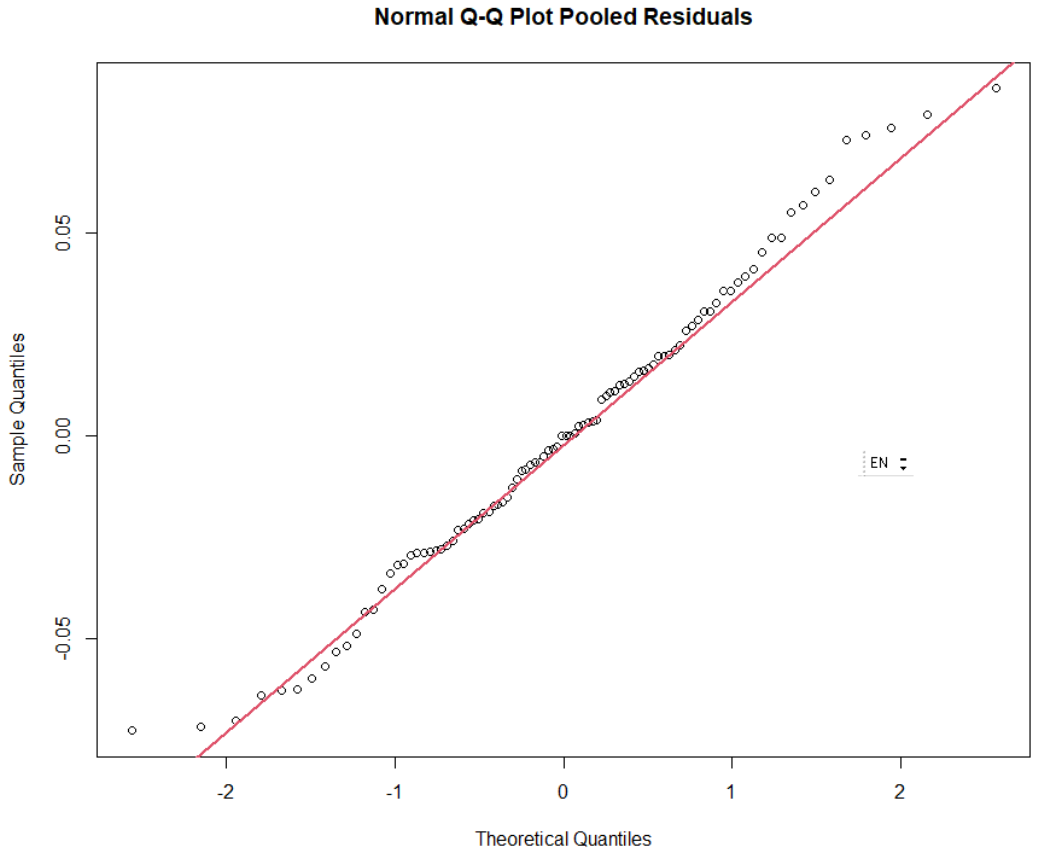
Regimes in Period (1)

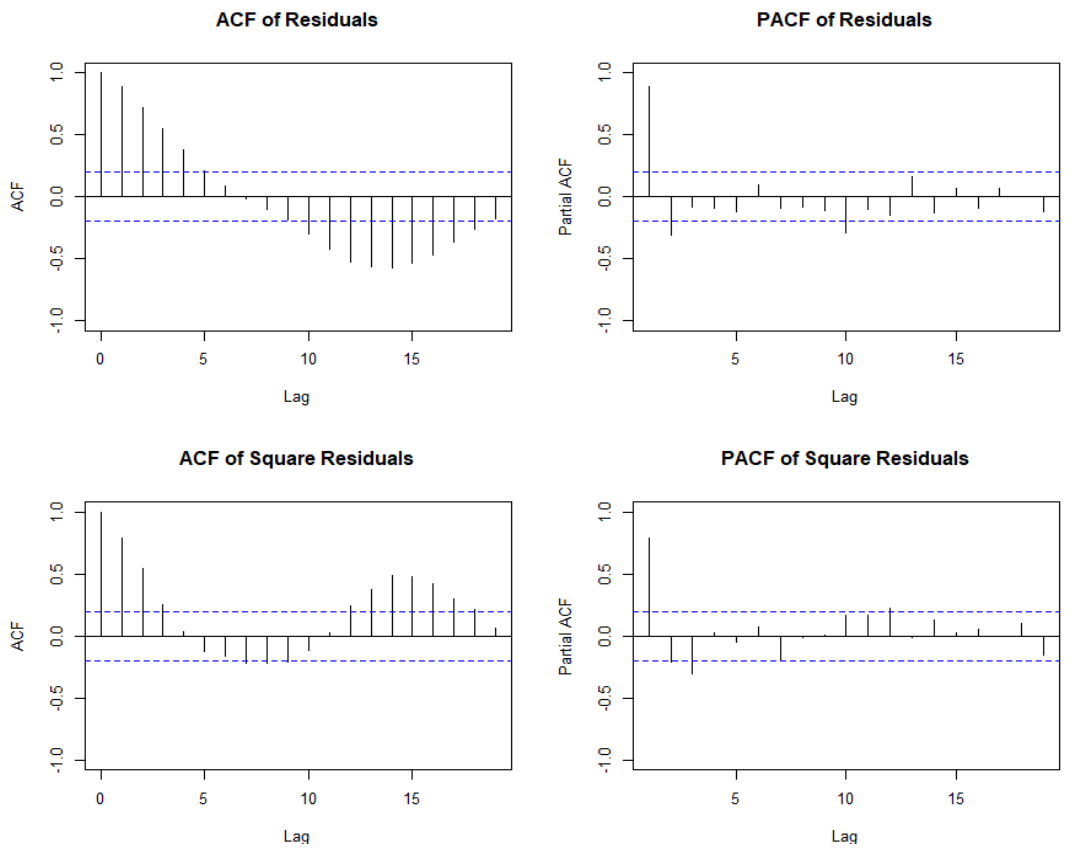
- Regimes 1 and 2 are consistent with the shipping cycle recognized in the industry.
- The coefficients of determination were very high (0.87 and 0.95).
- The regression coefficients show a large difference (0.27 and 0.14)
  - This means that charter rates are more sensitive to the supply-demand ratio in regime 2.

- Regime 3 is not consistent with the shipping cycle, and parameters are not as good as regimes 1 and 2.
  - This may be because it includes the two different shipping cycles at the beginning and the end.

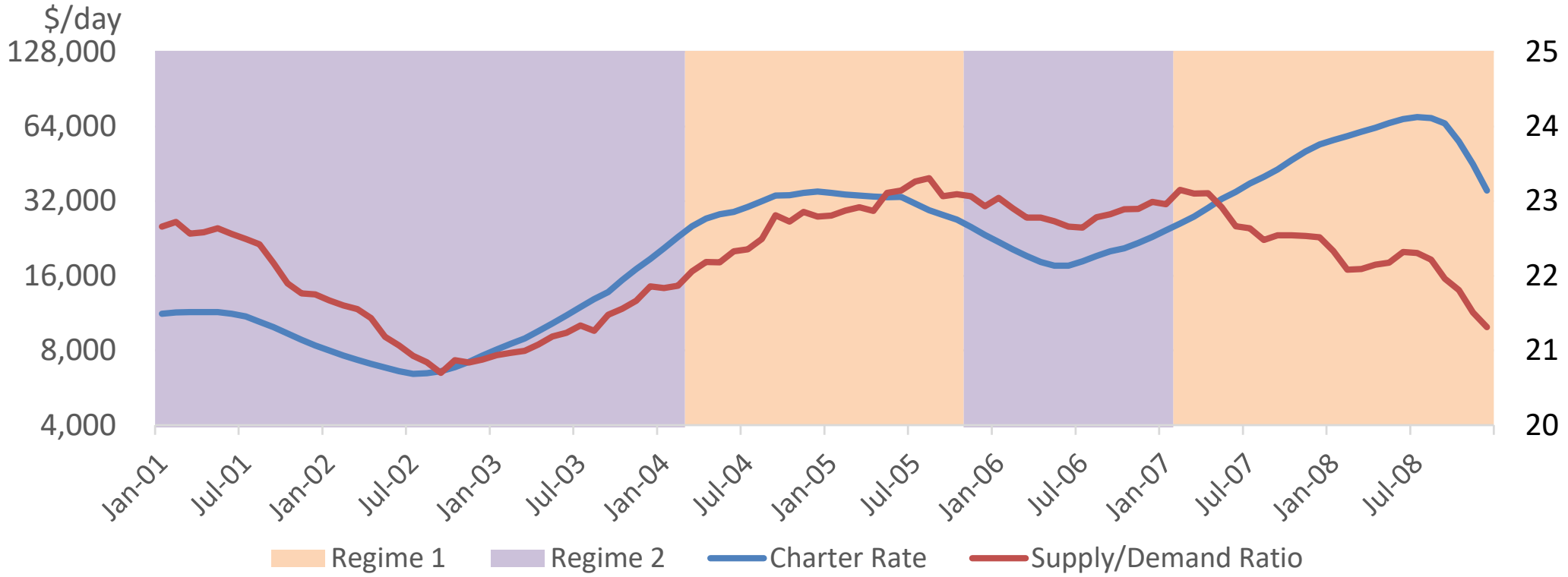
Q-Q Plot for Period (1)

- A Q-Q plot shows that the residuals are generally white noise.
- Also, there is no significant partial autocorrelation.





Detected Regimes in Period (2)



	Beginning/End of Regimes	Regression Coefficient	Intersection	Coefficients of Determination
Regime 1	2004/03～2005/10(20 mos.) 2007/02～2008/12(23 mos.)	-0.16	8.21	0.29
Regime 2	2001/01～2004/02(38 mos.) 2005/11～2007/01(15 mos.)	0.19	-0.15	0.60

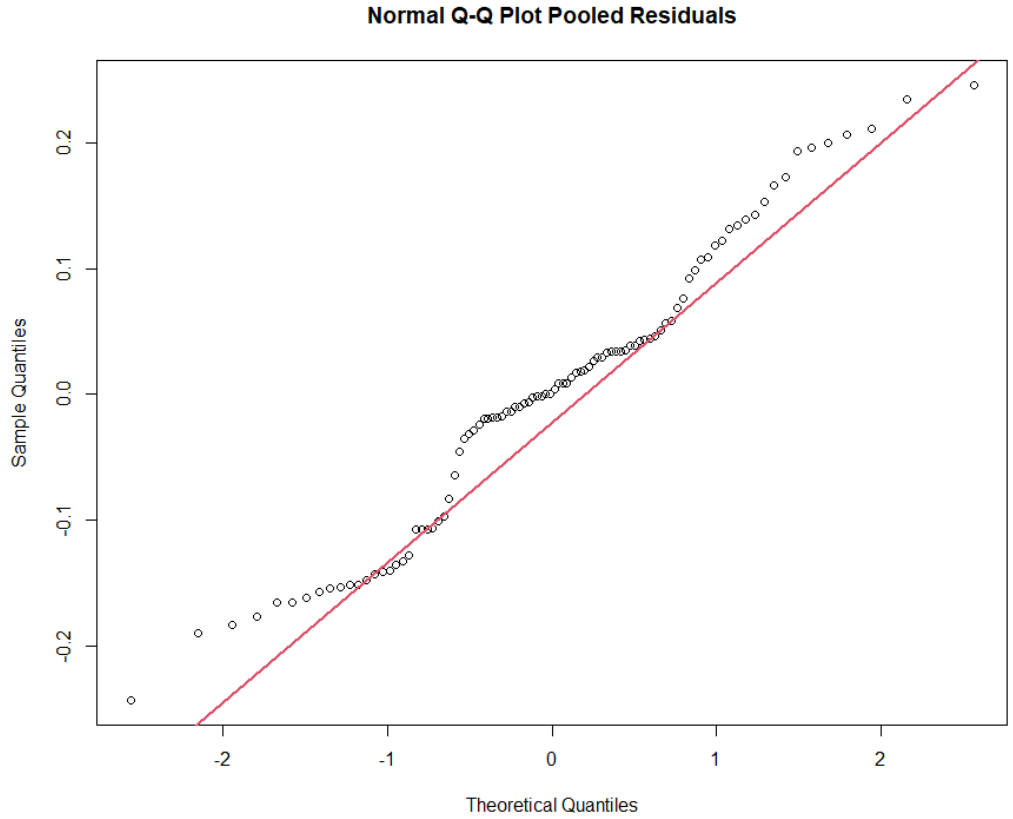
Regimes in Period (2)

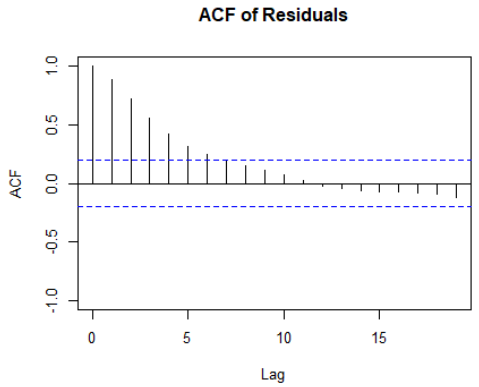
- Regimes 1 and 2 seem to be divided not by shipping cycles, but by whether charter rates are above or below a certain level.

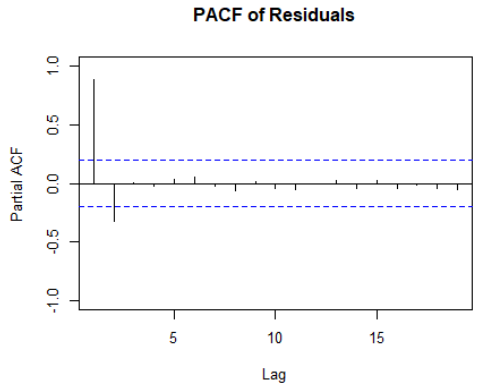
- In regime 1, the regression coefficient is negative (inverse correlation).
  - This suggests that the supply/demand ratio did not affect the charter rate within this regime.
- In regime 2, the regression coefficient is positive, but the coefficient of determination (0.60) is much smaller than Period (1).

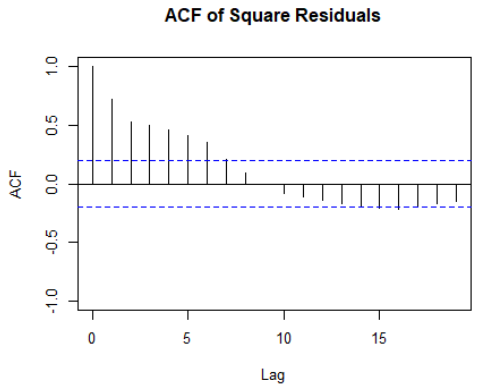
Q-Q Plot for Period (2)

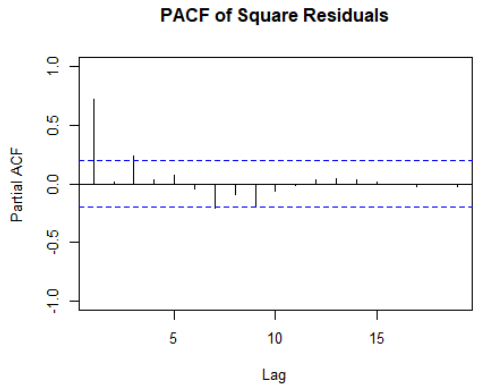
- A Q-Q plot suggests that the residuals are not white noise. Another factor needs to be included.
- Partial autocorrelation is almost non-existent and is not the reason for skewed residuals.











Summary

- MSwM is useful to detect the change in relationship model between charter rates and supply/demand ratio.

- However, the detected regimes don't always match the shipping cycles.
  - In Period (1), the regimes are consistent with the shipping cycles recognized in the industry.
  - In Period (2), the regimes are based on high/low charter rates (e.g., whether influence from the Capesize market exists or not).