Get to know the "tendencies" in the oil demand forecasts

OPEC is slightly bearish. IEA and DOE/EIA tend to linger in the past. Stickiness exists in the forward term forecasts.

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Summary

Crude oil prices are falling. It is reported that the softening trend of crude oil prices has become clear, triggered by IMF's downgrading of its world economic outlook on 7 October 2014, followed by the downward revision of the oil demand forecasts by the International Energy Agency (IEA) on 14 October 2014. In this context, the direction of revision of the oil demand forecasts is an important factor together with the amount of revision. In this report, an attempt is made to identify the respective "tendencies" in the forecasts published in the "Oil Market Report" of the IEA, the "Short-Term Energy Outlook" of the Energy Information Administration of the U.S. Department of Energy (DOE/EIA), and the "Monthly Oil Market Report" by the Organization of the Petroleum Exporting Countries (OPEC), which are the representative short-term world oil demand forecasts.

The expectation values in the amount of revisions in the forecasts made by the three organisations are almost 0 kb/d. Therefore, it can be interpreted that the revision is non-biased in general. However, in the case of the IEA and the DOE/EIA, the modal classes of the revisions of the current term forecasts are revised downward, whereas in the case of the OPEC, the said class is revised upward. In other words, characteristically, the most typical pattern of the IEA and the DOE/EIA is to present forecasts with higher values first and reduce them later, whilst that of the OPEC is to make modest predictions first and raise them later.

Concerning the forecasts of the IEA and the DOE/EIA for the term after next, when they make upward revisions on their current reports, the probability that they will revise upward again in their next reports has become higher. On the contrary, the probability that they will revise upward after revising downward to offset or diminish such a revision are very low. The number of cases in which the IEA makes an upward revision in this manner is less than one in three. The probability of the DOE/EIA revising upward in the issue following the one in which downward revision was made falls to as low as 24%. In short, a positive autocorrelation can be observed that revision in the same direction tends to continue in these revisions of the forecasts.

Keywords: Oil demand forecast, IEA, DOE/EIA, and OPEC

Figure | Probabilities of upward revision in the forecasts of the next issue when the oil demand forecasts are revised downward in the current issue
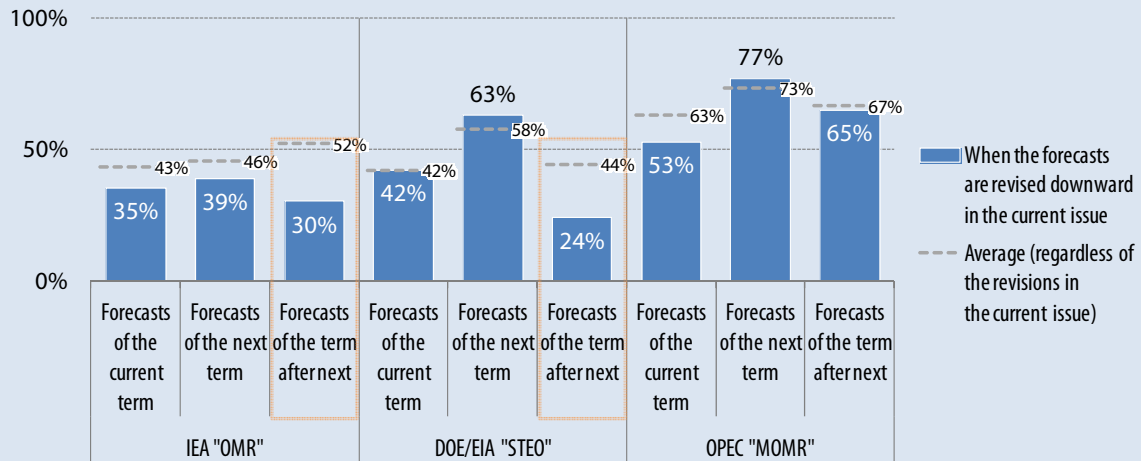

It is generally believed that the amount of revisions tends to become larger in the forward term predictions because it is difficult to predict further into the future. However, in the cases of all three organisations, the further the projected term, the smaller the standard deviation of the amount of revisions – even though autocorrelation can be observed in the revisions of the forecasts of the IEA and the DOE/EIA for the term after next. In the background of such a decrease, there can be a trend that the further in the future the forecasts go, the smaller the revisions become in the assumptions about factors such as size of the economy, temperatures, and energy prices that influence the oil demand (and its forecasts).

IEA's reduction of demand forecast that shook the oil market

The crude oil prices are falling (Figure 1). There are several theories as to the possible causes of the slump, however, there is widespread consensus that ease or the prospect of ease in the oil demand/supply situation is one of the fundamental factors.

Figure 1 | Brent crude oil prices
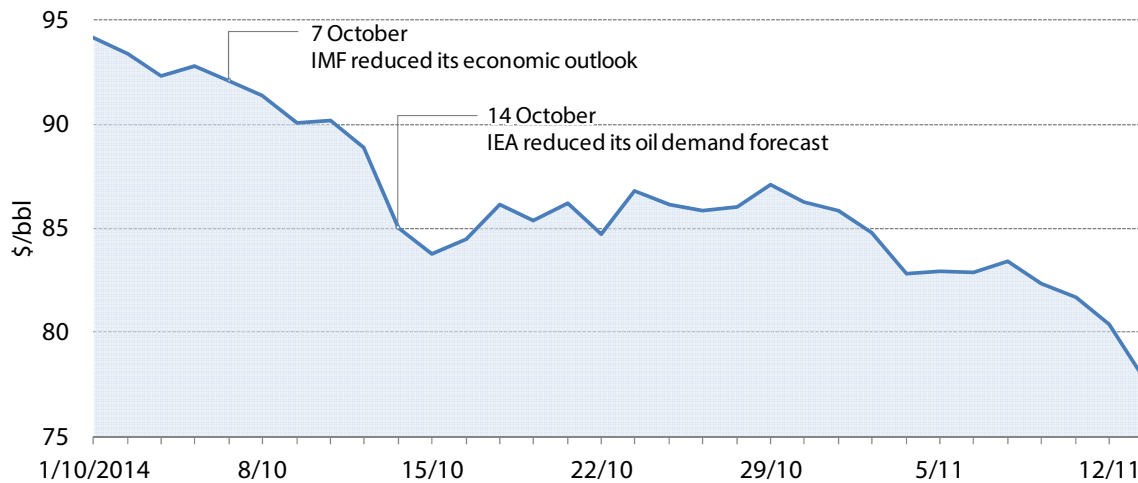
Note: Front month, settlement price
Source: Intercontinental Exchange

The softening trend of crude oil prices has become clearer in response to the reduction of the world economic outlook by the International Monetary Fund (IMF) on 7 October 2014. Moreover, the International Energy Agency (IEA) reduced its annually averaged 2014 oil demand forecast by more than 200 kb/d in the "Oil Market Report" (OMR) on 14 October, only a week after the IMF's announcement (Figure 2). As a result, the Brent crude oil prices significantly declined by $3.85/bbl. The crude oil market condition has been weak since then. The Brent crude oil price, which was $94/bbl in the beginning of October dropped to as low as $78/bbl within six weeks.

Figure 2 | World oil demand forecasts
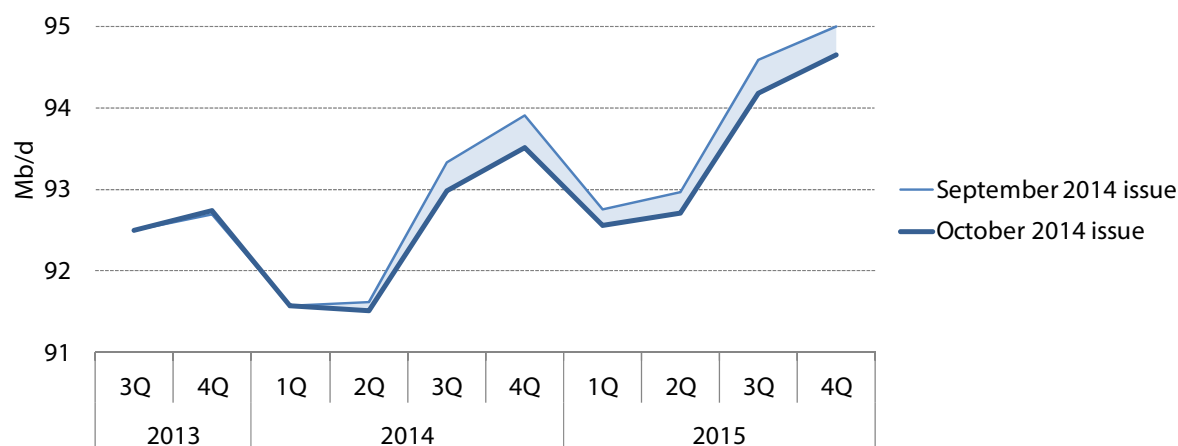
Note: Including biofuels
Source: IEA "Oil Market Report"

Revision of the oil demand forecasts is not unusual although it depends on the amount of the revisions. It, however, may result in considerable consequences like as the current circumstances. From this point of view, concerning the oil demand forecasts, the amount and direction of revision to the forecasts are as important as or even more important than the projected demands themselves. In this report, an attempt was made to summarise the trends observed in the revisions made in the representative short-term world oil demand forecasts from the previous to the current issues and to identify the "tendencies" of the revisions in those forecasts. The forecasts studied here are those published from January 2011 to October 2014 in (1) IEA's "OMR," (2) the "Short-Term Energy Outlook" of the Energy Information Administration of the U.S. Department of Energy (DOE/EIA "STEO") and (3) the "Monthly Oil Market Report" by the Organization of Petroleum Exporting Countries (OPEC "MOMR").

## OPEC is slightly more bearish than IEA and DOE/EIA

Almost no bias is found in the revisions for the current term[1] oil demand forecasts stated in IEA's "OMR", DOE/EIA's "STEO" and OPEC's "MOMR". Specifically, the expectation values in the revisions are 0 kb/d in the cases of DOE/EIA and OPEC, and +20 kb/d (about 0.02% of the demand) in the case of IEA. Therefore, it can be interpreted that there is no bias in the forecasts of these three organisations in general[2].

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[1] The current term means the first quarter if the forecast is presented in February, March, and April issues. For DOE/EIA, the forecast for a quarter is prepared by arranging the monthly forecasts.
[2] Since revisions are often made even after the forecast horizon was over and the forecast became the historical value, assessment as not forecast but statistics may require longer time.

However, the market's attention is directed to the amount of the revisions and directions such as the raise (upward revision) and reduction (downward revision) of the monthly announced forecast, rather than the average amount of revision. The characteristics of the forecasts of respective organisations can then be identified if we focus on the frequency in appearance of the amount of revisions according to class, rather than on the statistical amount such as the expectation values (Figure 3).

Figure 3 | Frequencies of the revisions made to the current term forecasts
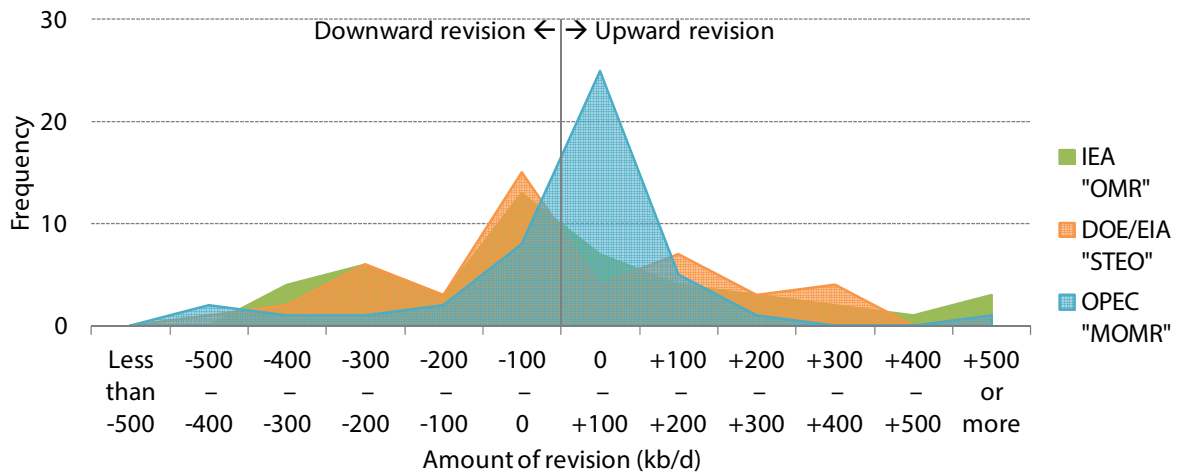
Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

It is common to all of the three organisations that the mode classes of revisions are located near 0 kb/d. However, in the case of the OPEC, this class is located on the side of upward revision (0 kb/d or more, to less than +100 kb/d), whereas in the case of the IEA and the DOE/EIA, the same classes are located on the side of downward revision (-100 kb/d or more, to less than 0 kb/d). In this report, the forecasts announced in the same period (from January 2011 to October 2014) are analysed; therefore, the changes in the real economy, temperatures, and energy prices that may affect the revisions of the oil demand forecasts are common to the forecasts made by the three organisations. In other words, there is no such case that the forecasts of the IEA and the DOE/EIA are more profoundly affected by the influence of economic recession and rise of energy prices whilst that of the OPEC is the other way around. Nevertheless, the mode classes of the IEA and the DOE/EIA are located on the side of downward revision, whereas the mode class of the OPEC is located on the side of the upward revision. In short, the most typical pattern characteristic to these three organisations is that the IEA and the DOE/EIA tend to propose higher forecasts first and reduce them later, whilst the OPEC tends to propose modest forecasts first and raise them later.

Next, focus is placed on the dispersion of the amount of revisions. In the case of the OPEC, more than half of the samples are concentrated in the mode class between 0 and +100 kb/d, whilst in the case of the IEA and the DOE/EIA, the samples are distributed across a relatively wide range. When

calculating the dispersions by the standard deviation, they are 160 kb/d for the OPEC, 210 kb/d for the DOE/EIA, and 290 kb/d for the IEA. The IEA reduced the demand forecasts for the third quarter of 2014 by 350 kb/d in its October 2014 issue of "OMR" and caused significant ripples in the market. However, the IEA in fact made four downward revisions[3] with the amount equal to or exceeding 300 kb/d in slightly less than four years, and 10 downward revisions with the amount equal to or exceeding 200 kb/d. Thus, the actions taken are not necessarily special. Essentially, forecasts and the amount of revisions should be evaluated with a certain amount of leeway.

Concerning the forecasts of the next term and the term after next, the mode classes of the revisions of all three organisations are located near 0 kb/d (Figure 4). What is slightly different from the current-term forecasts is that the mode class of the IEA's revision to the forecast for the term after next is located on the side of upward revision, unlike the forecasts for the current and the next terms.

Figure 4 | Frequencies of the revisions of the forecasts for the next term and the term after the next

(a) Forecasts for the next term

(b) Forecasts for the term after the next
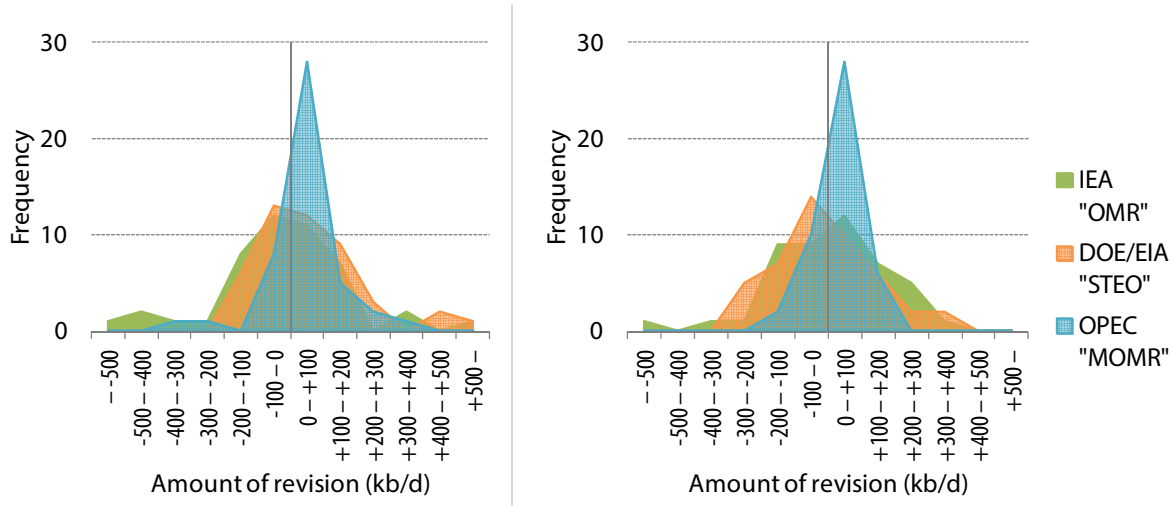
Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

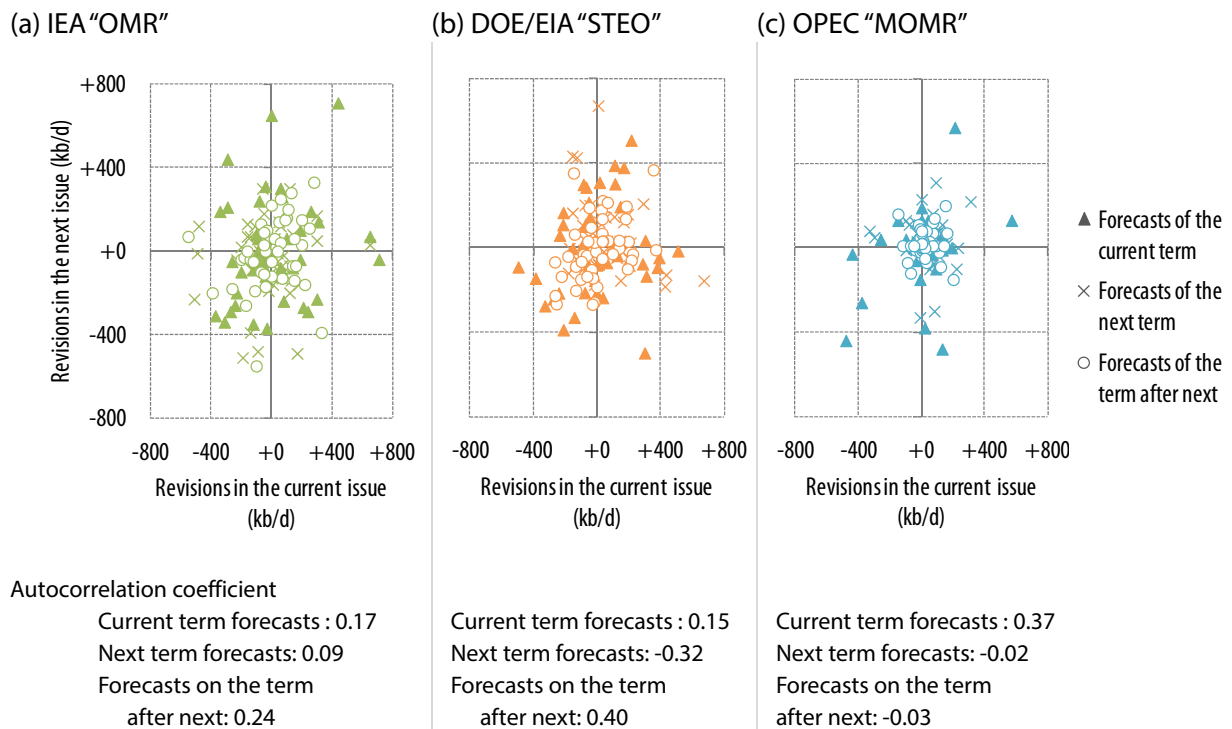## Forecasts of IEA and DOE/EIA tend to linger on the past

The previous chapter discussed the tendencies in the revisions of the oil demand forecasts announced monthly by the three organisations. However, people are generally keen to know about the future. Even those who are not directly associated with the oil market are concerned about whether or not there is a certain relation between the revisions of the forecasts announced in the next month and those announced in this month. In an attempt to address this concern, this chapter summarises the

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[3] Among these four revisions, only the revision in October 2014 caused the crude oil price to sharply decline on the day the forecast was announced. The day after the forecast in December 2011 was announced, the Brent crude oil price plunged by $4.48/bbl. Significant decrease of crude oil price was not found for other two revisions.

trend in the relations between the revisions of the demand forecasts announced in a certain month and those announced in the following month.

Figure 5 is the scatter plot of the revisions of the forecasts for the current term, the next term and the term after next, published in the current and the next issues. In all the forecasts made by the three organisations on any term, relations seem to be relatively poor, and the correlation coefficient is not large. However, it should be noted that the correlation coefficient merely measures the degree of application of the proportional relation such that when the revision to the forecast is doubled in a certain issue, the revision in the next issue also doubles[4].

Figure 5 | Autocorrelation of the revisions of the forecasts

(a) IEA "OMR"   (b) DOE/EIA "STEO"   (c) OPEC "MOMR"

Autocorrelation coefficient

Current term forecasts : 0.17	Current term forecasts : 0.15	Current term forecasts : 0.37
Next term forecasts: 0.09	Next term forecasts: -0.32	Next term forecasts: -0.02
Forecasts on the term after next: 0.24	Forecasts on the term after next: 0.40	Forecasts on the term after next: -0.03

Note: Part of the samples are omitted in the plot in the case of the IEA's "OMR"
Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

Let us then shift the viewpoint by using a standard of whether the revision is made in the positive direction (upward revision) or the negative direction (downward revision). First, results of simple calculations of the probabilities of upward revision of the forecasts (frequency) are shown in Figure 6[5]. This is equivalent to the rate of the number of samples located on the right-hand side of the line 0 of the X-axis (the amount of revision in the current issue) in Figure 5. This suggests that, in the overall trend, the IEA and the DOE/EIA tend to reduce the forecasts after proposing higher forecasts, similar

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[4] For example, when two variables (x and y) are distributed over the circle: $x^2 + y^2 = c$, the correlation coefficient is 0 even though x and y have some relationship.

[5] When the revision is 0 kb/d, it is counted as 0.5 times of upward revision and 0.5 times of downward revision.

to the results obtained from the viewpoint of the most typical pattern (the mode class) in the previous chapter. On the other hand, the OPEC tends to revise the lower projection upwardly later on. Consequently, the OPEC makes upward revision eight or nine times out of 12 forecasts per year.

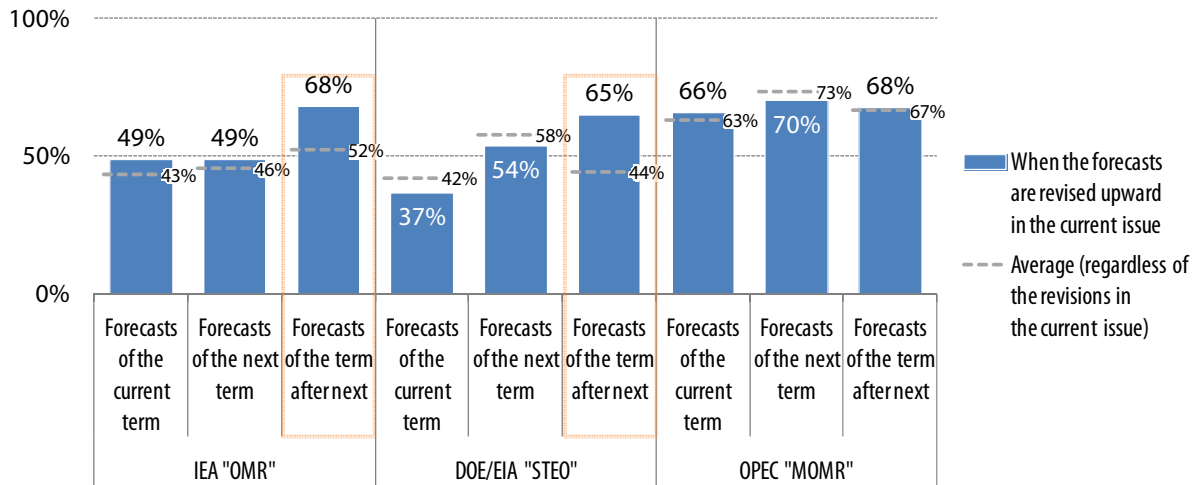Figure 6 | Probabilities of upward revision of the forecasts
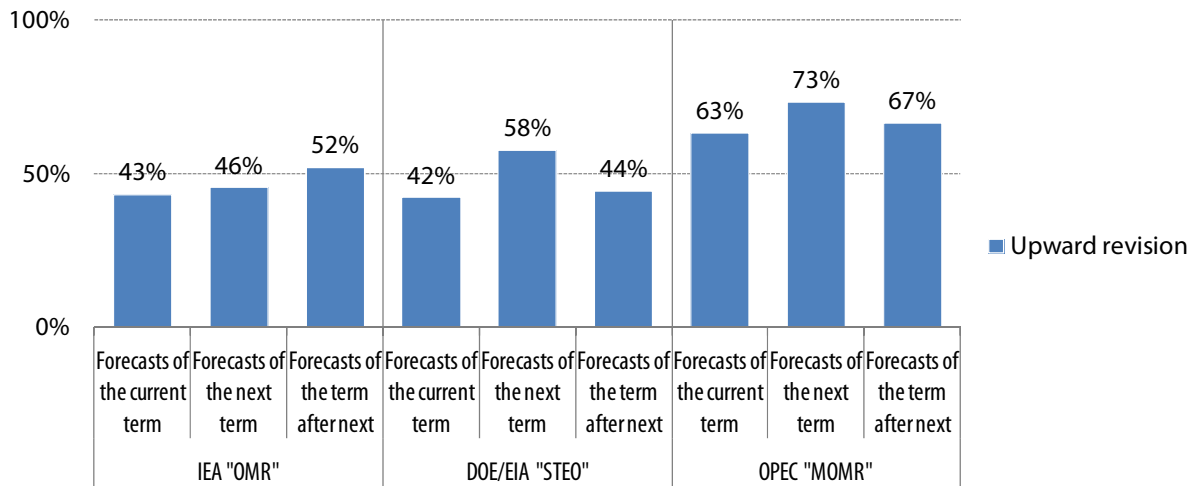
Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

Next, calculations were made for the probabilities[6] of making upward revisions consecutively in the following month when upward revisions are made in the current month (Figure 7). For comparison, simple probabilities of upward revisions shown in Figure 6 are inserted. Generally speaking, there is no major difference between the probabilities of the upward revision in the following issue after upward revision is made in the current issue, and the simple probabilities of the upward revision. However, concerning the IEA's forecasts on the term after next, and the DOE/EIA's forecasts for the term after next, the probabilities of upward revision in the following issue become higher when upward revision is made in the current issue. These increases are not so small, namely, 16 percentage points and 21 percentage points, respectively. In other words, there is a possibility that positive autocorrelation exists in the revisions of the forecasts of the term after next by the IEA and the DOE/EIA.

[6] In other words, these probabilities are conditional probabilities.

Figure 7 | Probabilities of upward revision in the following issue after upward revision is made in the current issue

Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

Figure 8 shows, on the contrary, the probabilities of upward revisions in the forecasts in the following issue after downward revisions are made in the current issue. In the case of the IEA's forecasts, originally the probabilities of upward revision were lower than or as low as the probabilities of downward revision. However, the probabilities of making upward revision after downward revision to offset or diminish the downward revision become even lower in all the forecasts on the current term, the next term, and the term after next. In the case of the term after next, the number of upward revisions after downward revisions is less than one in three. Also in the case of the DOE/EIA's forecasts on the term after next, the probability of upward revision in the issue following the issue in which downward revisions are made falls to as low as 24%. In these revisions of forecasts, positive autocorrelation – a tendency that downward revision is likely to continue once downward revisions are made – can be observed. Moreover, though positive autocorrelation can be observed in both cases of downward and upward revisions, the tendency of successive occurrences of downward revision is stronger than that of upward revision.

Figure 8 | Probabilities of upward revision in the following issue after downward revision is made in the current issue
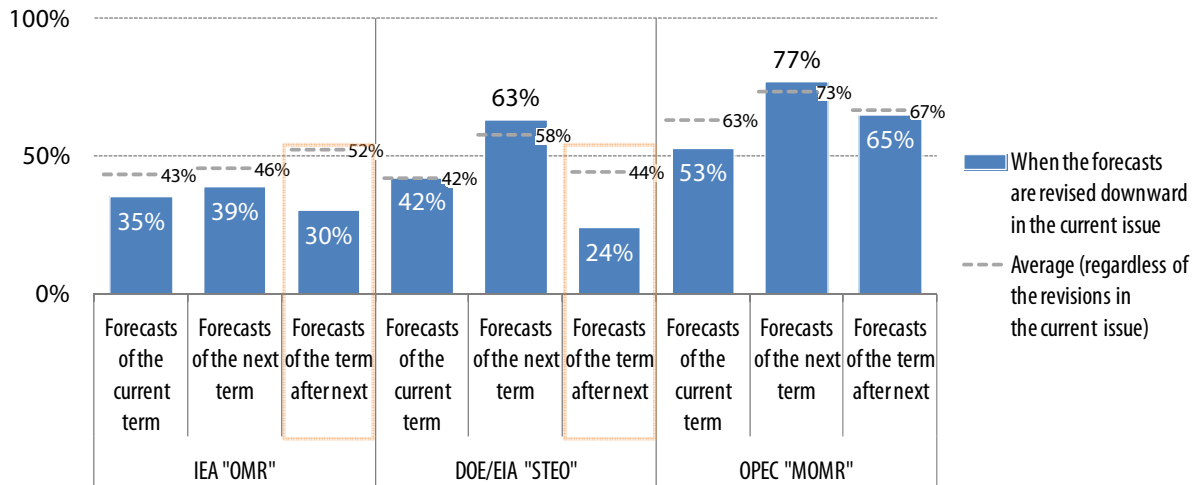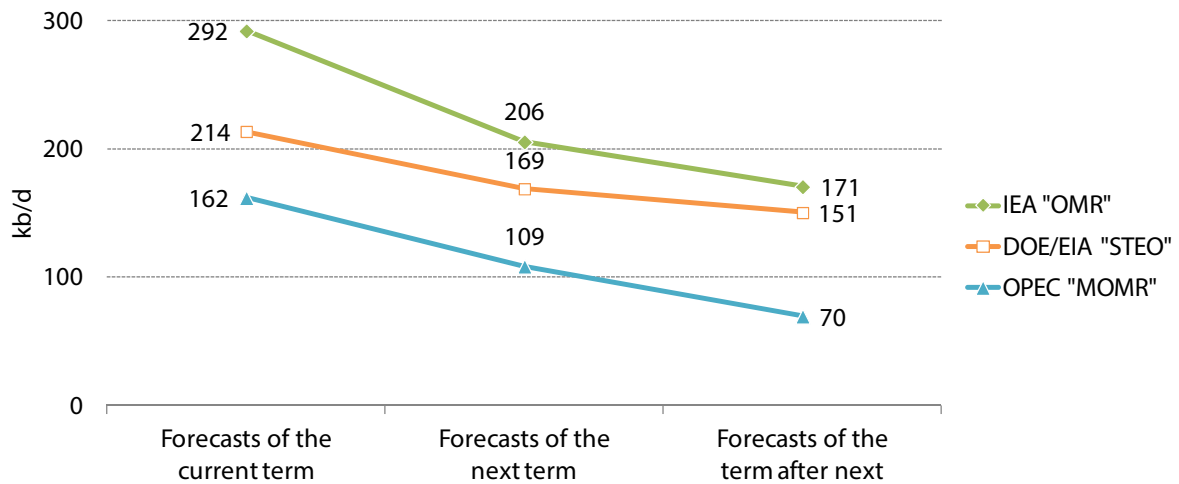

Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

The further the forecast period goes, the smaller the revisions

Generally, it is thought that the further the forecast period goes, the larger the differences. It is considered that uncertainties in the forecasts become larger because the assumptions used in forecasts for the period further in the future are less accurate, and the errors fundamentally increase in the time-series model. Therefore, it is natural to predict that the amount of revision tends to become larger the further in the future the forecast period is. However, in all cases of the three organisations, the amount of revision is found clustered in a smaller range in the next-term forecasts than in the current-term forecasts, and even smaller in the forecasts on the term after next than in the next-term forecasts (Figure 3, Figure 4). Actually, in the forecasts of all of the organisations, the standard deviation of the amount of revision becomes smaller the further the forecast period is in the future (Figure 9) even though, especially in the cases of the IEA and the DOE/EIA, autocorrelation can be observed in revisions of the forecasts for the term after next.

Figure 9 | Standard deviation of revisions of the forecasts

Source: Calculations are based on the January 2011 issues to the October 2014 issues of the IEA's "Oil Market Report," the DOE/EIA's "Short-Term Energy Outlook" and the OPEC's "Monthly Oil Market Report."

There may be certain reasoning for this trend of gradual decline in the amount of revision the further in the future the forecast period goes. Specifically, it can be considered that the further in the future the forecasts go, the smaller the revisions become with regard to assumptions about factors such as the size of economy, temperatures, and energy prices that influence the oil demand (and its forecasts) (Box 1).

Box 1 | Cases which demonstrate that the further the forecast period goes, the smaller the revisions

The circumstances in which the further the forecast period goes, the smaller the revisions, can be examined using a simple model.

Assuming that Y_t, the amount of revision of the oil demand forecasts of t term is influenced by X_t revision of the assumptions of exogenous factors such as the size of economy and contingent factors e_t. It is also assumed that Y_t is influenced by Y_{t-1}, the amount of revision of the demand forecast of t-1 period to allow for the possibility that there is autocorrelation in revision of the forecasts. The following expressions are considered as the simplest model to satisfy the above conditions:

$$Y_t = \beta_0 + \beta_X X_t + \beta_1 Y_{t-1} + e_t \ (t = 1,2),$$
$$Y_0 = \beta_0 + \beta_X X_0 + e_0$$

where β is a constant, e_t is white noise with variance of σ^2 and autocorrelation of 0. By repeating substitution to Y, Y_1 and Y_2 can be expressed as follows:

$$Y_1 = \beta_0(1 + \beta_1) + \beta_X(X_1 + \beta_1 X_0) + e_1 + \beta_1 e_0,$$
$$Y_2 = \beta_0(1 + \beta_1 + \beta_1^2) + \beta_X(X_2 + \beta_1 X_1 + \beta_1^2 X_0) + e_2 + \beta_1 e_1 + \beta_1^2 e_0.$$

As e_t is white noise, $cov\{e_t, X_s\}$, covariance of e_t and X_s, is 0[7]. Therefore, $V\{Y_t\}$, variance of Y_t is as follows:

$$V\{Y_0\} = \beta_X{}^2 V\{X_0\} + \sigma^2,$$
$$V\{Y_1\} = \beta_X{}^2 \left(V\{X_1\} + \beta_1{}^2 V\{X_0\}\right) + \left(1 + \beta_1{}^2\right)\sigma^2,$$
$$V\{Y_2\} = \beta_X{}^2 \left(V\{X_2\} + \beta_1{}^2 V\{X_1\} + \beta_1{}^4 V\{X_0\}\right) + \left(1 + \beta_1{}^2 + \beta_1{}^4\right)\sigma^2.$$

While the difference between $V\{Y_1\}$ and $V\{Y_0\}$ is:

$$V\{Y_1\} - V\{Y_0\} = \beta_X{}^2 \left(V\{X_1\} - V\{X_0\}\right) + \beta_1{}^2 \beta_X{}^2 V\{X_0\} + \beta_1{}^2 \sigma^2.$$

At least $V\{X_1\}$ in the first term must be smaller than $V\{X_0\}$, for $V\{Y_1\}$ to be smaller than $V\{Y_0\}$ since the second and the third terms on the right-hand side are both not negative. Similarly, the difference between $V\{Y_2\}$ and $V\{Y_1\}$ is expressed as follows:

$$V\{Y_2\} - V\{Y_1\} = \beta_X{}^2 \left(V\{X_2\} - V\{X_1\}\right) + \beta_X{}^4 \left(V\{X_1\} - V\{X_0\}\right) + \beta_1{}^4 \beta_X{}^2 V\{X_0\} + \beta_1{}^4 \sigma^2. \qquad (1)$$

At least the sum of the first and the second terms on the right-hand side must be negative, for $V\{Y_2\}$ to be smaller than $V\{Y_1\}$ since the third and the fourth terms on the right-hand side are both not negative. Typically, the condition in which $V\{X_2\}$ in the first term is smaller than $V\{X_1\}$ is assumed because of $|\beta_1| < 1$.

In other words, the possibility that revisions of exogenous factors remain small on average in the next term compared with the current term, and in the term after next compared with the next term, may be one of the reasons why there is a tendency that the amount of revision becomes smaller in the next term than in the current term, and in the term after next than in the next term.

When autocorrelation is strong in the revision of the forecast ($0 \ll |\beta_1| < 1$), the third and the fourth terms of the equation (1) become larger, and thus contribution to $V\{Y_2\}$ increases. Unlike in the case of the OPEC, in the case of the IEA and the DOE/EIA, the rate of decline of the standard deviation of the revision from the next-term forecasts to the forecasts on the term after next is more gradual than that of the revision from the current-term forecasts to the next-term forecasts (Figure 9). In this regard, autocorrelation observed in the revision of the forecasts on the term after next may have influence.

We cannot learn much about the origin of the stickiness of revision to these assumptions only from the forecast results. Is it because the forecasters think the factors for revising the assumptions in the

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[7] Depending on the kind of external factors, X_s may not be uncorrelated with past incidental factors (covariance is not 0). For example, revision of crude oil price can be influenced by past incidental factors.

current term will be eased in the forward month? Or is it because of psychological resistance acting against revision? Or is it due to a totally different reason?

Conclusion

The trends in revisions of the forecasts are summarised based on the study on the IEA's "OMR," the DOE/EIA's "STEO," and the OPEC's "MOMR," which are the representative short-term oil demand and supply forecasts that attract attention of not only the oil market players but of a significant portion of the public. The trends which emerged from the study are as follows:

▌ The most typical pattern is that the IEA and the DOE/EIA propose higher forecasts first and then reduce them later, whilst the OPEC proposes modest forecasts first and raises them later.

▌ Concerning the IEA's and the DOE/EIA's forecasts for the term after next, when upward revisions are made in the current issue, the probabilities of upward revisions in the following issue increase. On the contrary, the probabilities of making upward revisions on the forecasts for the term after next, after making downward revisions, offsetting or diminishing such downward revisions, are low.

▌ On average, the amount of revision is smaller in the next-term forecasts than in the current-term forecasts, and in the term after next than in the next term. It may be one of the reasons that the further the forecast period goes, the smaller the revision of the assumptions that influence the oil demand (and its forecasts).

If we face the oil demand forecasts with these "tendencies" in mind, we may be able to see a landscape somewhat different from what we used to see.

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