

Joint IEA-IEF-OPEC Report

Quantitative Assessment of the Impact of the *Principles for Oil Price Reporting Agencies* on the Physical Oil Market

22 July 2015

Contents

Background

The G20 initiative on Oil Price Reporting Agencies is a multi-year effort being carried out by the International Organization of Securities Commissions (IOSCO) working in close collaboration with OPEC, the IEA and IEF to enhance the reliability of oil price assessments by Price Reporting Agencies (PRAs).

The current report is based on the Communiqué of the G-20 Finance Ministers Meeting in Mexico City, Mexico, in November 2012, which states:

"We welcome the report on recommendations to improve the functioning and oversight of Oil Price Reporting Agencies, and ask IOSCO to liaise with the IEA, IEF and OPEC to assess the impact of the principles on physical markets and report back."

To this end, assessments have been carried out following both qualitative and quantitative approaches. The results of the qualitative approach have been published in April 2015 and presented to the 2nd Meeting of the G20 Energy Sustainability Working Group (ESWG), held in Istanbul, Turkey, on 25-26 May 2015.

The following report represents the second, "quantitative" assessment of the impact of the PRA Principles on the physical market.

Quantitative Assessment

In broad terms, the aims of the PRA Principles have been to:

- Increase transparency and market confidence in the methodologies used in the assessments of the oil price reporting agencies;
- Ensure the quality and integrity of the price assessment process; and
- Ensure a complaints process through which stakeholders can meaningfully and transparently engage with the PRAs.

In order to arrive at a quantitative assessment of the impact of the Principles, the analysis focuses on the daily differences between the PRAs price assessments for major marker crudes since the end of the implementation period of the *PRA Principles* and compares it to a period prior to the *PRA Principles*. Although this has not been one of the aims of the Principles, a greater convergence of price assessments from the independent price assessment agencies considered here – namely, Argus, Platts and ICIS[1] – would imply that a higher degree of confidence could be attached to the assessments. Alternatively, wide

[1] While active in the G20 PRA initiative, the price reporting agency OPIS does not assess the crudes considered in this report.

divergence of assessments would imply a lower degree of confidence in the assessments, potentially as a result of an unintended impact of implementation of the *PRA Principles*. Therefore, in this report, outcomes are considered to be positive if they result in greater convergence between price assessments over time, or negative if there is a wider divergence. Additionally, the extent of these differences provides an indicator as to whether the price assessments are more comparable in terms of prices reported.

At the same time, it is important to recognise that the PRA assessments are the output of three independent price reporting agencies assessing, in a competitive setting, inherently complex heterogeneous physical grades that are traded in active international markets. Given that there are a range of equally-valid methodologies for identifying prevailing open-market price levels, some degree of difference between the PRAs' price assessments is to be expected.

The report consists of two parts: *Section I* provides descriptive statistics based on the whole time series giving the average and standard deviation of the differences between the daily assessments; *Section II* provides an inferential statistical analysis that focuses on a comparison between Platts and Argus price assessments.

Section I: Descriptive Statistical Analysis

This section provides a follow up of the 2011 exercise, which is summarised in the first report on Oil Price Reporting Agencies, submitted to the G20 Finance Ministers in October 2012.[2] As the *PRA Principles* were published in October 2012 and provided a year to allow for implementation, the post-implementation period is considered to begin in November 2013.

Figures 1-7 in the Annex show the results of a comparison of the price assessments of three PRAs for the following crudes included in the 2011 report, namely, Dated Brent and Dated Brent components (Brent Ninian Blend, Forties, Oseberg, Ekofisk); Dubai; and Oman. Additionally, assessments for US physical benchmark crudes Light Louisiana Sweet (LLS) and Mars have also been included to broaden the scope of the findings (**Figures 8-9**).

This comparison shows that, over the observed period, the average daily difference for Dated Brent – the assessment that serves as the benchmark for the price of physical, light North Sea crude oil – has been a negligible 1¢/b and there are only two days out of 335 observations in which the differences are greater than 50¢/b.[3] Regarding the Brent components, the assessments have also shown considerable convergence in terms of

[2] http://www.iosco.org/library/pubdocs/pdf/IOSCOPD364.pdf

[3] This was in two consecutive days, namely 19 and 20 August 2015, when the difference stood at 58¢/b and 54¢/b.

average price difference, with the exception of Ekofisk, although none show an average difference of more than 4¢/b. The price assessments of ICIS show greater daily difference than those of Argus and Platts of 9¢-12¢/b for Dated Brent.

The Argus and Platts assessments for the Middle East crude oil maker grades Dubai and Oman have also seen greater convergence, with the Dubai assessment considered as comparable with an average daily difference of 1¢/b. The difference between the Argus and Platts assessments for Oman has also narrowed, but remain at a relatively high level of 15¢/b. The ICIS Dubai price assessments show greater differences of 9-11¢/b compared to Argus and Platts. For Oman, the ICIS average price assessments show no divergence compared to Argus but a 15¢/b difference compared to Platts.

With regard to the US crudes LLS and Mars, the average daily differences in the price assessments of Argus and Platts remain at 2¢/b.

To further enrich the assessment, the daily differences between Argus and Platts assessments for Dated Brent were further analysed according to the respective statistical distribution function (**Figure 10**). Differences have been found to be approximately normally distributed, with an expected average of $0.008/b and a variance of $0.016/b. In this regard, and by means of quartiles, the probability that Argus' quotations will be 50¢/b more than Platts' quotation is equal to 0.0025%. These results further underscore the comparability of the assessments.

Section II: Inferential Statistical Analysis

In order to arrive at an inferential statistical judgment, this report has also incorporated an additional approach to determine whether prices reported by the different agencies are statistically comparable. The following analysis focuses on a comparison between Platts and Argus assessments for Dated Brent and Dated Brent components (Brent Ninian Blend, Forties, Oseberg, and Ekofisk), as well as Dubai, Oman, Light Louisiana Sweet (LLS) and Mars (**Figures 11-19**).

The methodology used first compares the two means from Argus and Platts for Dated Brent and its components using the one way Analysis of Variance (ANOVA) test. Afterwards, a two-sample test has been used to assess the statistical significance of the means between Argus and Platts in all of the considered crude streams. A third approach was used taking a one-sample test to confirm that the average daily differences between these grades are statistically different to zero.

Based on the analysis, with the exception of Oman, all the results show that the null hypothesis could not be rejected at the chosen significance level of 0.05, indicating that the differences are not statistically significantly different from zero. In the case of Oman, the grade passed the two sample t-test; however, the one-sample t-test was rejected due to the higher t-value (**Figure 17**). Beginning in August 2014, the differences have seen greater divergence. A factor behind these variances may be methodological differences between the PRAs. For example, Argus' methodology for Oman is based on full cargoes of 500,000 barrels, whereas Platts' methodology reflects 'partials' of 25,000 barrels.

Conclusion

Taken together, the results of both the descriptive statistics and the inferential statistical analysis find that the PRA price assessments have seen a greater convergence for the crudes considered in the period since the implementation of the *PRA Principles*. Therefore the PRA price assessments may be considered to be more comparable in terms of prices reported.

It is important to note that the PRA assessments are the product of three independent organisations assessing, in a competitive setting, inherently complex heterogeneous physical grades that are traded in active international markets. Given that there are a range of equally valid methodologies for identifying prevailing open-market price levels, some degree of difference between PRAs' price assessments is likely to persist.

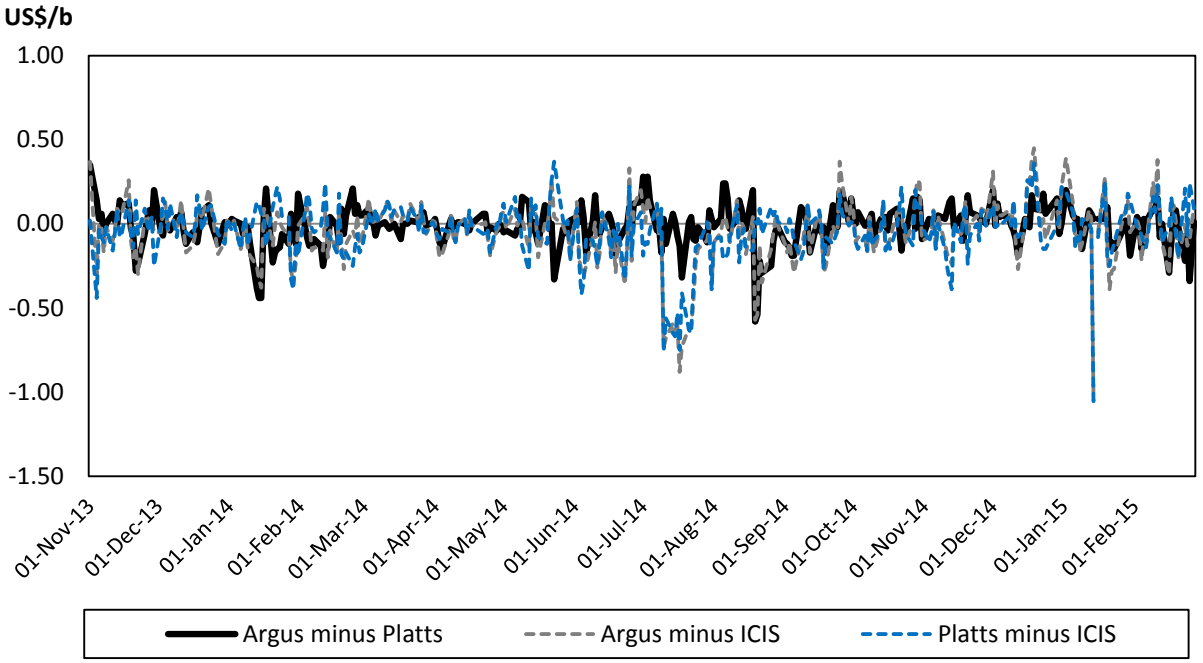
Notwithstanding these inherent differences, the higher degree of convergence seen since the implementation of the *PRA Principles* in price assessments of PRA's means that the overall comparability of these independent assessments has improved in terms of prices reported. The PRA Principles can therefore be considered to have made a positive contribution to the development of greater energy market transparency. This is also in conformity with the joint IEA-IEF-OPEC report on the qualitative analysis that concluded that the *PRA Principles* market impact is positive to neutral.[4]

[4] Joint IEA-IEF-OPEC Report on the IOSCO PRA Principles Market Impact Survey of Oil Market Participants, April 2015

Annexes

Annex I: Descriptive Statistical Analysis

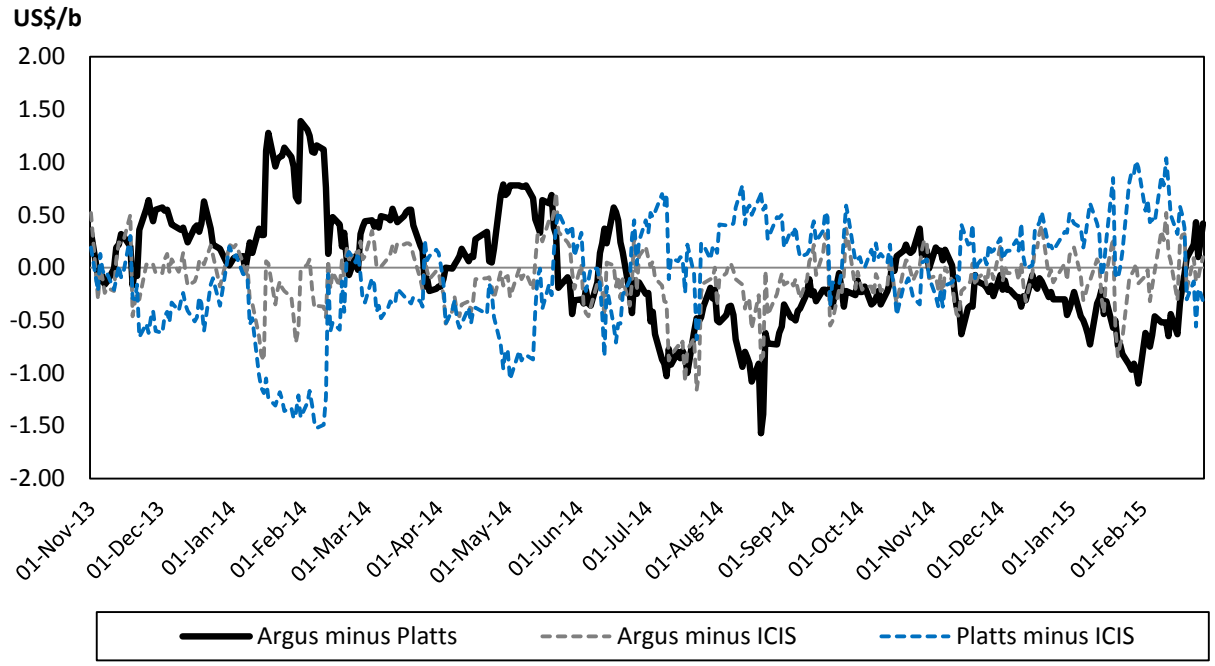
Figure 1: Dated Brent: Argus, ICIS and Platts



2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	94.57	94.77	94.58
Min	45.28	45.25	45.22
Max	115.14	115.43	115.32
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.01	-0.05	-0.04
Standard deviation	0.12	0.19	0.17
Min	-0.58	-1.05	-1.08
Max	0.35	0.45	0.37
No. of observation	335	334	334
Difference > 0.49	2	12	9
%	0.6%	3.6%	2.7%

Figure 2: Brent Ninian Blend: Argus, ICIS and Platts compared



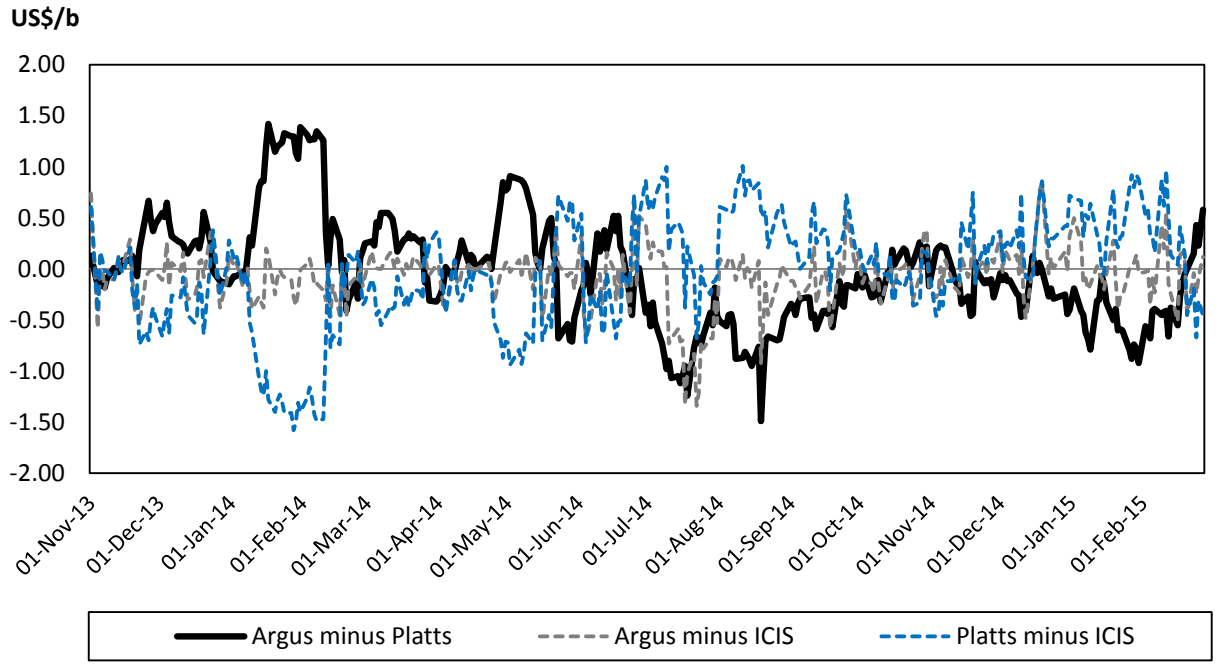
2011 report

US$/b	Argus	ICIS	Platts
Average	81.42	81.41	81.60
Min	33.56	33.18	34.96
Max	144.98	144.47	145.28
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.18	0.01	0.19
Standard deviation	0.47	0.34	0.54

2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	94.57	94.65	94.58
Min	45.28	45.25	45.22
Max	115.14	115.43	115.32
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.01	-0.08	-0.07
Standard deviation	0.12	0.58	0.57

Figure 3: Forties: Argus, ICIS and Platts compared



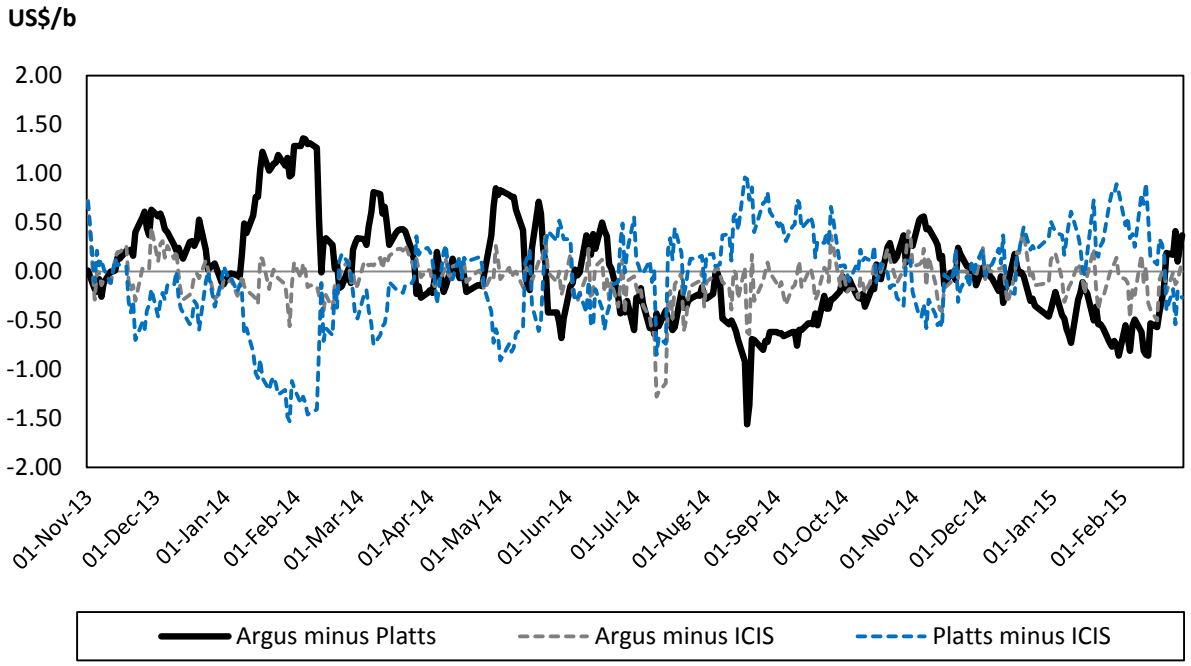
2011 report

US$/b	Argus	ICIS	Platts
Average	78.89	78.88	79.02
Min	31.96	31.93	33.66
Max	143.43	143.47	144.22
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.14	0.01	0.15
Standard deviation	0.50	0.21	0.49

2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	94.60	94.67	94.64
Min	44.92	44.97	45.22
Max	115.64	115.93	115.42
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.04	-0.07	-0.04
StdDev	0.53	0.29	0.54

Figure 4: Oseberg: Argus, ICIS and Platts compared



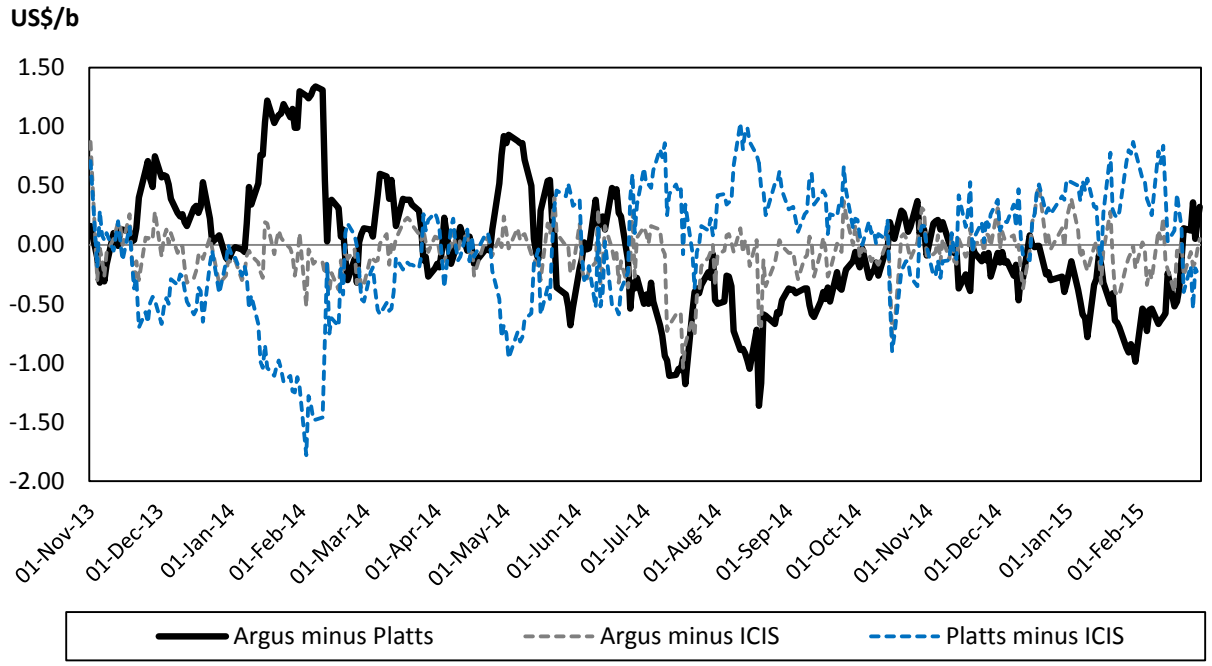
2011 report

US$/b	Argus	ICIS	Platts
Average	80.50	80.47	80.60
Min	34.11	34.18	35.76
Max	147.38	147.37	148.53
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.10	0.03	0.13
Standard deviation	0.51	0.21	0.51

2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	95.75	95.82	95.76
Min	46.03	46.00	46.25
Max	116.29	116.58	116.22
	Argus - Platts	**Argus - ICIS**	**Platts – ICIS**
Average	0.00	-0.07	-0.07
Standard deviation	0.50	0.22	0.48

Figure 5: Ekofisk: Argus, ICIS and Platts compared



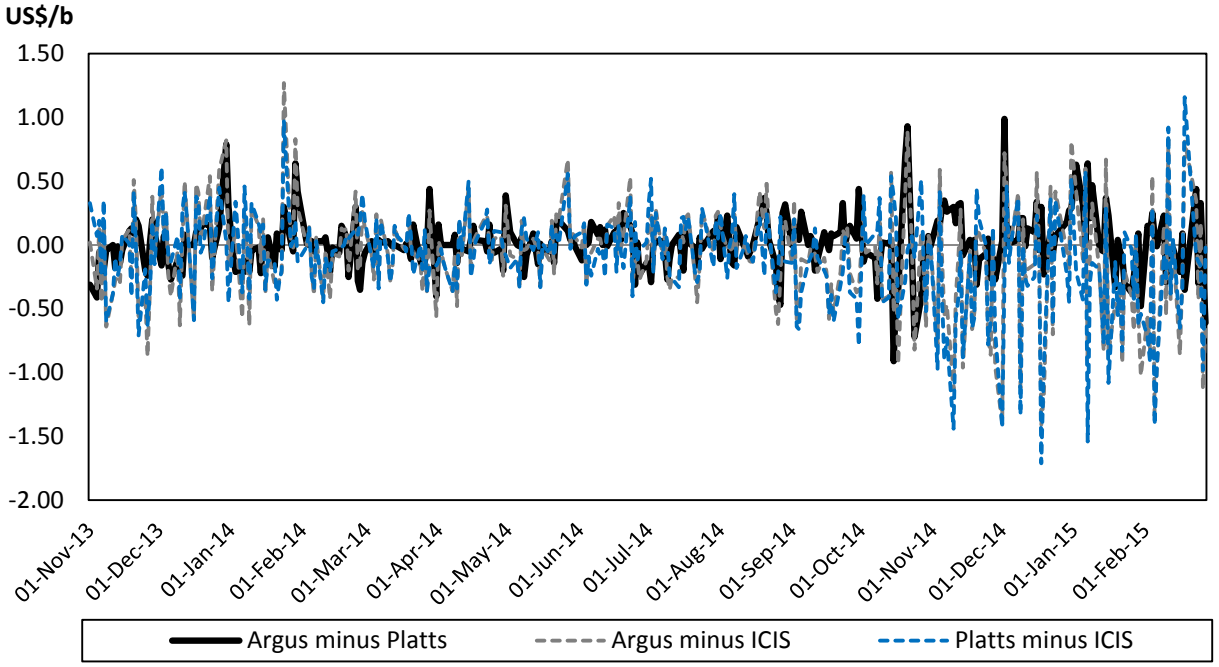
2011 report

US$/b	Argus	ICIS	Platts
Average	80.19	80.11	80.25
Min	33.86	33.88	35.56
Max	147.08	147.02	148.33
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.06	0.08	0.14
Standard deviation	0.48	0.24	0.50

2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	95.35	95.42	95.39
Min	45.48	45.45	45.77
Max	116.43	116.75	116.16
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	-0.04	-0.07	-0.03
Standard deviation	0.51	0.22	0.50

Figure 6: Dubai: Argus, ICIS and Platts compared



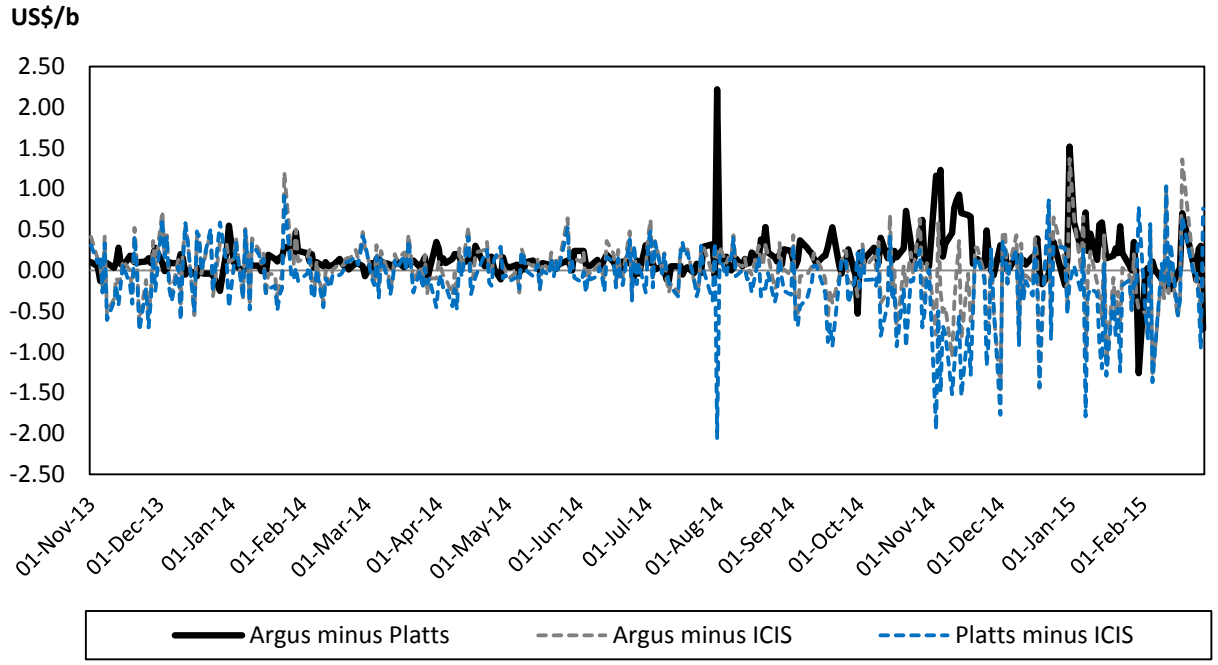
2011 report

US$/b	ARGUS	ICIS	PLATTS
Average	76.81	76.82	76.76
Min	36.77	36.20	36.65
Max	140.57	141.08	140.77
	Argus - Platts	**Argus - ICIS**	**Platts – ICIS**
Average	0.05	-0.01	-0.06
Standard deviation	0.37	0.48	0.45

2015 report (after 1 November 2013)

US$/b	Argus	ICIS	Platts
Average	92.41	92.50	92.40
Min	42.00	42.83	42.05
Max	111.31	110.89	111.16
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	0.01	-0.09	-0.11
Standard deviation	0.22	0.40	0.38

Figure 7: Oman: Argus, ICIS and Platts compared



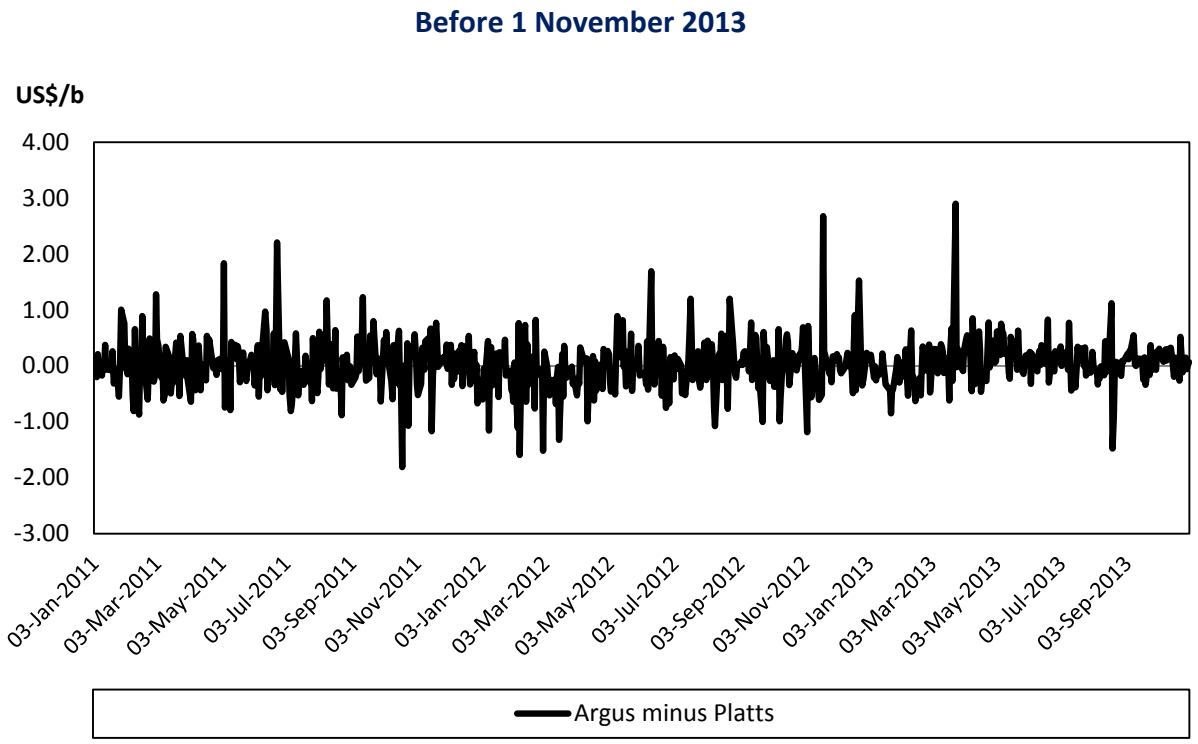
2011 report

US$/b	Argus	ICIS	Platts
Average	77.31	77.04	77.14
Min	37.22	36.64	37.10
Max	141.42	141.35	141.30
	Argus - Platts	**Argus - ICIS**	**Platts – ICIS**
Average	0.17	0.27	0.10
Standard deviation	0.44	0.68	0.64

2015 report (after 1 November 2013)

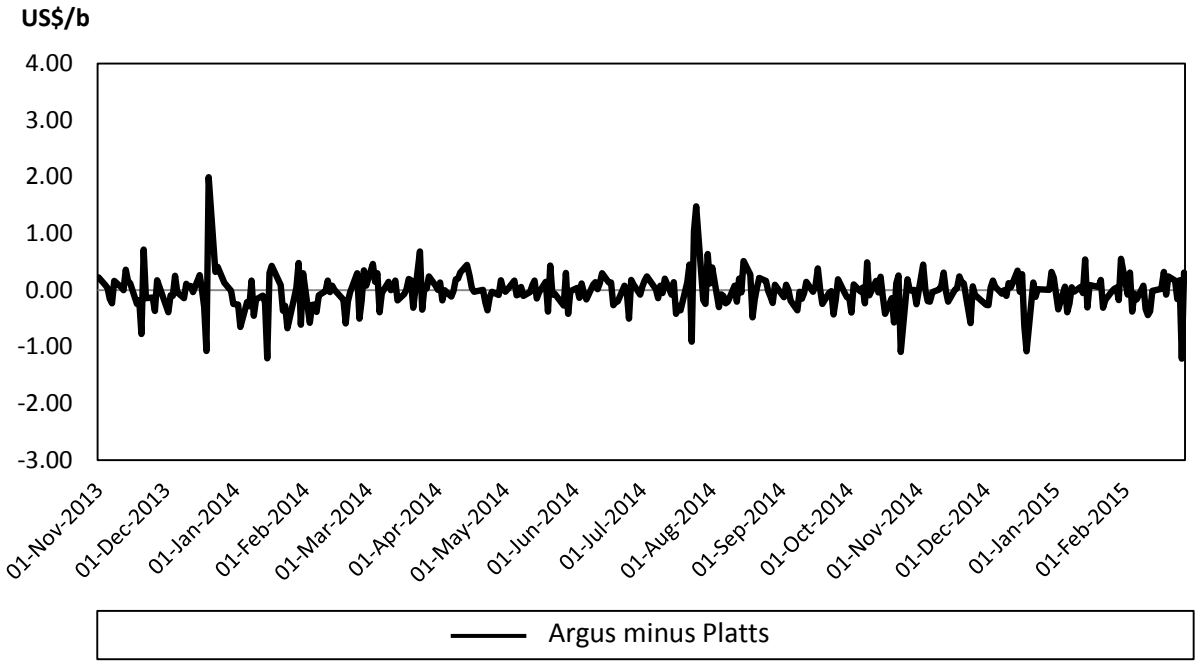
US$/b	Argus	ICIS	Platts
Average	92.91	92.91	92.76
Min	43.41	43.92	42.82
Max	111.26	110.89	111.16
	Argus - Platts	**Argus - ICIS**	**Platts - ICIS**
Average	0.15	0.00	-0.15
Standard deviation	0.26	0.38	0.45

Figure 8: Light Louisiana Sweet (LLS): Argus and Platts compared



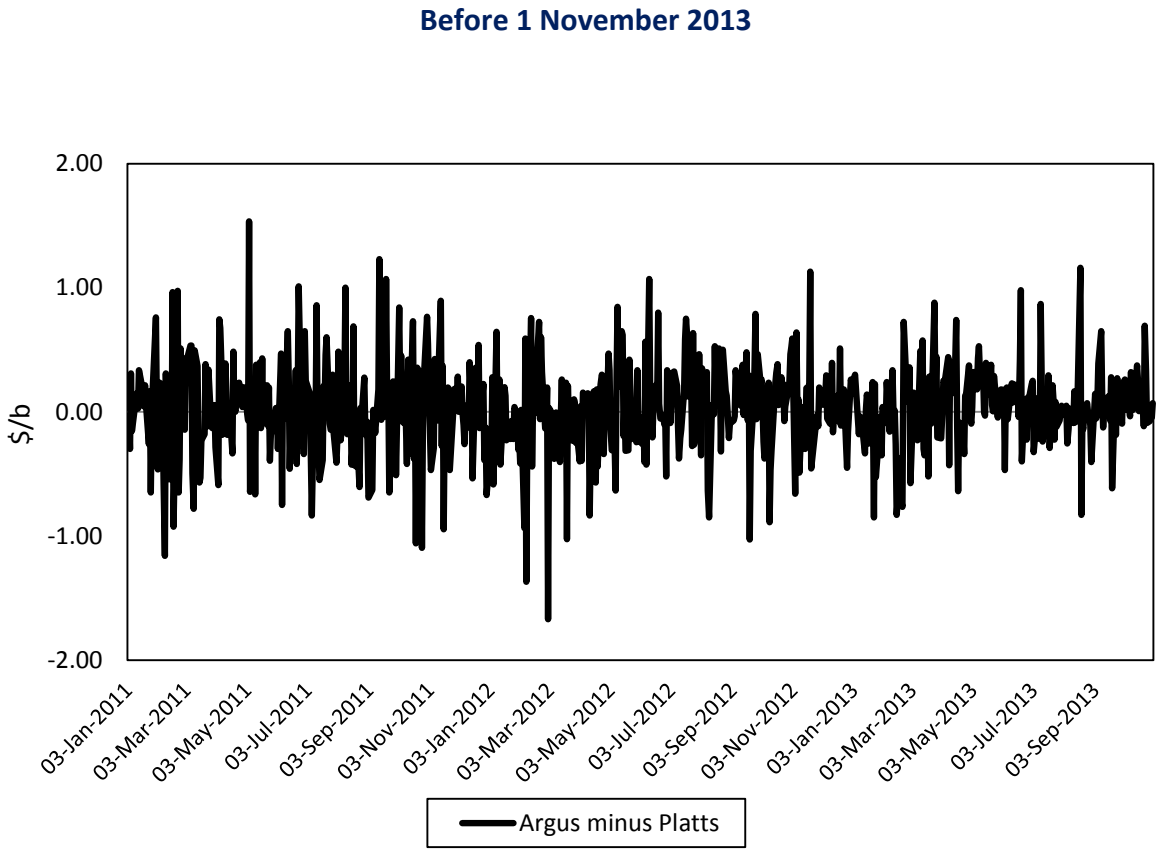
US$/b	Argus	Platts
Average	111.05	111.03
Min	89.69	90.36
Max	130.64	130.78
	Argus - Platts	
Average	0.02	
Standard deviation	0.45	

After 1 November 2013



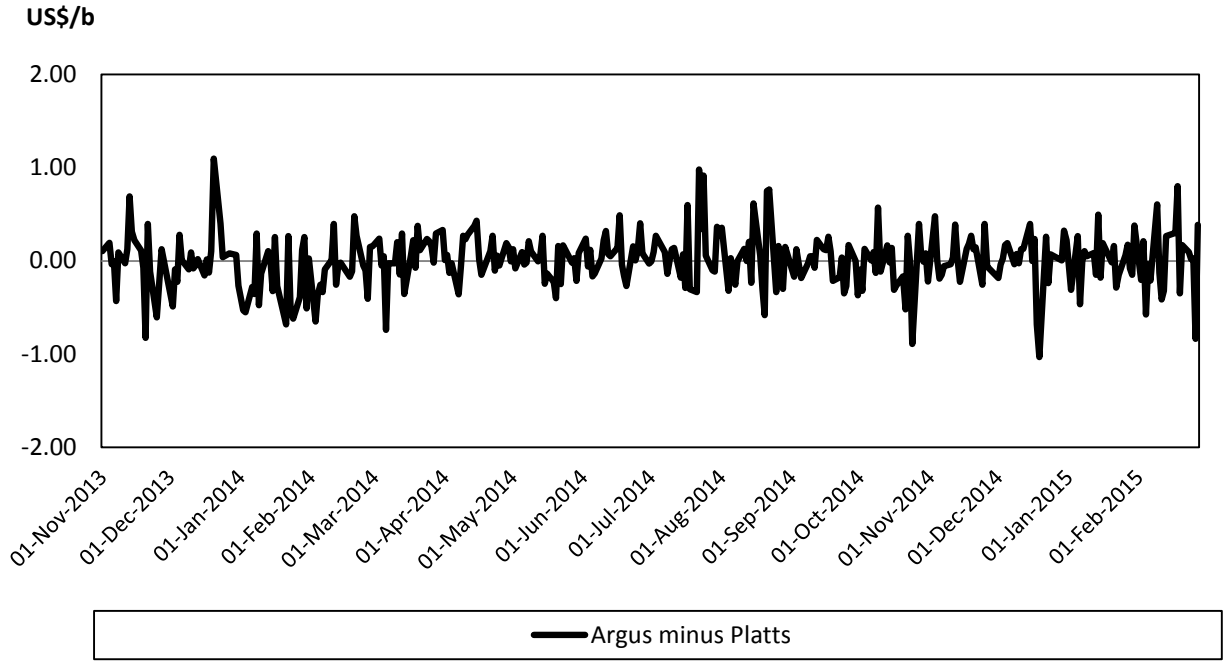
US$/b	Argus	Platts
Average	91.92	91.94
Min	46.68	46.63
Max	111.19	111.11
	Argus - Platts	
Average	-0.02	
Standard deviation	0.32	

Figure 9: Mars: Argus and Platts compared



US$/b	Argus	Platts
Average	106.14	106.11
Min	86.39	86.49
Max	123.02	123.91
	Argus - Platts	
Average	0.02	
Standard deviation	0.37	

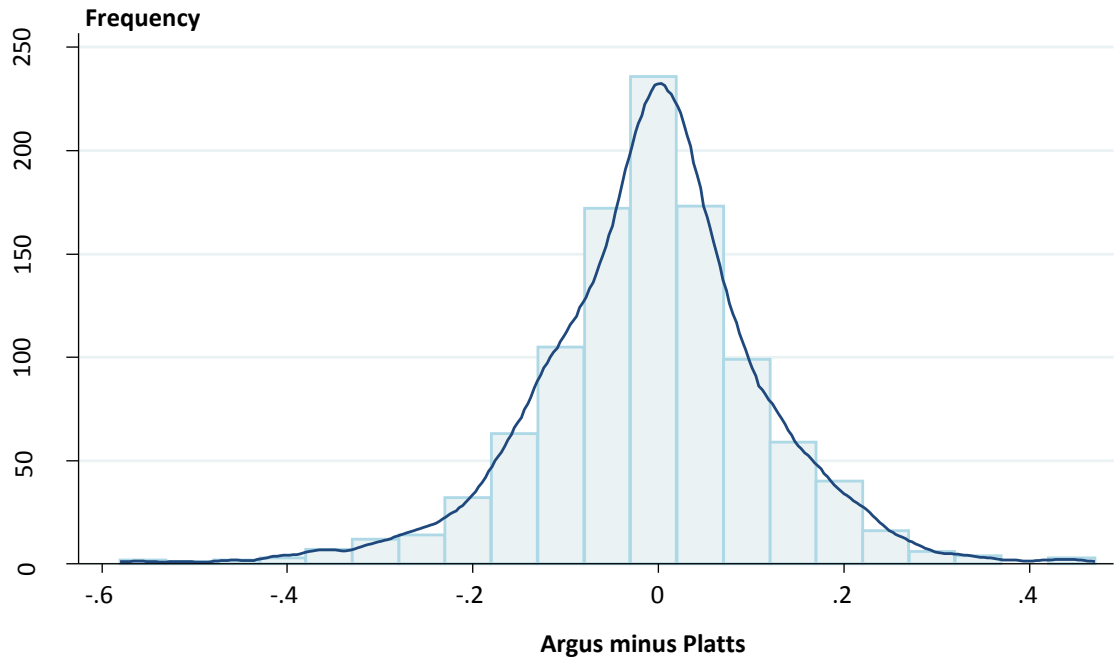
After 1 November 2013



US$/b	Argus	Platts
Average	87.81	87.80
Min	42.45	42.44
Max	107.67	107.43
	Argus - Platts	
Average	0.01	
Standard deviation	0.29	

Figure 10: Dated Brent: Statistical distribution of daily differences

Argus minus Platts (1 January 2011 – 27 February 2014)



	Percentage
Probability: < -0.50	0.0045%
Probability: > 0.50	0.0025%

95% confidence	
Margin of error	0.01
Lower bound	-0.02
Upper bound	0.00

Annex II: Inferential Statistical Analysis

Main objective: As a follow-up exercise, the report aims to statistically test if the assessment methodologies of the two main PRAs, Argus and Platts, are converging. In this context the crude oil price quotations of Dated Brent, Brent Ninian Blend (BNB), Forties, Oseberg, Ekofisk, Dubai, Oman, Light Louisiana Sweet (LLS) and Mars are carefully examined. In order to provide at some valuable insights, the following results are presented:

1. Descriptive statistics to present general statistical properties;

2. Prior to running the t-test, it would be interesting to run a one-way ANOVA to statistically examine if the means of the components of Dated Brent as reported by Argus are equal. The same exercise will also be conducted with the corresponding crude streams of Platts. The test hypotheses are as follows:

$$H_0: \mu_{BNB} = \mu_{Forties} = \mu_{Oseberg} = \mu_{Ekofisk} \text{ ; and}$$

$$H_A: Any\ two\ means\ are\ different$$

3. A two sample t-test is computed for each crude stream to test whether the means of Argus' and Platts' reported figures are statistically different from zero.

$$H_0: \mu_{Argus} - \mu_{Platts} = 0 \quad \text{; and}$$
$$H_A: \mu_{Argus} - \mu_{Platts} \neq 0$$

4. A one sample t-test is conducted to empirically confirm that the average daily differences of the concerned crude stream as reported by Argus and Platts are statistically different from zero.

$$H_0: Difference_{Argus-Platts} = 0; \text{ and}$$
$$H_A: Difference_{Argus-Platts} \neq 0$$

Conclusion: The test-results of the one-way ANOVA for Argus and Platts assessments for Dated Brent and its components suggest not to reject H_0, thus implying that the means of these crude streams are not statistically significantly different from zero (**Figure 13**).

Furthermore and with regard to the conducted two-sample t-tests for all crude streams, the test statistics suggest in all cases not to reject H_0, hence indicating that the means of Argus' and Platts' daily reported crude oil prices are not statistically significantly different from zero (**Figure 13-21**).

Finally, the test results of the one sample t-test for all crudes with the exception of Oman were not statistically significant and therefore the null hypothesis are not rejected. However, in the case of Oman, the hypothesis that the average daily differences of this crude stream is different from zero is rejected. This result could be anticipated from the onset as descriptive statistics have already indicated that the t-test would yield a high t-value to reject H_0, mainly due to the high obtained mean value, which is significantly different from zero, and the higher standard deviation (**Figure 19**).

The test results are presented on the subsequent pages.

Figure 11: Brent Dated: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	335	94.57	20.56	45.28	115.14
Platts	335	94.58	20.56	45.22	115.32
Argus Minus Platts	335	-0.01	0.12	-0.58	0.35

2. **Inferential Statistics:**

	One-way ANOVA Argus	One-way ANOVA Platts	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	F(3, 1332) = 0.17 p = 0.92	F(3, 1332) = 0.17 p = 0.92	t(668) = -0.01, p = 1.00	t(334) = -1.61, p = 0.11
Conclusion	Accept H_0	Accept H_0	Accept H_0	Accept H_0

Figure 12: Brent Ninian Blend: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	335	94.91	20.81	45.18	115.74
Platts	335	94.94	20.58	45.47	115.5
Argus Minus Platts	335	-0.03	0.51	-1.57	1.39

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(668) = -0.02, p = 0.99	t(334) = -0.94, p = 0.35
Conclusion	Accept H_0	Accept H_0

Figure 13: Forties: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	335	94.60	20.76	44.92	115.64
Platts	335	94.64	20.58	45.22	115.42
Argus Minus Platts	335	-0.04	0.53	-1.49	1.42

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(668) = -0.02, p = 0.98	t(334) = -1.32, p = 0.19
Conclusion	Accept H_0	Accept H_0

Figure 14: Oseberg: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	334	95.75	20.65	46.03	116.29
Platts	334	95.76	20.47	46.25	116.22
Argus Minus Platts	334	0.00	0.50	-1.56	1.36

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(666) = -0.00, p = 1.00	t(333) = -0.18, p = 0.86
Conclusion	Accept H_0	Accept H_0

Figure 15: Ekofisk: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	335	95.35	20.87	45.48	116.43
Platts	335	95.39	20.67	45.77	116.16
Argus Minus Platts	335	-0.04	0.51	-1.36	1.34

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(668) = -0.03, p = 0.98	t(334) = -1.42, p = 0.16
Conclusion	Accept H_0	Accept H_0

Figure 16: Dubai: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	330	92.41	20.28	42	111.31
Platts	330	92.40	20.30	42.05	111.16
Argus Minus Platts	330	0.01	0.22	-0.91	0.99

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(658) = 0.01, p = 0.99	t(329) = 1.07, p = 0.27
Conclusion	Accept H_0	Accept H_0

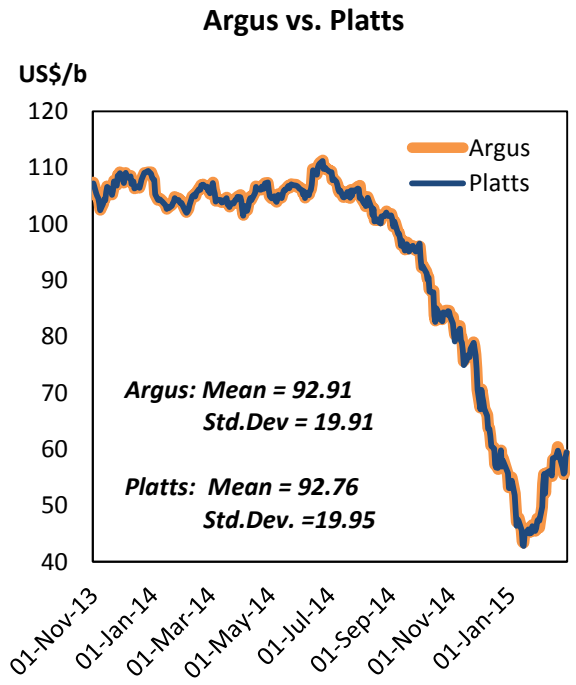
Figure 17: Oman: Argus vs. Platts

1. Descriptive Statistics:

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	330	92.91	19.91	43.41	111.26
Platts	330	92.76	19.95	42.82	111.16
Argus Minus Platts	330	0.15	0.26	-1.26	2.22

2. Inferential Statistics:

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(658) = 0.10, p = 0.92	t(329) = 10.38, p = 0.00
Conclusion	Accept H_0	Reject H_0



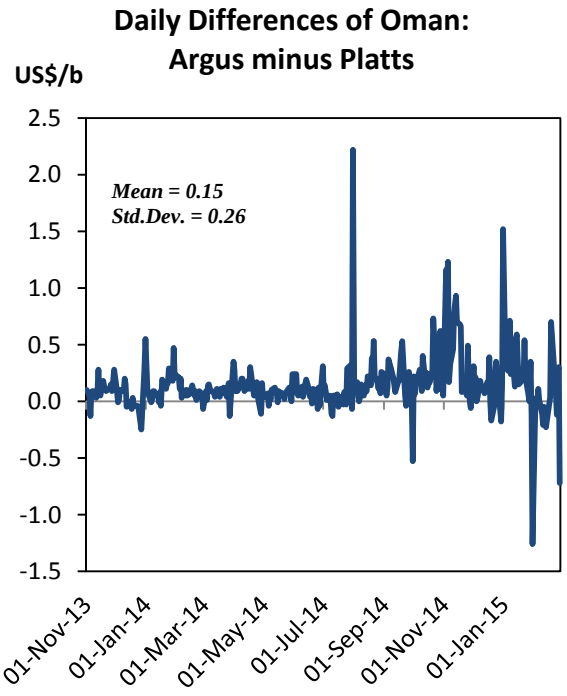


Figure 18: LLS: Argus vs. Platts

1. **Descriptive Statistics:**

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	328	91.92	18.97	46.675	111.19
Platts	328	91.94	18.96	46.63	111.11
Argus Minus Platts	328	-0.02	0.32	-1.21	1.99

2. **Inferential Statistics:**

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(654) = -0.01, p = 0.99	t(327) = -1.12, p = 0.26
Conclusion	Accept H_0	Accept H_0

Figure 19: Mars: Argus vs. Platts

1. Descriptive Statistics:

Variable	Obs	Mean	Std.Dev.	Min	Max
Argus	328	87.81	18.87	42.45	107.67
Platts	328	87.80	18.86	42.44	107.43
Argus Minus Platts	328	0.01	0.29	-1.03	1.095

2. Inferential Statistics:

	Two-Sample t-test (equal variances)	One-Sample t-test of Differences
Test Results	t(654) = 0.00, p = 1.00	t(327) = 0.38, p = 0.70
Conclusion	Accept H_0	Accept H_0