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Oil and Natural Gas Reserve Prices: Addendum to CEEPR WP 03-016; Including Results for 2003 and Revisions to 2001

by

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Introduction. A working paper entitled "Oil and Natural Gas Reserve Prices 1982-2002: Implications for Depletion and Investment Cost" was published in October 2003 (cited hereafter as Adelman & Watkins [2003]). Since then we have obtained data for 2003 and estimated oil and natural gas reserve prices for that year. We have also revised our previous estimates of reserve prices for 2001.

This addendum paper reports on the nature and significance of the results for 2003 and the revisions to 2001. We have also extended the analysis by adding two new features. First is the expression of reserve prices in real terms – previously we had only reported nominal prices. Second, we have estimated levelized or constant field prices that appear to underlie reserve prices, for each year. We refer to these as *planning* prices. Previously we had only published estimated growth rates in field prices from levels prevailing for a given year, congruent with our estimates of reserve prices.

Section 1 of this Addendum paper highlights the 2003 results. Section 2 discusses the revisions for year 2001. Section 3 outlines the nature of the analytical extensions, presents the results, and discusses what they show. Concluding remarks are in Section 4.

Adelman & Watkins [2003] included an extensive set of tables in Appendices. The revisions to all these tables to include 2003 and revised 2001 data are attached here as Appendices.

This paper is to be read in conjunction with, not as a substitute for, Adelman & Watkins [2003]: analysis and description in the 2003 paper is not repeated here.

1. Results: 2003.

Transaction Characteristics. As before, the source of our data on reserve transactions was the Scotia Group. The number of usable transactions for 2003 was 40, the lowest since 1986[1]. Of these, four were identified as outliers (for outlier criteria, see discussion in Adelman & Watkins [2003, pp13-14]).

[1] Of the 40 transactions, 5 were 'pure' oil, 23 'pure' gas ('pure' refers to transactions where only oil or gas reserves were identified).

In common with all other years of the data set, the distribution of transaction values was skewed to the left (though less so than for other years) and the hypothesis of log Normality was not rejected. The four outliers were of larger than average value: the mean transaction value fell from some $150mm for the 40 observations (before exclusion of outliers) to $120 mm for the 36 observations (after exclusion of outliers).

Regression Results. Linear regression (without a constant) of all transaction values on oil and natural gas reserve volumes disclosed an oil reserve price of $9.87/bbl and $1.12/mcf for gas[2]. After elimination of the four outliers, the reserve prices changed to $8.17/bbl and $1.19/mcf respectively[3].

These values marked a very noticeable increase compared with 2002 of $2.43/bbl or about 40 per cent for oil, $0.31/mcf or 35 per cent for gas (variation is for results after exclusion of outliers)[4].

Reserve Status. As in Adelman & Watkins [2003] tests were made of whether reserves were on production or not would influence reserve values. In the case of oil, the 2003 observation set (excluding outliers) did not provide evidence that reserves on production exhibited higher values than those that were seemingly fallow. In contrast, for gas the conclusion was that shut-in reserves had higher reserve prices than those on production. If valid, we ascribe this result to expected appreciation of in-ground reserves by the time they are produced, without dilution by interim production.

Influence of R/P Ratio. Year 2003 did not provide evidence that, other things equal, the higher the R/P ratio, the lower the reserve price. In the case of oil, although the coefficient intended to detect any such influence had the expected sign, it was insignificant; for gas the corresponding coefficient was virtually zero.

Reserve Prices and Field Prices. Our interest here relates to the influence of field prices (prices for flowing oil) on in-ground prices. Addition of 2003 to the regression of reserve prices on contemporary prices, prices lagged one year, and prices lagged two years did not appreciably affect the earlier results. Oil reserve prices remained positively and significantly affected by field prices: about 15 per cent of any change in field prices would be reflected in reserve prices (but the degree of linear fit of the three oil equations remained modest).

Natural gas reserve prices were positively related to field prices; moreover, in the case of contemporary prices and prices lagged one year, the coefficient was now significant; about 10 per cent of any change in field prices would be reflected in reserve prices (as before, the linear fit remained trivial).

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[2]The adjusted R^2 was 0.93. Both reserve values were strongly significant. Estimation of the equation with an intercept revealed it was not significant.

[3]Adjusted R^2 was 0.97; both reserve coefficients highly significant. An intercept, when inserted in the equation, was found to be negative and significant. However, it had little impact on the reserve coefficients in comparison with its value when the intercept was suppressed.

[4] The results on reserve prices are discussed in more detail in Section 3.

Reserve Prices and Hotelling Values. Hotelling's valuation principle (HVP) sees the in-ground price of a mineral as equal to the prevailing net field price (field price less operating cost). The 2003 Hotelling oil reserve value was more than double our estimated reserve price, equivalent to over 20 standard deviations above it. As with almost every other year, the results for 2003 do not support the HVP. The conclusions for gas were similar: the ratio for the HV to the reserve price was 2.7, representing a spread between them of 32 standard deviations.

Implicit Growth Rates in Prices. Implicit growth rates in field prices embedded in reserve prices can be estimated, given some simplifying assumptions. For oil, the reserve price in 2003 of $8.17/bl did not seem to anticipate any change in field prices, up or down (the 95 per cent confidence interval was about three percentage points either side). The natural gas value of $1.45/mcf appeared to reflect a seven per cent annual reduction in field prices (the confidence interval was a symmetrical two percentage points)[5].

Returns to Holding Reserves. The HVP implies in-ground prices increase in adjacent years at industry's discount rate. In 2003, the rise in both oil and gas reserve prices exceeded the discount associated with minimum risk by a considerable margin.

2. Revised Results: 2001.

The results for 2001 as published in Adelman & Watkins [2003] showed an increase in reserve values over year 2000 values of about 19 per cent in the case of oil, but more than doubled in the case of natural gas (which then fell as dramatically in 2002). The numbers quoted related to the equation without a constant and excluding outliers[6].

Such an unusual spike in natural gas prices suggested revisiting the underlying transaction data. We examined all the 61 observations used in Adelman & Watkins [2003] to check again for irregularities, unusual values, transactions that involved international assets, transactions that employed 'barrels of oil equivalence' and so forth.

This additional scrutiny identified 11 observations of doubtful parentage, and these were added to the list of excluded transactions. Hence the original 61 observations were reduced to 50. Of the 50, four were identified as outliers, leaving 46 observations after their exclusion. Of the original 61 observations, nine outliers had been identified, leaving 52 observations after outliers. Thus the difference between the original number of observations excluding outliers and the corresponding revised number is six (52 less 46). Hence of the original observations, on a net basis five outliers (9 less 4) were subsequently eliminated from the data set[7].

[5] In Section 3 we estimate implicit levelized field prices embedded in reserve prices.
[6] See Table B-2a, Adelman &Watkins [2003, p66].
[7] It so happens that these five observations identified as outliers in Adelman & Watkins [2003] were five of the 11 observations eliminated from the data set in the review.

Transaction Characteristics. The reduced data set did not shift the leftward distribution of transaction values; log Normality would not be rejected for the 50 observation set. The four outliers were of larger than average value: the mean transaction value fell from $127mm for the 52 observations to $101mm for the 46 observations. And in physical terms, the mean reserve sizes fell.

Regression Results. Linear regression (without a constant) of the 50 transaction values on oil and natural gas reserve volumes disclosed an oil reserve value of $6.40/bl and $1.32/mcf for gas[8]. After elimination of the four outliers, these reserve values changed to $5.75/bl and $1.45/mcf respectively[9].

The revised year 2001 oil reserve value of $5.75/bbl (after exclusion of outliers) was an increase of about a third over the original value of $4.21/bbl in Adelman & Watkins [2003]. The natural gas reserve value fell from $1.68/mcf to $1.45/mcf, or by some 15 per cent. In short, the original analysis tended to underestimate oil reserve values but overestimate gas reserve values.

Reserves Status. Tests of whether reserve prices were influenced by reserves being on production or not disclosed no evidence that reserves on production exhibited higher in-ground values than those seemingly fallow. In the case of oil this result was consistent with the original results; in contrast, for gas the original results had suggested that shut-in reserves had significantly higher reserve prices than those on production.

Influence of R/P Ratio. For oil, the coefficient intended to detect whether R/P ratios influenced reserve values now had the expected (negative) sign, although it was insignificant (in the original results it had been positive but insignificant). For gas, the corresponding coefficient remained negative and significant.

Reserve Prices and Field Prices. The revised 2001 reserve prices had little impact on the results after inclusion of year 2003, reported on above. For oil, the effect of a change in field prices on reserve prices went up slightly to 16 per cent, and the degree of equation fit improved marginally. For gas, there was no appreciable change.

Reserve Prices and Hotelling Values. The ratio of the Hotelling value to the oil reserve prices remained well over two (2.5), although falling from 3.4 beforehand. The spread between the two values was 8.7 standard deviations, a result that continued to provide no support for the HVP. In the case of gas the ratio increased from 1.6 originally to 1.8, with a spread of 7.5 standard deviations – again, no support for the HVP.

Implicit Growth Rates in Prices. The revised 2001 oil reserve price was associated with an increase in the implicit annual growth rate in field prices from minus

[8]The adjusted R^2 was 0.98. Both reserve values were strongly significant. When the equation was estimated with an intercept, the latter was insignificant.

[9]Adjusted R^2 was 0.97; both reserve coefficients highly significant. An intercept, when inserted in the equation, was found to be negative and significant. However, it had little impact on the reserve coefficients estimated when it was suppressed.

nine per cent to minus two per cent (the 95 per cent confidence interval was wide at about 10 percentage points either side). The natural gas value of $1.45/mcf suggested a two per cent annual growth rate in field price, below the four per cent previously (the confidence interval is about a symmetric four percentage points, modestly higher than beforehand).

Returns to Holding Reserves. The increase in the oil reserve value enhances the 'surplus' apparent achieved risk premium over minimum levels already observed with the original data. In the case of natural gas, the achieved risk premium fell with the lower gas reserve value, but still remained comfortably above minimum levels.

3. Extensions to Analysis.

In this section we report on reserve prices after adjustment for inflation and comment on the trends revealed. We also specify estimation of levelized field prices and review those results.

Reserve Values after Adjustment for Inflation. In Adelman & Watkins [2003] all estimated reserve values were shown in money-of-the day terms. Now we display them also in real terms. To do this, three indexes were considered: the US Consumer Price Index (CPP); the US GDP Price Index (GDPPI); and the US Producer Price Index (PPI). Reserve values are an alternative to piecemeal sales at wholesale prices, hence a retail price index would not be suitable. The GDPPI is preferable to the CPI, but its breadth is a disadvantage here. The PPI was selected as the best option.

The oil reserve values in $/bbl are shown in Table 1 and plotted in Figure 1; those for natural gas (in $/mcf) are listed in Table 2 and plotted in Figure 2. The estimates in the tables and plots are with outliers excluded and without an intercept. They are shown in both nominal and real terms, with the adjustment for inflation made by applying the US producer price index (2003 = 1.0). Adjustments using the GDPPI or CPI index resulted in higher real values than under the PPI.

Figure 1 reveals no visible secular trend in oil reserve prices, 1982-2003. Sometimes prices fall, sometimes they rise, as they have recently – but to levels in 2003 only marginally higher than at the previous peak in 1985 in money-of-the-day terms.

In real terms, oil prices tended to fall from the mid-1980s until the mid-1990s. Between then and year 2000 they were quite flat. Since year 2000 reserve prices have moved to distinctly higher levels, as field prices used in company evaluations have increased. This registered OPEC's new found quota discipline and resulting ability to keep wellhead prices comfortably above $20/bbl. Nevertheless the estimated 2003 oil reserve price after adjustment for inflation is still around 20 per cent below the 1985 peak.

Figure 2 shows close to a plateau in natural gas reserve prices from 1986 to year 2000 in terms of money-of-the-day. Since then they have risen, including an unusual blip

in 2001. The 2003 natural gas reserve price remains below real levels of the mid 1980s (excepting 2001).

Table 1: Estimates of In-Ground Crude Oil Prices, United States, 1982-2003 (nominal and real terms)

Year	In-Ground Oil Price ($US/bbl)		Year	In-Ground Oil Price ($US/bbl)	
	Nominal $	$2003 (1)		Nominal $	$2003 (1)
1982	7.13	10.22	1993	3.54	4.07
1983	3.37	4.75	1994	2.9	3.31
1984	6.95	9.6	1995	3.81	4.27
1985	7.74	10.6	1996	3.67	4.00
1986	5.10	7.08	1997	5.01	5.45
1987	4.40	5.98	1998	2.85	3.12
1988	5.69	7.55	1999	3.59	3.87
1989	4.61	5.81	2000	3.55	3.68
1990	3.64	4.38	2001	5.75	5.85
1991	4.44	5.23	2002	5.74	5.92
1992	4.14	4.81	2003	8.17	8.17

(1) Expressed in US$2003 using US Producer Price Index
Source: Adelman & Watkins [2003, Table B-2a] and Adelman & Watkins [2005].

Table 2: Estimates of In-Ground Natural Gas Prices, United States, 1982-2003 (nominal and real terms)

Year	Natural Gas Price ($US/bbl)		Year	Natural Gas Price ($US/bbl)	
	Nominal $	$2003 (1)		Nominal $	$2003 (1)
1982	0.36	0.51	1993	0.87	1
1983	0.64	0.91	1994	0.77	0.88
1984	0.86	1.19	1995	0.60	0.68
1985	0.52	0.72	1996	0.69	0.75
1986	0.96	1.34	1997	0.93	1.01
1987	1.02	1.39	1998	0.62	0.68
1988	0.99	1.31	1999	0.67	0.73
1989	0.88	1.11	2000	0.75	0.78
1990	0.90	1.08	2001	1.45	1.48
1991	0.87	1.02	2002	0.88	0.91
1992	0.82	0.96	2003	1.19	1.19

(1) Expressed in US$2003 using US Producer Price Index
Source: Adelman & Watkins [2003, Table B-2a] and Adelman & Watkins [2005].

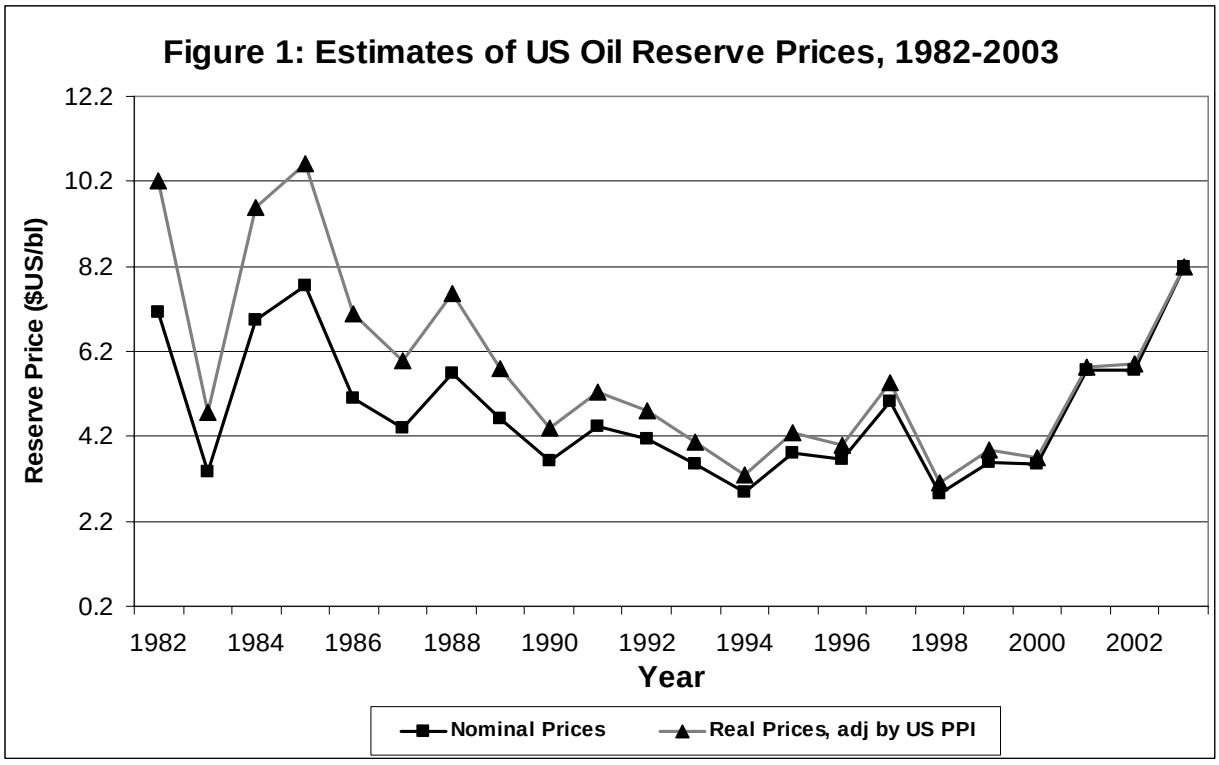


Figure 1: Estimates of US Oil Reserve Prices, 1982-2003
Reserve Price ($US/bl)
12.2
10.2
8.2
6.2
4.2
2.2
0.2
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
Year
Nominal Prices
Real Prices, adj by US PPI

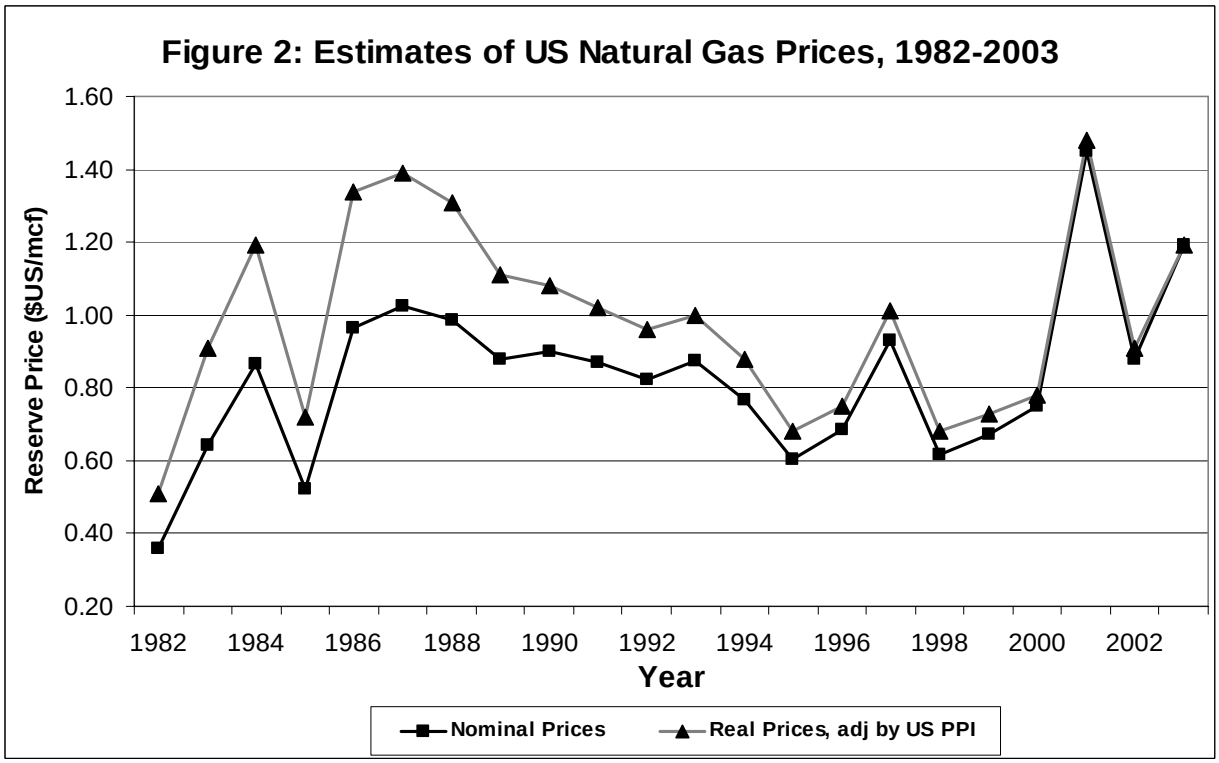


Figure 2: Estimates of US Natural Gas Prices, 1982-2003
Reserve Price ($US/mcf)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
Year
Nominal Prices
Real Prices, adj by US PPI

Levelized Field Prices Implicit in Reserve Prices. In Adelman & Watkins [2003], for any given level of reserve prices we derived implicit field price expectations. The approximation was expressed as expected growth rates from prevailing field prices – negative or positive.

Another way of looking at field prices seemingly embedded in reserve prices is to express them as equivalent constant prices, that is, as levelized prices over the reserve's life. This approach has more in common with industry practice in evaluating reserve properties of adopting a flat price for estimating cash flow, rather than to assume a price trend. The flat price might be in nominal or real terms. The industry vernacular refers to price used for project appraisal as the 'price deck'.

After making some simplifying assumptions, the general expression for the uniform 'planning' price implicit in the price of a reserve in the ground is given by:

$$P_L = V(a + i)/a + c. \qquad (1).$$

where P_L = uniform planning field price
a = production decline rate, percentage per year
i = discount rate
V = reserve price
c = unit extraction cost.

This formula can be derived from expression (6) in Adelman & Watkins [2003, p32] after setting g, the growth rate equal to zero, and then solving for price[10].

The results of applying (1) are shown in Table 3 for both oil and natural gas. The respective series are plotted in Figures 3 (oil) and 4 (gas). Each plot also shows actual field prices.

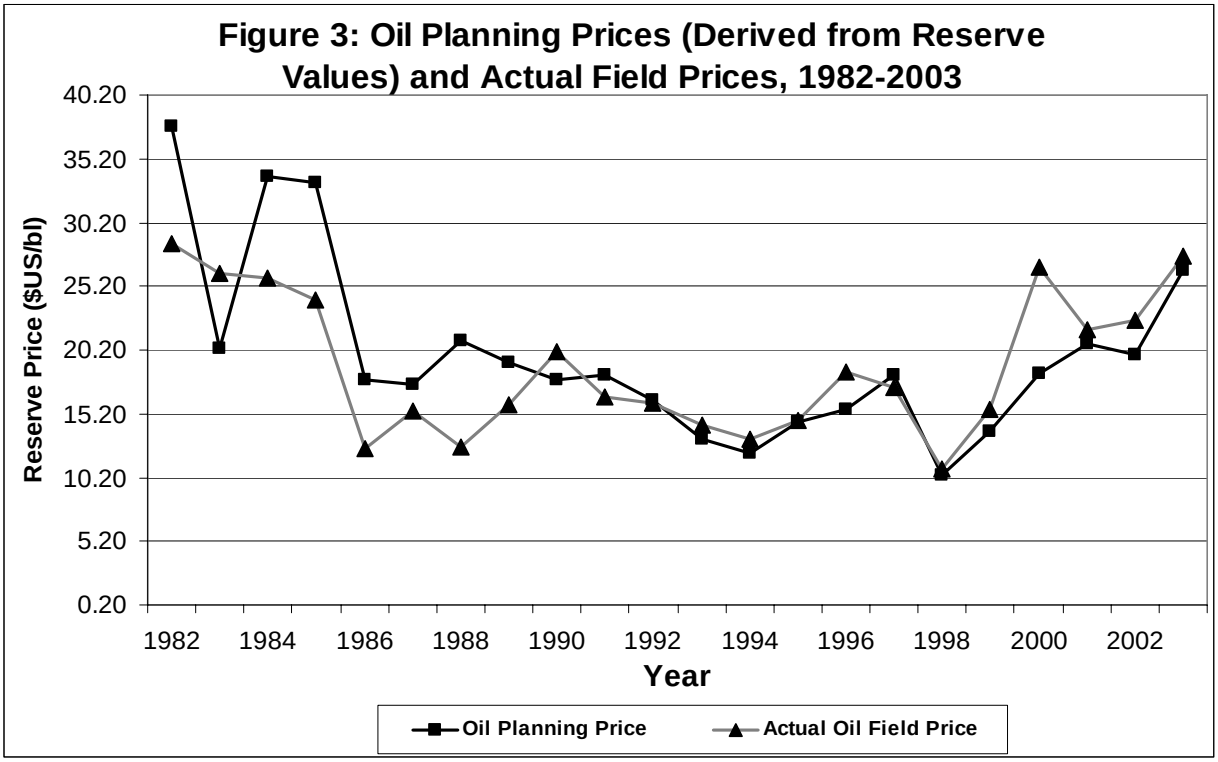
From the mid 1980s to the late 1990s fixed planning prices for oil were close to actual prices; but from 1999 to 2002 planning prices were consistently below actual prices – the implication was that parties making oil reserve transactions did not see realized field prices as being sustainable. In 2002 and especially 2003 that mood had seemingly changed, and indeed in 2003 oil planning prices approximated actual prices.

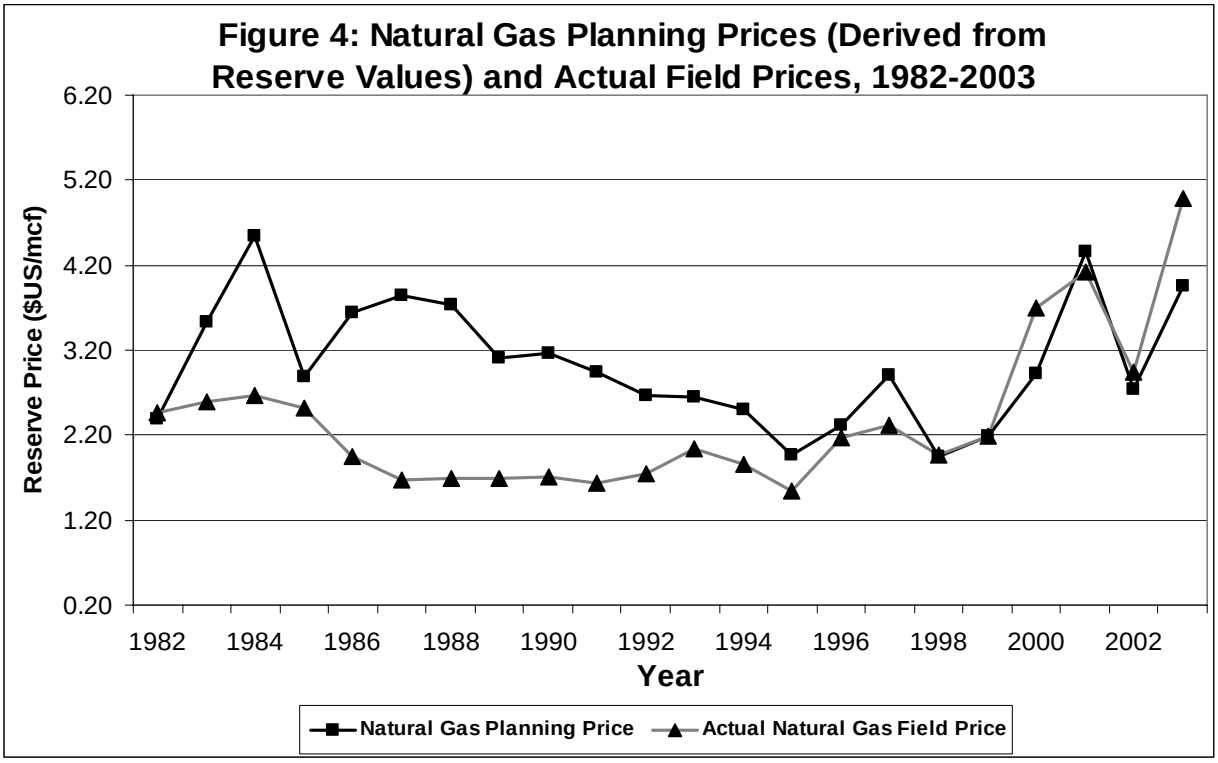
In the case of natural gas, from the mid-1980s to the mid 1990s planning prices were consistently above actual field prices, an indication that corporations misjudged the impact of deregulation. From the mid 1990s on, there was a close approximation between planning and actual prices, except in 2003, when actual field prices appreciably exceeded planning prices.

[10] The planning prices estimated from equation (1) are related to those expressed in terms of growth rates (see earlier) in the following way: an expected positive growth rate in field prices would be associated with a planning price that exceeded the actual field price for the year in question, and vice versa.

Table 3: Oil and Natural Gas Planning Prices, 1982-2003

Year	Oil ($/BBL)	Natural Gas ($/MCF)	Year	Oil ($/BBL)	Natural Gas ($/MCF)
1982	37.70	2.39	1993	13.20	2.65
1983	20.28	3.52	1994	12.14	2.50
1984	33.76	4.54	1995	14.57	1.96
1985	33.33	2.90	1996	15.53	2.32
1986	17.83	3.64	1997	18.29	2.90
1987	17.54	3.84	1998	10.37	1.96
1988	20.97	3.73	1999	13.85	2.19
1989	19.16	3.11	2000	18.33	2.93
1990	17.92	3.16	2001	20.66	4.37
1991	18.29	2.94	2002	19.84	2.73
1992	16.23	2.67	2003	26.45	3.96





4. <u>Concluding Remarks</u>.

Addition of the year 2003 to the data base, and revisions to previous estimates of reserve prices for 2001 do not alter the main character of the results in Adelman & Watkins [2003]. This applies to our findings on the influence of reserves status, R/P ratios and field prices on reserve prices. The Hotelling Valuation Principle continues to provide little or no clue on what industry pays for in-ground reserves.

Yet the reserve prices estimated for 2003 do inject new information on how industry is valuing reserve assets. The strong rise in oil reserve prices provides a clear indication that field prices in the mid $20s per barrel are viewed more as a floor than as a ceiling, and that prices in the teens are not countenanced. This picture is illustrated by the estimates of planning prices underlying the prices paid for developed reserves.

It also follows that if development costs have increased to a lesser degree than the 40 per cent increase in reserve prices estimated in 2003, then an additional margin is available to cover finding costs – increasing the attraction of more expensive sources of reserve additions.

Reassessment of reserve prices in 2001 suggested our earlier estimates were too low in for oil, too high for natural gas. Although we are now carrying a lower reserve price for natural gas, the sharp blip in comparison with year 2000 remains. This seems to be attributable to euphoria over the strong increases in field prices after 1999, before a collapse in 2002.

Some might conclude that the increase in oil reserve prices in 2003 was evidence of nascent shortages. This inference would be false. Tighter world supply and resulting higher prices demonstrated OPEC's improved ability to control a surplus, not its extinction. Greater OPEC discipline was not lost on market participants – it translated in to amounts paid for reserves in the ground, amounts that were still below those paid in 1985, in real terms.

Explanation of higher prices being paid for natural gas reserves in 2003 does not parallel that for oil. While more of an international market is just being to emerge for natural gas, by far the main determinant of prices remains the conditions in North America. Here, higher prices do register tighter supply and a climb up the supply curve.

APPENDICES

Table A-1: Number of Identified Transactions

1	2	3	4	5	6	7	8	9	10
		All Inclusive			*Number of Outliers*			*Excluding Outliers*	
Year	*All Types*	*Pure Oil*	*Pure Gas*	*All Types*	*Pure Oil*	*Pure Gas*	*All Types*	*Pure Oil*	*Pure Gas*
All Years	1592	345	435	106	32	29	1486	313	406
1982	14	1	0	1	0	0	13	1	0
1983	22	2	1	1	0	0	21	2	1
1984	34	8	1	3	1	0	31	7	1
1985	35	5	4	1	0	0	34	5	4
1986	27	3	3	2	0	0	25	3	3
1987	51	12	5	2	2	0	49	10	5
1988	66	14	9	2	1	0	64	13	9
1989	104	19	18	5	1	0	99	18	18
1990	160	38	29	9	3	2	151	35	27
1991	101	20	18	7	1	0	94	19	18
1992	92	20	20	6	2	2	86	18	18
1993	122	28	28	7	1	2	115	27	26
1994	98	17	33	6	2	2	92	15	31
1995	124	35	33	10	5	2	114	30	31
1996	100	31	31	6	1	2	94	30	29
1997	72	16	27	5	3	1	67	13	26
1998	91	19	45	8	3	3	83	16	42
1999	62	13	26	5	1	2	57	12	24
2000	70	15	28	4	1	2	66	14	26
2001	50	10	17	4	1	3	46	9	14
2002	57	14	36	8	3	4	49	11	32
2003	40	5	23	4	0	2	36	5	21

Outliers are defined as follows:

For pure transactions, a reserve price more than two standard deviations for that year.
For mixed transactions, a transaction value more than two standard deviations away from the fitted value.
Transactions of value less than $0.55 per barrel or $0.10 per mcf, or greater than $27.50 per barrel or $5 per mcf.

Source: The Scotia Group M&A Database, January 2004

Table A-2: Summary Statistics for Transaction Values, All Transactions
[Millions of Nominal $, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	99.5	276.9	16.6	2.70	4.80	30.21	---	1592
1982	480.4	1569.7	38.0	3.27	3.32	12.04	Not Rejected	14
1983	103.7	224.3	14.4	2.16	2.37	7.13	Not Rejected	22
1984	979.0	2918.8	39.2	2.98	3.32	12.93	Not Rejected	34
1985	232.5	913.1	17.4	3.93	5.41	31.07	Not Rejected	35
1986	133.7	243.6	10.5	1.82	1.99	5.98	Not Rejected	27
1987	36.9	100.4	7.0	2.72	4.89	28.99	Not Rejected	51
1988	95.4	343.2	7.2	3.60	6.22	44.65	Not Rejected	66
1989	40.8	106.5	8.1	2.61	5.51	38.79	Not Rejected	104
1990	30.3	80.3	5.6	2.65	4.77	29.41	Not Rejected	160
1991	29.1	85.2	5.0	2.92	4.71	25.56	Not Rejected	101
1992	39.7	134.6	5.2	3.39	6.92	56.16	Not Rejected	92
1993	37.9	115.7	7.0	3.06	6.81	56.70	Not Rejected	122
1994	38.8	90.6	9.7	2.33	4.02	20.01	Not Rejected	98
1995	32.8	74.5	8.3	2.27	4.09	21.61	Not Rejected	124
1996	35.5	93.8	11.0	2.64	5.88	41.81	Not Rejected	100
1997	120.1	238.2	26.4	1.98	4.22	24.18	Not Rejected	72
1998	114.0	494.6	17.0	4.34	6.41	42.60	Not Rejected	91
1999	35.0	54.8	14.5	1.57	2.65	9.38	Not Rejected	62
2000	216.2	600.3	23.9	2.78	4.73	25.84	Not Rejected	70
2001	239.0	597.9	42.5	2.50	3.26	12.45	Not Rejected	50
2002	178.4	326.1	62.0	1.83	2.97	11.89	Not Rejected	57
2003	150.5	145.3	106.0	0.97	0.99	3.02	Not Rejected	40

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-3: Summary Statistics for Transaction Values, Excluding Outliers
[Millions of Nominal $, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	47.4	90.4	15.0	1.72	2.87	12.58	---	1486
1982	61.2	63.2	32.0	1.03	0.76	1.90	Not Rejected	13
1983	74.5	182.2	13.8	2.45	3.20	12.48	Not Rejected	21
1984	320.2	1047.2	33.7	3.27	4.66	24.10	Not Rejected	31
1985	80.5	161.2	16.8	2.00	2.97	11.02	Not Rejected	34
1986	78.2	143.2	10.1	1.83	1.86	4.89	Not Rejected	25
1987	19.8	35.8	6.0	1.81	2.81	10.23	Not Rejected	49
1988	56.3	142.9	6.7	2.54	3.66	15.73	Not Rejected	64
1989	28.3	59.7	8.0	2.11	4.99	34.37	Not Rejected	99
1990	16.8	32.3	5.0	1.93	3.12	12.33	Not Rejected	151
1991	13.5	22.6	5.0	1.67	2.82	11.39	Not Rejected	94
1992	19.0	33.6	4.4	1.77	2.85	11.85	Not Rejected	86
1993	20.4	31.8	7.0	1.56	2.77	11.32	Not Rejected	115
1994	20.0	29.6	8.2	1.48	2.59	9.95	Not Rejected	92
1995	19.1	31.2	8.0	1.64	2.89	11.29	Not Rejected	114
1996	20.7	28.2	10.5	1.36	2.90	13.11	Not Rejected	94
1997	85.5	120.8	25.1	1.41	1.72	5.39	Not Rejected	67
1998	42.3	55.5	17.0	1.31	1.82	5.63	Not Rejected	83
1999	22.4	24.0	13.7	1.07	1.61	5.16	Not Rejected	57
2000	116.0	209.3	22.0	1.80	2.42	8.05	Not Rejected	66
2001	101.0	217.2	32.2	2.15	4.76	28.23	Not Rejected	46
2002	106.7	141.9	60.0	1.33	2.63	10.44	Not Rejected	49
2003	119.9	112.5	95.5	0.94	0.87	2.72	Not Rejected	36

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-4: Summary Statistics for Pure Oil Transaction Values, Excluding Outliers
[Millions of Nominal $, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
1982	159.3	---	159.3	---	---	---	---	1
1983	14.0	17.6	14.0	1.26	0.00	1.00	Not Rejected	2
1984	263.4	633.7	18.7	2.41	2.04	5.16	Not Rejected	7
1985	8.3	10.4	4.2	1.25	1.34	3.01	Not Rejected	5
1986	32.9	43.9	15.0	1.33	0.62	1.50	Not Rejected	3
1987	4.2	6.6	1.7	1.56	2.43	7.34	Not Rejected	10
1988	79.6	189.3	2.9	2.38	2.48	7.80	Not Rejected	13
1989	21.3	47.5	3.5	2.23	3.15	12.06	Not Rejected	18
1990	10.1	27.6	1.3	2.72	4.72	25.64	Not Rejected	35
1991	14.6	24.1	2.9	1.65	1.70	4.19	Not Rejected	19
1992	12.3	28.4	2.4	2.30	2.95	10.56	Not Rejected	18
1993	13.8	15.1	7.8	1.09	1.55	4.89	Not Rejected	27
1994	19.7	29.7	6.2	1.51	2.00	6.07	Not Rejected	15
1995	18.4	39.4	2.6	2.14	2.95	10.61	Not Rejected	30
1996	19.5	33.5	8.7	1.72	3.44	15.44	Not Rejected	30
1997	93.2	122.0	18.7	1.31	1.08	2.46	Not Rejected	13
1998	48.9	51.4	36.3	1.05	1.46	4.78	Not Rejected	16
1999	15.1	21.4	7.5	1.42	1.79	4.71	Not Rejected	12
2000	57.5	106.6	11.6	1.85	2.32	7.51	Not Rejected	14
2001	21.3	35.0	4.0	1.64	1.62	4.19	Not Rejected	9
2002	157.0	213.3	58.0	1.36	1.98	5.94	Not Rejected	11
2003	85.3	118.1	46.1	1.38	1.44	3.17	Not Rejected	5

--- Insufficient data points.

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-5: Summary Statistics for Pure Natural Gas Transaction Values, Excluding Outliers
[Millions of Nominal $, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
1982	---	---	---	---	---	---	---	0
1983	7.5	---	7.5	---	---	---	---	1
1984	294.0	---	294.0	---	---	---	---	1
1985	72.0	54.9	64.8	0.76	0.43	1.97	Not Rejected	4
1986	137.6	231.6	4.3	1.68	0.71	1.50	Not Rejected	3
1987	9.2	7.9	7.3	0.86	1.10	2.77	Not Rejected	5
1988	83.1	237.0	3.2	2.85	2.47	7.12	Not Rejected	9
1989	25.0	40.8	5.7	1.63	2.22	6.74	Not Rejected	18
1990	18.1	31.1	4.3	1.72	2.25	7.01	Not Rejected	27
1991	26.5	38.5	9.4	1.45	1.57	3.97	Not Rejected	18
1992	9.5	14.5	3.1	1.52	2.02	6.46	Not Rejected	18
1993	28.2	41.1	6.6	1.46	2.08	7.12	Not Rejected	26
1994	20.3	34.1	7.4	1.68	2.82	11.00	Not Rejected	31
1995	24.9	31.2	11.4	1.25	1.94	5.80	Not Rejected	31
1996	24.5	29.8	12.1	1.22	2.20	7.34	Not Rejected	29
1997	58.6	95.3	22.6	1.63	2.26	6.80	Not Rejected	26
1998	42.5	49.8	19.8	1.17	1.71	5.55	Not Rejected	42
1999	26.6	26.7	18.2	1.00	1.34	4.25	Not Rejected	24
2000	146.8	227.6	44.3	1.55	2.11	6.55	Not Rejected	26
2001	60.1	104.5	28.9	1.74	2.80	9.82	Not Rejected	14
2002	92.5	123.0	56.8	1.33	2.18	7.21	Not Rejected	32
2003	118.9	119.5	100.00	1.01	1.12	3.22	Not Rejected	21

--- Insufficient data points.

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-6: Summary Statistics for Size of Oil Reserves, All Transactions
[Millions of Barrels, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	9.8	37.4	0.5	3.36	5.42	38.06	---	1592
1982	53.3	181.7	1.7	3.41	3.32	12.04	Not Rejected	14
1983	12.8	28.8	0.8	2.25	2.24	6.54	Not Rejected	22
1984	137.3	477.7	2.0	3.48	3.66	14.69	Rejected	34
1985	24.2	115.6	0.6	4.78	5.54	32.14	Not Rejected	35
1986	7.4	16.5	0.4	2.22	2.96	11.55	Not Rejected	27
1987	4.7	16.8	0.5	3.62	4.85	25.69	Not Rejected	51
1988	5.7	18.6	0.6	3.27	4.92	27.53	Not Rejected	66
1989	2.2	4.4	0.5	2.02	4.00	22.74	Not Rejected	104
1990	3.1	13.9	0.3	4.47	7.68	68.52	Not Rejected	160
1991	2.2	7.5	0.2	3.44	6.18	46.48	Not Rejected	101
1992	3.7	12.1	0.4	3.25	5.49	35.73	Not Rejected	92
1993	2.1	4.5	0.4	2.07	3.91	21.96	Not Rejected	122
1994	3.6	10.8	0.3	3.00	5.20	33.14	Not Rejected	98
1995	3.8	16.1	0.3	4.17	8.37	81.30	Not Rejected	124
1996	3.1	6.9	0.3	2.26	3.36	14.22	Not Rejected	100
1997	12.8	47.4	0.8	3.70	6.96	54.47	Not Rejected	72
1998	20.6	118.7	0.0	5.76	7.10	54.08	Not Rejected	91
1999	1.9	5.3	0.3	2.86	5.20	33.12	Not Rejected	62
2000	22.2	111.2	0.3	5.02	6.54	46.88	Not Rejected	70
2001	5.9	14.3	0.3	2.42	4.02	20.56	Not Rejected	50
2002	9.3	24.2	0.0	2.61	3.65	16.56	Not Rejected	57
2003	6.6	8.2	3.6	1.26	2.35	8.32	Not Rejected	40

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-7: Summary Statistics for Size of Natural Gas Reserves, All Transactions
[BCFs, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	58.1	153.7	9.9	2.65	4.64	29.49	---	1592
1982	178.3	564.7	9.9	3.17	3.27	11.82	Not Rejected	14
1983	59.9	181.0	3.6	3.02	3.78	16.34	Not Rejected	22
1984	414.1	1259.9	13.8	3.04	3.29	12.63	Not Rejected	34
1985	109.3	366.9	10.8	5.26	5.04	27.95	Not Rejected	35
1986	111.0	229.3	7.0	2.07	2.35	7.55	Not Rejected	27
1987	14.4	24.0	4.9	1.67	2.22	7.11	Not Rejected	51
1988	57.5	220.8	3.6	3.84	5.94	40.41	Not Rejected	66
1989	30.3	72.9	7.8	2.41	4.85	29.51	Not Rejected	104
1990	23.3	80.5	3.2	3.45	7.57	68.64	Not Rejected	160
1991	19.9	55.1	2.7	2.76	4.24	21.12	Not Rejected	101
1992	26.7	94.5	4.0	3.54	6.09	40.45	Not Rejected	92
1993	26.9	63.5	3.9	2.36	3.85	19.30	Not Rejected	122
1994	23.3	49.2	4.7	2.11	3.37	14.50	Not Rejected	98
1995	24.5	55.0	3.5	2.24	3.49	15.87	Not Rejected	124
1996	24.6	54.8	4.9	2.23	5.42	40.05	Rejected	100
1997	71.1	154.1	11.1	2.17	4.20	24.31	Not Rejected	72
1998	57.3	180.4	11.9	3.15	7.32	62.11	Rejected	91
1999	32.7	54.6	11.1	1.67	2.58	9.53	Not Rejected	62
2000	141.4	349.1	15.5	2.47	4.31	24.39	Not Rejected	70
2001	154.5	439.5	21.2	2.84	3.68	15.47	Not Rejected	50
2002	104.9	234.8	26.1	2.24	4.18	23.45	Not Rejected	57
2003	121.8	121.2	102.0	0.99	1.87	8.09	Not Rejected	40

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-8: Summary Statistics for Reserve Size in Thermal Equivalence, All Transactions
[Trillion BTUs, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	111.1	315.5	19.7	2.52	4.68	28.84	---	1592
1982	471.4	1562.3	27.0	3.31	3.31	12.01	Not Rejected	14
1983	130.5	305.8	11.5	2.34	2.72	9.63	Not Rejected	22
1984	1169.4	3746.3	28.6	3.20	3.50	14.06	Not Rejected	34
1985	242.3	998.4	18.0	4.12	5.41	31.05	Not Rejected	35
1986	151.8	291.3	11.0	1.92	2.26	7.27	Not Rejected	27
1987	39.9	95.0	9.4	2.38	4.12	20.55	Not Rejected	51
1988	88.8	288.2	10.7	3.25	5.71	38.84	Not Rejected	66
1989	42.4	83.2	13.3	1.96	4.24	24.40	Not Rejected	104
1990	40.4	119.9	8.1	2.97	5.55	37.44	Not Rejected	160
1991	31.9	88.8	5.7	2.78	5.01	29.96	Not Rejected	101
1992	47.1	144.4	8.1	3.07	6.23	45.98	Not Rejected	92
1993	38.7	79.1	11.6	2.04	3.94	19.44	Not Rejected	122
1994	43.2	89.3	13.3	2.07	4.45	27.45	Not Rejected	98
1995	45.7	103.8	10.6	2.27	5.33	39.92	Not Rejected	124
1996	41.4	78.4	17.5	1.89	5.57	41.67	Not Rejected	100
1997	141.6	315.5	31.4	2.23	4.80	27.92	Not Rejected	72
1998	170.6	747.5	24.0	4.38	6.43	43.14	Not Rejected	91
1999	42.9	58.2	21.1	1.36	2.20	7.30	Not Rejected	62
2000	263.3	778.9	31.5	2.96	4.93	27.34	Not Rejected	70
2001	187.0	449.4	41.8	2.40	3.37	13.44	Not Rejected	50
2002	155.9	250.0	66.0	1.60	3.27	16.21	Not Rejected	57
2003	121.9	119.7	99.5	0.98	1.75	7.52	Not Rejected	40

Trillion BTUs: 1 Trillion BTUs = 1 Billion Cubic Feet at 1,000 BTUs per cubic foot (TBTUs)
Thermal equivalence factor of 5.5 million BTUs per barrel used.

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table A-9: Summary Statistics for Reserve Size in Thermal Equivalence, Excluding Outliers
[Trillion BTUs, where relevant]

1	2	3	4	5	6	7	8	9
Year	*Mean*	*Std. Dev.*	*Median*	*Coeff. Of Variation*	*Skewness*	*Kurtosis*	*Log Normality*	*# Obs.*
All Years	53.0	98.5	17.6	1.65	2.83	12.46	---	1486
1982	54.4	84.9	26.3	1.56	2.35	7.64	Not Rejected	13
1983	107.3	293.0	9.7	2.73	3.26	12.65	Not Rejected	21
1984	298.6	1060.8	28.5	3.55	4.87	25.87	Not Rejected	31
1985	76.1	177.1	17.3	2.33	4.11	20.45	Not Rejected	34
1986	81.9	148.9	10.8	1.82	1.87	4.94	Not Rejected	25
1987	22.5	34.6	8.1	1.54	2.29	7.13	Not Rejected	49
1988	57.9	139.8	9.8	2.41	3.66	15.84	Not Rejected	64
1989	33.8	60.0	12.5	1.78	4.32	27.64	Not Rejected	99
1990	20.9	39.7	7.3	1.89	3.65	18.07	Not Rejected	151
1991	16.2	25.6	5.5	1.58	2.72	10.99	Not Rejected	94
1992	24.6	39.3	7.4	1.59	2.55	9.60	Not Rejected	86
1993	25.8	36.3	11.0	1.41	2.36	8.75	Not Rejected	115
1994	28.3	42.1	12.6	1.49	2.47	8.72	Not Rejected	92
1995	28.6	47.8	10.2	1.67	2.94	11.96	Rejected	114
1996	30.9	36.3	17.1	1.17	1.92	6.41	Not Rejected	94
1997	94.4	121.5	30.0	1.29	1.70	5.90	Not Rejected	67
1998	61.0	87.5	23.8	1.43	2.61	11.00	Not Rejected	83
1999	31.0	34.1	21.0	1.10	1.89	6.48	Not Rejected	57
2000	137.5	243.7	23.9	1.77	2.71	10.57	Not Rejected	66
2001	85.4	164.0	39.0	1.92	4.72	28.15	Not Rejected	46
2002	110.9	144.8	59.9	1.31	2.04	6.52	Not Rejected	49
2003	100.0	86.2	73.0	0.86	0.62	2.27	Not Rejected	36

Trillion BTUs: 1 Trillion BTUs = 1 Billion Cubic Feet at 1,000 BTUs per cubic foot (TBTUs)
Thermal equivalence factor of 5.5 million BTUs per barrel used.

The normality test used is Jarque-Bera; reject indicates that normality of the log distribution was rejected at 95% confidence level.

Source: The Scotia Group M&A Database, January 2004

Table B-1a: Regression Results for All Transactions (No Constant)

1	2	3	4	5	6	7
Year	*# Obs*	*Oil Coeff ($/bbl)*	*t-stat*	*Gas Coeff ($/mcf)*	*t-stat*	*Adjusted R^2*
1982	14	7.59	11.03	0.35	1.58	0.99
1983	22	4.35	6.89	0.65	6.19	0.92
1984	34	3.71	31.85	1.02	23.36	0.99
1985	35	5.62	12.72	0.73	5.38	0.99
1986	27	2.12	3.26	0.97	21.16	0.97
1987	51	5.60	27.45	0.94	7.38	0.94
1988	66	6.07	22.13	1.20	51.47	0.99
1989	104	4.60	5.38	1.21	22.58	0.88
1990	160	4.18	21.33	0.48	14.49	0.84
1991	101	3.35	11.18	1.16	28.97	0.97
1992	92	6.34	28.07	0.75	25.82	0.98
1993	122	2.60	2.26	1.49	18.08	0.83
1994	98	5.59	13.28	0.74	8.36	0.81
1995	124	3.16	24.01	0.88	24.44	0.91
1996	100	6.98	14.71	0.95	15.92	0.90
1997	72	2.88	19.48	1.13	26.45	0.95
1998	91	3.53	100.81	0.76	34.03	0.99
1999	62	4.97	13.38	0.86	26.30	0.94
2000	70	4.21	30.18	0.75	17.90	0.96
2001	50	6.40	7.75	1.32	47.96	0.98
2002	57	6.49	10.92	1.21	20.15	0.90
2003	40	9.87	7.61	1.12	20.42	0.93

Note: Transaction values are regressed on reserves of oil (in bbls) and natural gas (in mcf).

Source: The Scotia Group M&A Database, January 2004

Table B-1b: Regression Results for All Transactions (Constant Included)

1	2	3	4	5	6	7	8	9
Year	*# Obs*	*Constant*	*t-stat*	*Oil Coeff ($/bbl)*	*t-stat*	*Gas Coeff ($/mcf)*	*t-stat*	*Adjusted R^2*
1982	14	16.54	1.36	7.79	11.44	0.28	1.26	0.99
1983	22	10.91	0.67	4.22	6.33	0.64	6.05	0.91
1984	34	53.79	1.76	3.70	32.83	1.01	23.55	0.99
1985	35	21.18	1.86	5.96	12.85	0.61	4.21	0.99
1986	27	12.79	1.31	1.96	3.01	0.96	20.48	0.97
1987	51	-3.70	-0.87	5.64	26.77	1.00	6.79	0.94
1988	66	-9.20	-2.05	6.17	22.65	1.21	52.64	0.99
1989	104	-8.15	-1.85	5.17	5.75	1.24	22.59	0.87
1990	160	6.82	2.42	4.10	20.94	0.46	13.68	0.82
1991	101	-1.42	-0.82	3.37	11.19	1.16	28.45	0.96
1992	92	-4.29	-1.87	6.41	28.38	0.76	26.21	0.98
1993	122	-9.92	-1.96	3.23	2.73	1.52	18.35	0.82
1994	98	1.76	0.36	5.57	12.99	0.73	7.69	0.77
1995	124	-1.24	-0.51	3.18	23.48	0.89	22.53	0.90
1996	100	-11.88	-3.60	7.41	15.99	1.01	17.21	0.90
1997	72	3.25	0.41	2.87	18.88	1.13	24.04	0.94
1998	91	-2.37	-0.60	3.53	100.39	0.76	32.92	0.99
1999	62	-3.73	-1.46	5.17	13.15	0.89	23.31	0.91
2000	70	19.49	1.21	4.20	30.05	0.73	16.48	0.96
2001	50	-3.45	-0.24	6.48	7.25	1.32	45.39	0.98
2002	57	-11.82	-0.65	6.65	10.25	1.23	18.30	0.87
2003	40	7.75	0.60	9.52	6.63	1.09	14.69	0.86

Note: Transaction values are regressed on reserves of oil (in bbls) and natural gas (in mcf).

Source: The Scotia Group M&A Database, January 2004

Table B-1c: Comparisons of Oil Regression Values with Pure Oil Values for All Transactions (No Constant)

1	2	3	4	5	6
Year	*Oil Coefficient ($/bbl)*	*# Obs*	*Weighted ppb from Pure Oil Transactions ($/bbl)*	*# Obs*	*Ratio of Estimated Oil Coefficient to Pure Transaction ppb*
1982	7.59	14	7.11	1	1.07
1983	4.35	22	10.15	2	0.43
1984	3.71	34	6.93	8	0.53
1985	5.62	35	3.39	5	1.66
1986	2.12	27	8.86	3	0.24
1987	5.60	51	5.27	12	1.06
1988	6.07	66	6.44	14	0.94
1989	4.60	104	4.72	19	0.97
1990	4.18	160	4.50	38	0.93
1991	3.35	101	4.69	20	0.71
1992	6.34	92	4.75	20	1.34
1993	2.60	122	3.90	28	0.67
1994	5.59	98	7.70	17	0.73
1995	3.16	124	3.36	35	0.94
1996	6.98	100	5.36	31	1.30
1997	2.88	72	3.67	16	0.79
1998	3.53	91	3.40	19	1.04
1999	4.97	62	4.23	13	1.18
2000	4.21	70	4.07	15	1.04
2001	6.40	50	4.43	10	1.44
2002	6.49	57	5.52	14	1.18
2003	9.87	40	6.41	5	1.54

Source: The Scotia Group M&A Database, January 2004

Note: The pure oil value observations are weighted volumetrically by the barrels in each transaction for a given year. This is equivalent to summing the value of all pure transactions in a given year and dividing by the total volumes of oil reserves sold.

Table B-1d: Comparisons of Natural Gas Regression Values with Pure Gas Values for All Transactions (No Constant)

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1	2	3	4	5	6
Year	*Gas Coefficient ($/mcf)*	*# Obs*	*Weighted ppmcf from Pure Gas Transactions ($/mcf)*	*# Obs*	*Ratio of Estimated Gas Coefficient to Pure Transaction ppmcf*
1982	0.35	14	---	0	---
1983	0.65	22	1.05	1	0.62
1984	1.02	34	1.32	1	0.77
1985	0.73	35	1.34	4	0.55
1986	0.97	27	0.92	3	1.06
1987	0.94	51	0.89	5	1.05
1988	1.20	66	1.00	9	1.21
1989	1.21	104	1.18	18	1.03
1990	0.48	160	0.83	29	0.58
1991	1.16	101	0.90	18	1.28
1992	0.75	92	0.66	20	1.14
1993	1.49	122	0.73	28	2.04
1994	0.74	98	0.88	33	0.84
1995	0.88	124	0.75	33	1.18
1996	0.95	100	0.63	31	1.51
1997	1.13	72	0.93	27	1.22
1998	0.76	91	0.69	45	1.09
1999	0.86	62	0.85	26	1.02
2000	0.75	70	0.79	28	0.95
2001	1.32	50	1.31	17	1.01
2002	1.21	57	1.13	36	1.07
2003	1.12	40	1.22	23	0.92

--- Insufficient data points.

Source: The Scotia Group M&A Database, January 2004

Note: The pure gas value observations are weighted volumetrically by the cubic feet in each transaction for a given year. This is equivalent to summing the value of all pure transactions in a given year and dividing by the total volumes of gas reserves sold.

Table B-2a: Regression Results for All Transactions (No Constant), Excluding Outliers (with Robust Standard Errors, rather than OLS Standard Errors)

1	2	3	4	5	6	7
Year	*# Obs*	*Oil Coeff ($/bbl)*	*t-stat*	*Gas Coeff ($/mcf)*	*t-stat*	*Adjusted R^2*
1982	13	7.13	9.18	0.36	1.26	0.76
1983	21	3.37	39.87	0.64	58.92	0.99
1984	31	6.95	177.40	0.86	173.62	0.90
1985	34	7.74	1.66	0.52	1.05	0.89
1986	25	5.10	6.66	0.96	20.63	0.99
1987	49	4.40	6.48	1.02	6.96	0.92
1988	64	5.69	22.87	0.99	32.97	0.98
1989	99	4.61	3.56	0.88	5.75	0.82
1990	151	3.64	9.07	0.90	15.61	0.94
1991	94	4.44	12.36	0.87	29.63	0.96
1992	86	4.14	6.95	0.82	11.43	0.89
1993	115	3.54	15.00	0.87	13.45	0.94
1994	92	2.90	4.32	0.77	19.58	0.91
1995	114	3.81	16.85	0.60	9.93	0.95
1996	94	3.67	3.98	0.69	17.76	0.86
1997	67	5.01	14.24	0.93	15.52	0.92
1998	83	2.85	3.15	0.62	6.33	0.81
1999	57	3.59	6.31	0.67	7.39	0.88
2000	66	3.55	1.96	0.75	6.17	0.74
2001	46	5.75	5.92	1.45	8.91	0.97
2002	49	5.74	10.20	0.88	9.69	0.95
2003	36	8.17	17.81	1.19	18.52	0.97

Source: The Scotia Group M&A Database, January 2004

Table B-2b: Regression Results for All Transactions (Constant Included), Excluding Outliers (with Robust Standard Errors, rather than OLS Standard Errors)

1	2	3	4	5	6	7	8	9
Year	*# Obs*	*Constant*	*t-stat*	*Oil Coeff ($/bbl)*	*t-stat*	*Gas Coeff ($/mcf)*	*t-stat*	*Adjusted R^2*
1982	13	26.09	1.99	5.71	4.57	0.28	1.32	0.65
1983	21	8.37	2.84	3.28	55.43	0.64	75.33	0.99
1984	31	16.29	2.80	6.88	157.34	0.86	227.36	0.90
1985	34	21.87	2.13	8.22	1.85	0.39	0.77	0.88
1986	25	0.33	0.11	5.09	6.91	0.96	18.74	0.98
1987	49	-2.29	-2.11	4.61	6.05	1.05	6.69	0.90
1988	64	-2.36	-1.22	5.72	23.13	0.99	35.14	0.98
1989	99	-1.13	-0.40	4.69	3.42	0.88	5.40	0.77
1990	151	-0.25	-0.46	3.65	8.84	0.90	14.80	0.92
1991	94	-0.30	-0.76	4.47	11.85	0.87	31.11	0.95
1992	86	-0.70	-0.53	4.17	6.77	0.83	11.36	0.86
1993	115	-0.20	-0.34	3.56	14.60	0.87	12.86	0.92
1994	92	1.49	1.69	2.82	4.12	0.75	18.20	0.87
1995	114	1.17	1.40	3.76	15.86	0.59	9.03	0.93
1996	94	-0.46	-0.33	3.71	3.65	0.69	16.38	0.78
1997	67	-2.70	-0.91	5.08	14.78	0.94	16.34	0.89
1998	83	9.76	2.68	2.54	2.86	0.57	5.65	0.72
1999	57	3.12	1.43	3.24	4.48	0.63	5.58	0.79
2000	66	21.40	2.16	3.17	1.81	0.71	5.85	0.67
2001	46	-11.25	-2.72	5.85	6.27	1.49	9.59	0.97
2002	49	3.82	0.63	5.67	9.18	0.86	8.11	0.92
2003	36	-7.82	-2.14	8.54	22.43	1.23	17.11	0.93

Source: The Scotia Group M&A Database, January 2004

Table B-2c: Effect of Including Constant on Regression Coeffcients
(Excluding Outliers)

.

1	2	3	4	5	6	7	8
	Oil Coefficient ($/bbl)			Gas Coefficient ($/mcf)			
Year	*Constant Included*	*No Constant*	*Ratio*	*Constant Included*	*No Constant*	*Ratio*	*# Obs*
1982	5.71	7.13	0.80	0.28	0.36	0.79	13
1983	3.28	3.37	0.97	0.64	0.64	0.99	21
1984	6.88	6.95	0.99	0.86	0.86	1.00	31
1985	8.22	7.74	1.06	0.39	0.52	0.74	34
1986	5.09	5.10	1.00	0.96	0.96	1.00	25
1987	4.61	4.40	1.05	1.05	1.02	1.03	49
1988	5.72	5.69	1.01	0.99	0.99	1.01	64
1989	4.69	4.61	1.02	0.88	0.88	1.01	99
1990	3.65	3.64	1.00	0.90	0.90	1.00	151
1991	4.47	4.44	1.01	0.87	0.87	1.01	94
1992	4.17	4.14	1.01	0.83	0.82	1.01	86
1993	3.56	3.54	1.01	0.87	0.87	1.00	115
1994	2.82	2.90	0.97	0.75	0.77	0.98	92
1995	3.76	3.81	0.99	0.59	0.60	0.98	114
1996	3.71	3.67	1.01	0.69	0.69	1.01	94
1997	5.08	5.01	1.01	0.94	0.93	1.01	67
1998	2.54	2.85	0.89	0.57	0.62	0.92	83
1999	3.24	3.59	0.90	0.63	0.67	0.94	57
2000	3.17	3.55	0.89	0.71	0.75	0.95	66
2001	5.85	5.75	1.02	1.49	1.45	1.03	46
2002	5.67	5.74	0.99	0.86	0.88	0.98	49
2003	8.54	8.17	1.04	1.23	1.19	1.04	36

Source: The Scotia Group M&A Database, January 2004

Table B-2d: Effect of Outliers on Reserve Coefficients
(No Constant)

.

1	2	3	4	5	6	7
	Oil Coefficient ($/bbl)			Gas Coefficient ($/mcf)		
Year	*All Data*	*Excluding Outliers*	*Ratio 2/3*	*All Data*	*Excluding Outliers*	*Ratio 5/6*
1982	7.59	7.13	1.06	0.35	0.36	0.97
1983	4.35	3.37	1.29	0.65	0.64	1.01
1984	3.71	6.95	0.53	1.02	0.86	1.18
1985	5.62	7.74	0.73	0.73	0.52	1.40
1986	2.12	5.10	0.42	0.97	0.96	1.01
1987	5.60	4.40	1.27	0.94	1.02	0.91
1988	6.07	5.69	1.07	1.20	0.99	1.22
1989	4.60	4.61	1.00	1.21	0.88	1.38
1990	4.18	3.64	1.15	0.48	0.90	0.53
1991	3.35	4.44	0.76	1.16	0.87	1.33
1992	6.34	4.14	1.53	0.75	0.82	0.91
1993	2.60	3.54	0.73	1.49	0.87	1.71
1994	5.59	2.90	1.93	0.74	0.77	0.96
1995	3.16	3.81	0.83	0.88	0.60	1.46
1996	6.98	3.67	1.90	0.95	0.69	1.39
1997	2.88	5.01	0.58	1.13	0.93	1.22
1998	3.53	2.85	1.24	0.76	0.62	1.23
1999	4.97	3.59	1.39	0.86	0.67	1.28
2000	4.21	3.55	1.19	0.75	0.75	1.00
2001	6.40	5.75	1.11	1.32	1.45	0.91
2002	6.49	5.74	1.13	1.21	0.88	1.37
2003	9.87	8.17	1.21	1.12	1.19	0.94

Source: The Scotia Group M&A Database, January 2004

Table B-2e: Comparisons of Oil Regression Values (No Constant) with Pure Oil Values, Excluding Outliers

1	2	3	4	5	6
Year	*Oil Coefficient ($/bbl)*	*# Obs*	*Weighted ppb from Pure Oil Transactions ($/bbl)*	*# Obs*	*Ratio of Estimated Oil Coefficient to Pure Transaction ppb*
1982	7.13	13	7.11	1	1.00
1983	3.37	21	10.15	2	0.33
1984	6.95	31	6.94	7	1.00
1985	7.74	34	3.39	5	2.28
1986	5.10	25	8.86	3	0.58
1987	4.40	49	3.56	10	1.24
1988	5.69	64	6.15	13	0.93
1989	4.61	99	4.72	18	0.98
1990	3.64	151	4.22	35	0.86
1991	4.44	94	4.66	19	0.95
1992	4.14	86	3.46	18	1.20
1993	3.54	115	3.70	27	0.96
1994	2.90	92	3.71	15	0.78
1995	3.81	114	3.63	30	1.05
1996	3.67	94	3.84	30	0.96
1997	5.01	67	4.81	13	1.04
1998	2.85	83	3.34	16	0.85
1999	3.59	57	4.22	12	0.85
2000	3.55	66	3.46	14	1.03
2001	5.75	46	3.88	9	1.48
2002	5.74	49	5.19	11	1.11
2003	8.17	36	6.41	5	1.28

Source: The Scotia Group M&A Database, January 2004

Note: The pure oil value observations are weighted volumetrically by the barrels in each transaction for a given year. This is equivalent to summing the value of all pure transactions in a given year and dividing by the total volumes of oil reserves sold.

Table C-1: Proven Reserves to Production Ratios

.

1	2	3	4	5	6	7
	Crude Oil (millions of barrels)			Natural Gas (bcf)		
Year	*Beginning Year Reserves*	*Annual Production*	*Ratio 2/3*	*Beginning Year Reserves*	*Annual Production*	*Ratio 5/6*
1982	29426	2950	10.0	201730	17506	11.5
1983	27858	3020	9.2	201512	15788	12.8
1984	27735	3037	9.1	200247	17193	11.6
1985	28446	3052	9.3	197463	15985	12.4
1986	28416	2973	9.6	193369	15610	12.4
1987	26889	2873	9.4	191586	16114	11.9
1988	27256	2811	9.7	187211	16670	11.2
1989	26825	2586	10.4	168024	16983	9.9
1990	26501	2505	10.6	167116	17233	9.7
1991	26254	2512	10.5	169346	17202	9.8
1992	24682	2446	10.1	167062	17423	9.6
1993	23745	2339	10.2	165015	17789	9.3
1994	22957	2268	10.1	162415	18322	8.9
1995	22457	2213	10.1	163837	17966	9.1
1996	22351	2173	10.3	165146	18861	8.8
1997	22017	2138	10.3	166474	19211	8.7
1998	22546	1991	11.3	167233	18720	8.9
1999	21034	1952	10.8	164041	18928	8.7
2000	21765	1880	11.6	167406	19219	8.7
2001	22045	1915	11.5	177427	19779	9.0
2002	22446	2106	10.7	183460	20351	9.0
2003	22677	1877	12.1	186946	19425	9.6

Note: Beginning reserves indicate remaining reserves at January 1.

Source: EIA/DOE "US Crude Oil, Natural Gas, and Natural Gas Liquids Reserves"

Table B-2f: Comparisons of Natural Gas Regression Values (No Constant) with Pure Gas Values, Excluding Outliers

.

1	2	3	4	5	6
Year	*Gas Coefficient ($/mcf)*	*# Obs*	*Weighted ppmcf from Pure Gas Transactions ($/mcf)*	*# Obs*	*Ratio of Estimated Gas Coefficient to Pure Transaction ppmcf*
1982	0.36	13	---	0	---
1983	0.64	21	1.05	1	0.61
1984	0.86	31	1.32	1	0.65
1985	0.52	34	1.34	4	0.39
1986	0.96	25	0.92	3	1.05
1987	1.02	49	0.89	5	1.15
1988	0.99	64	1.00	9	0.99
1989	0.88	99	1.18	18	0.74
1990	0.90	151	0.81	27	1.11
1991	0.87	94	0.90	18	0.96
1992	0.82	86	0.56	18	1.47
1993	0.87	115	0.77	26	1.13
1994	0.77	92	0.76	31	1.01
1995	0.60	114	0.70	31	0.87
1996	0.69	94	0.60	29	1.14
1997	0.93	67	0.90	26	1.03
1998	0.62	83	0.69	42	0.89
1999	0.67	57	0.83	24	0.82
2000	0.75	66	0.73	26	1.03
2001	1.45	46	1.07	14	1.36
2002	0.88	49	0.96	32	0.91
2003	1.19	36	1.20	21	0.99

--- Insufficient data points.

Source: The Scotia Group M&A Database, January 2004

Note: The pure gas value observations are weighted volumetrically by the cubic feet in each transaction for a given year. This is equivalent to summing the value of all pure transactions in a given year and dividing by the total volumes of gas reserves sold.

Table C-2: Regression Results for Transactions with Information on Reserve Status (No Constant), Excluding Outliers

.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Oil ($/bbl)				Natural Gas ($/mcf)								
Year	*a1*	*t-stat*	*a2*	*t-stat*	*a1*	*t-stat*	*a2*	*t-stat*	*Adj. R^2*	*Total Obs*	*No. of Obs: No Oil or Gas Prod*	*No. of Obs: No Oil Prod*	*No. of Obs: No Gas Prod*
1982	7.13	4.02	---	---	0.36	1.54	---	---	0.72	13	13	13	13
1983	5.84	0.10	-2.47	-0.04	0.64	25.51	---	---	0.99	21	20	20	21
1984	3.50	4.72	3.47	4.71	2.05	0.47	-0.94	-0.22	0.99	31	31	31	33
1985	-3.28	-0.04	12.46	0.16	1.38	2.51	-1.05	-1.76	0.89	34	32	32	32
1986	6.94	1.07	-1.82	-0.28	1.19	3.85	-0.24	-0.76	0.99	25	24	24	25
1987	4.44	1.06	-0.68	-0.16	0.80	3.83	0.33	1.42	0.92	49	41	41	44
1988	5.50	41.66	2.76	6.28	1.02	46.41	-0.25	-5.45	0.99	64	55	55	56
1989	5.15	2.94	-0.02	-0.01	1.02	16.29	-0.50	-4.62	0.85	99	85	87	89
1990	4.58	1.33	-0.96	-0.28	0.82	14.41	0.10	1.49	0.94	151	142	146	149
1991	4.33	18.84	0.47	1.09	0.79	7.22	0.08	0.70	0.96	94	80	81	89
1992	4.18	10.23	0.08	0.13	0.78	9.34	0.11	0.90	0.89	86	57	63	67
1993	3.57	12.15	-0.57	-0.97	0.81	29.57	0.19	3.91	0.95	115	74	84	81
1994	3.14	12.81	-0.64	-1.38	0.79	24.20	-0.26	-2.38	0.91	92	53	63	55
1995	3.93	28.77	-1.20	-2.63	0.66	22.35	-0.07	-1.76	0.95	114	78	90	85
1996	4.01	14.34	-1.58	-2.53	0.74	16.77	-0.15	-1.83	0.87	94	57	67	63
1997	3.56	4.45	1.86	2.09	0.90	11.46	0.07	0.70	0.93	67	46	53	53
1998	1.81	5.21	3.01	5.00	0.80	13.77	-0.27	-3.85	0.87	83	46	68	54
1999	3.79	8.19	-0.56	-0.30	0.58	13.11	0.25	3.50	0.90	57	26	43	30
2000	6.02	3.10	-3.32	-1.48	0.77	11.06	-0.10	-0.83	0.74	66	29	50	34
2001	5.43	7.72	-0.34	-0.27	1.38	14.71	0.22	1.25	0.97	46	18	31	25
2002	5.55	9.19	0.23	0.34	1.06	9.48	-0.21	-1.77	0.95	49	27	47	36
2003	8.37	11.55	-3.89	-1.38	1.24	29.31	-0.29	-2.69	0.97	36	29	28	11

--- Insufficient data points.

Note: Reserve status - whether reserves are on production or not.

Equation Specification:

$$adjprice = [a_1^o + a_2^o D_o]R_o + [a_1^g + a_2^g D_g]R_g$$

where:

adjprice is transaction price (after elimination of non reserve assets)
the 'o' superscript denotes oil
the 'g' superscript denotes gas
a_1 and a_2 are the two coefficients for each reserve being tested
R denotes reserves sold
D denotes dummy variable for reserves on production

Table C-3: Regression Results for Transactions with Information on R/P Ratios (No Constant), Excluding Outliers

.

1	2	3	4	5	6	7	8	9	10	11
	Oil ($/bbl)				Natural Gas ($/mcf)					
Year	*a1*	*t-stat*	*a2*	*t-stat*	*a1*	*t-stat*	*a2*	*t-stat*	*Adjusted R^2*	*Obs*
1982	---	---	---	---	---	---	---	---	---	---
1983	---	---	---	---	---	---	---	---	---	---
1984	---	---	---	---	---	---	---	---	---	---
1985	---	---	---	---	---	---	---	---	---	---
1986	---	---	---	---	---	---	---	---	---	---
1987	---	---	---	---	---	---	---	---	---	---
1988	---	---	---	---	---	---	---	---	---	---
1989	11.00	3.35	-1.64	-2.00	0.80	4.30	0.03	1.17	0.97	17
1990	4.95	2.57	-0.39	-0.61	1.08	24.70	-0.04	-6.22	0.99	14
1991	---	---	---	---	---	---	---	---	---	---
1992	3.81	4.40	0.07	0.33	1.05	7.29	-0.08	-2.37	0.93	32
1993	3.85	10.11	-0.06	-1.15	1.21	20.16	-0.09	-7.22	0.97	46
1994	2.31	3.44	0.22	1.43	1.08	7.16	-0.07	-1.97	0.93	42
1995	5.00	7.57	-0.29	-1.66	0.72	8.49	-0.01	-0.77	0.97	42
1996	4.55	11.16	-0.01	-2.95	0.86	5.72	-0.02	-0.91	0.89	41
1997	5.00	5.35	-0.29	-1.73	0.93	25.56	0.00	-0.28	0.98	24
1998	5.68	8.14	-0.29	-5.62	1.06	13.96	-0.04	-2.97	0.95	42
1999	4.71	2.30	-0.16	-0.46	0.58	3.20	0.00	-0.03	0.86	32
2000	11.53	3.15	-0.66	-1.44	0.95	10.68	-0.03	-2.92	0.88	37
2001	5.19	3.05	-0.07	-0.22	2.20	11.66	-0.16	-5.21	0.96	28
2002	10.33	7.96	-0.99	-3.75	1.45	8.31	-0.08	-2.44	0.97	27
2003	9.44	4.12	-0.51	-0.54	1.23	26.97	0.00	0.21	0.97	29

--- Insufficient data points.

R/P ratio is the ratio of remaining reserves to annual production.

Equation Specification:

$$adjprice = [a_1^o + a_2^o H_o]R_o + [a_1^g + a_2^g H_g]R_g$$

where:

adjprice is transaction price (after elimination of non reserve assets)
the 'o' superscript denotes oil
the 'g' superscript denotes gas
a_1 and a_2 are the two coefficients for each reserve being tested
R denotes reserves sold
H denotes the R/P ratio

Table C-4: Oil and Natural Gas Reserve and Field Prices

.

1	2	3	4	5	6	7
	Oil ($/bbl)			Natural Gas ($/mcf)		
Year	*Field Price*	*Reserve Price*	*Ratio 3/2*	*Field Price*	*Reserve Price*	*Ratio 6/5*
1982	28.52	7.13	0.250	2.46	0.36	0.145
1983	26.19	3.37	0.129	2.59	0.64	0.248
1984	25.88	6.95	0.268	2.66	0.86	0.325
1985	24.09	7.74	0.321	2.51	0.52	0.208
1986	12.51	5.10	0.408	1.94	0.96	0.497
1987	15.40	4.40	0.286	1.67	1.02	0.613
1988	12.58	5.69	0.452	1.69	0.99	0.583
1989	15.86	4.61	0.291	1.69	0.88	0.519
1990	20.03	3.64	0.182	1.71	0.90	0.526
1991	16.54	4.44	0.268	1.64	0.87	0.530
1992	15.99	4.14	0.259	1.74	0.82	0.473
1993	14.25	3.54	0.248	2.04	0.87	0.428
1994	13.19	2.90	0.220	1.85	0.77	0.415
1995	14.62	3.81	0.261	1.55	0.60	0.390
1996	18.46	3.67	0.199	2.17	0.69	0.317
1997	17.23	5.01	0.291	2.32	0.93	0.401
1998	10.87	2.85	0.262	1.96	0.62	0.315
1999	15.56	3.59	0.231	2.19	0.67	0.308
2000	26.72	3.55	0.133	3.69	0.75	0.203
2001	21.84	5.75	0.263	4.12	1.45	0.352
2002	22.51	5.74	0.255	2.95	0.88	0.298
2003	27.56	8.17	0.296	4.98	1.19	0.239

Sources:
Cols 2, 5 EIA/DOE "Monthly Energy Review" November 2004
Cols 3, 6 Table B2-a

Table C-5: Regression Results: Reserve Prices and Field Prices

Reserve Prices Against Field Prices

.

1	2	3	4	5	6	7
	Constant	*t-stat*	*Coeff*	*t-stat*	*Adj. R^2*	*Obs*
Oil Contemporary Price ($/bbl)	1.75	1.73	0.16	3.13	0.30	22
Gas Contempory Price ($/mcf)	0.57	4.26	0.11	2.03	0.13	22
Oil 1 Period Lag Price ($/bbl)	1.74	1.69	0.16	2.98	0.28	21
Gas 1 Period Lag Price ($/mcf)	0.59	3.80	0.12	1.80	0.10	21
Oil 2 Period Lag Price ($/bbl)	1.78	1.73	0.16	3.01	0.30	20
Gas 2 Period Lag Price ($/mcf)	0.69	4.22	0.08	1.09	0.01	20

Reserve Prices Against First Differences in Field Prices

Oil Contemporary Price ($/bbl)	4.69	13.93	-0.02	-0.29	-0.05	21
Gas Contempory Price ($/mcf)	0.84	18.12	0.08	1.16	0.02	21
Oil 1 Period Lag Price ($/bbl)	4.77	13.76	0.03	0.46	-0.04	20
Gas 1 Period Lag Price ($/mcf)	0.86	18.21	0.09	0.99	0.00	20
Oil 2 Period Lag Price ($/bbl)	4.64	13.42	-0.02	-0.31	-0.05	19
Gas 2 Period Lag Price ($/mcf)	0.86	16.56	-0.01	-0.12	-0.06	19

Table D-1: Estimates of Hotelling Values and Price Expectations, Oil

.

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/bbl*	*SE of Reserve Price $/bbl*	*Operating Cost (c) $/bbl*	*Field Price (p) $/bbl*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/bbl*	*Ratio of HV to Reserve Price*	*HV Spread SDs*
1982	0.10	0.09	7.13	0.78	9.98	28.52	0.12	18.54	2.60	14.7
1983	0.11	0.10	3.37	0.08	9.17	26.19	-0.17	17.02	5.05	161.4
1984	0.11	0.10	6.95	0.04	9.06	25.88	0.11	16.82	2.42	252.1
1985	0.11	0.10	7.74	4.66	8.43	24.09	0.11	15.66	2.02	1.7
1986	0.10	0.09	5.10	0.77	4.38	12.51	0.10	8.13	1.59	4.0
1987	0.11	0.10	4.40	0.68	5.39	15.40	0.05	10.01	2.27	8.3
1988	0.10	0.09	5.69	0.25	4.40	12.58	0.14	8.18	1.44	10.0
1989	0.10	0.09	4.61	1.30	5.55	15.86	0.06	10.31	2.23	4.4
1990	0.09	0.09	3.64	0.40	7.01	20.03	-0.05	13.02	3.58	23.4
1991	0.10	0.09	4.44	0.36	5.79	16.54	0.03	10.75	2.42	17.6
1992	0.10	0.09	4.14	0.60	5.60	15.99	0.01	10.39	2.51	10.5
1993	0.10	0.09	3.54	0.24	4.99	14.25	-0.03	9.26	2.62	24.3
1994	0.10	0.09	2.90	0.67	4.62	13.19	-0.03	8.57	2.96	8.5
1995	0.10	0.09	3.81	0.23	5.12	14.62	0.00	9.50	2.49	25.2
1996	0.10	0.09	3.67	0.92	6.46	18.46	-0.07	12.00	3.27	9.0
1997	0.10	0.09	5.01	0.35	6.03	17.23	0.02	11.20	2.24	17.6
1998	0.09	0.08	2.85	0.90	3.80	10.87	-0.01	7.07	2.48	4.7
1999	0.09	0.08	3.59	0.57	5.45	15.56	-0.04	10.11	2.82	11.5
2000	0.09	0.08	3.55	1.81	9.35	26.72	-0.19	17.37	4.89	7.6
2001	0.09	0.08	5.75	0.97	7.64	21.84	-0.02	14.20	2.47	8.7
2002	0.09	0.09	5.74	0.56	7.88	22.51	-0.04	14.63	2.55	15.8
2003	0.08	0.08	8.17	0.46	9.65	27.56	0.00	17.91	2.19	21.2

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2a, Col 3.
(5) Regression Results.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-4.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread: Standard Deviations, [Column (9) - Column (4)] / Column (5).

Table D-2: Estimates of Hotelling Values and Price Expectations, Pure Oil

.

1	2	3	4	5	6	7	8.00	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/bbl*	*SE of Reserve Price $/bbl*	*Operating Cost (c) $/bbl*	*Field Price (p) $/bbl*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/bbl*	*Ratio of HV to Reserve Price*	*HV Spread SDs*
1982	0.10	0.09	7.11	---	9.98	28.52	0.12	18.54	2.61	---
1983	0.11	0.10	10.15	3.38	9.17	26.19	0.16	17.02	1.68	2.0
1984	0.11	0.10	6.94	0.47	9.06	25.88	0.11	16.82	2.43	21.0
1985	0.11	0.10	3.39	2.24	8.43	24.09	-0.13	15.66	4.62	5.5
1986	0.10	0.09	8.86	1.95	4.38	12.51	0.16	8.13	0.92	-0.4
1987	0.11	0.10	3.56	2.03	5.39	15.40	-0.01	10.01	2.81	3.2
1988	0.10	0.09	6.15	1.62	4.40	12.58	0.15	8.18	1.33	1.3
1989	0.10	0.09	4.72	1.50	5.55	15.86	0.07	10.31	2.19	3.7
1990	0.09	0.09	4.22	1.71	7.01	20.03	-0.01	13.02	3.08	5.2
1991	0.10	0.09	4.66	1.89	5.79	16.54	0.04	10.75	2.31	3.2
1992	0.10	0.09	3.46	1.59	5.60	15.99	-0.04	10.39	3.01	4.4
1993	0.10	0.09	3.70	2.01	4.99	14.25	-0.02	9.26	2.50	2.8
1994	0.10	0.09	3.71	2.93	4.62	13.19	0.02	8.57	2.31	1.7
1995	0.10	0.09	3.63	1.45	5.12	14.62	-0.01	9.50	2.62	4.1
1996	0.10	0.09	3.84	2.09	6.46	18.46	-0.06	12.00	3.12	3.9
1997	0.10	0.09	4.81	2.60	6.03	17.23	0.01	11.20	2.33	2.5
1998	0.09	0.08	3.34	1.87	3.80	10.87	0.02	7.07	2.11	2.0
1999	0.09	0.08	4.22	1.71	5.45	15.56	0.00	10.11	2.40	3.4
2000	0.09	0.08	3.46	2.26	9.35	26.72	-0.20	17.37	5.02	6.1
2001	0.09	0.08	3.88	0.31	7.64	21.84	-0.11	14.20	3.66	33.8
2002	0.09	0.09	5.19	2.08	7.88	22.51	-0.06	14.63	2.82	4.5
2003	0.08	0.08	6.41	1.55	9.65	27.56	-0.04	17.91	2.79	7.4

--- Insufficient data points.

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2e, Col 4.
(5) Statistical Results.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-4.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread: Standard Deviations, [Column (9) - Column (4)] / Column (5).

Table D-3: Estimates of Hotelling Values and Price Expectations, Natural Gas

.

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/mcf*	*SE of Reserve Price $/mcf*	*Operating Cost (c) $/mcf*	*Field Price (p) $/mcf*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/mcf*	*Ratio of HV to Reserve Price*	*HV Spread SDs*
1982	0.09	0.08	0.36	0.28	0.86	2.46	-0.02	1.60	4.48	4.4
1983	0.08	0.07	0.64	0.01	0.91	2.59	0.10	1.68	2.62	95.5
1984	0.09	0.08	0.86	0.00	0.93	2.66	0.17	1.73	2.00	173.7
1985	0.08	0.07	0.52	0.50	0.88	2.51	0.05	1.63	3.12	2.2
1986	0.08	0.07	0.96	0.05	0.68	1.94	0.13	1.26	1.31	6.3
1987	0.08	0.08	1.02	0.15	0.58	1.67	0.16	1.09	1.06	0.4
1988	0.09	0.08	0.99	0.03	0.59	1.69	0.17	1.10	1.11	3.8
1989	0.10	0.09	0.88	0.15	0.59	1.69	0.15	1.10	1.25	1.5
1990	0.10	0.09	0.90	0.06	0.60	1.71	0.15	1.11	1.24	3.7
1991	0.10	0.09	0.87	0.03	0.57	1.64	0.14	1.07	1.23	6.7
1992	0.10	0.09	0.82	0.07	0.61	1.74	0.11	1.13	1.37	4.3
1993	0.11	0.10	0.87	0.06	0.71	2.04	0.07	1.33	1.52	7.0
1994	0.11	0.10	0.77	0.04	0.65	1.85	0.08	1.20	1.57	11.1
1995	0.11	0.10	0.60	0.06	0.54	1.55	0.07	1.01	1.67	6.6
1996	0.11	0.10	0.69	0.04	0.76	2.17	0.02	1.41	2.05	18.7
1997	0.12	0.10	0.93	0.06	0.81	2.32	0.06	1.51	1.62	9.6
1998	0.11	0.10	0.62	0.10	0.69	1.96	0.00	1.27	2.06	6.7
1999	0.12	0.10	0.67	0.09	0.77	2.19	0.00	1.42	2.11	8.2
2000	0.11	0.10	0.75	0.12	1.29	3.69	-0.10	2.40	3.21	13.6
2001	0.11	0.10	1.45	0.16	1.44	4.12	0.02	2.68	1.84	7.5
2002	0.11	0.10	0.88	0.09	1.03	2.95	-0.02	1.92	2.18	11.5
2003	0.10	0.09	1.19	0.06	1.74	4.98	-0.07	3.24	2.72	31.9

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2a, Col 5.
(5) Regression Results.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-4.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread: Standard Deviations, [Column (9) - Column (4)] / Column (5).

Table D-4: Estimates of Hotelling Values and Price Expectations, Pure Natural Gas

.

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/mcf*	*SE of Reserve Price $/mcf*	*Operating Cost (c) $/mcf*	*Field Price (p) $/mcf*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/mcf*	*Ratio of HV to Reserve Price*	*HV Spread SDs*
1982	0.09	0.08	---	---	0.86	2.46	---	1.60	---	---
1983	0.08	0.07	1.05	---	0.91	2.59	0.18	1.68	1.61	---
1984	0.09	0.08	1.32	---	0.93	2.66	0.23	1.73	1.31	---
1985	0.08	0.07	1.34	11.01	0.88	2.51	0.20	1.63	1.22	0.0
1986	0.08	0.07	0.92	0.18	0.68	1.94	0.13	1.26	1.37	1.9
1987	0.08	0.08	0.89	0.34	0.58	1.67	0.15	1.09	1.22	0.6
1988	0.09	0.08	1.00	0.27	0.59	1.69	0.17	1.10	1.10	0.4
1989	0.10	0.09	1.18	0.59	0.59	1.69	0.18	1.10	0.93	-0.1
1990	0.10	0.09	0.81	0.29	0.60	1.71	0.14	1.11	1.37	1.0
1991	0.10	0.09	0.90	0.35	0.57	1.64	0.14	1.07	1.18	0.5
1992	0.10	0.09	0.56	0.21	0.61	1.74	0.04	1.13	2.02	2.7
1993	0.11	0.10	0.77	0.28	0.71	2.04	0.05	1.33	1.71	2.0
1994	0.11	0.10	0.76	0.34	0.65	1.85	0.08	1.20	1.58	1.3
1995	0.11	0.10	0.70	0.24	0.54	1.55	0.09	1.01	1.45	1.3
1996	0.11	0.10	0.60	0.17	0.76	2.17	-0.01	1.41	2.35	4.6
1997	0.12	0.10	0.90	0.33	0.81	2.32	0.06	1.51	1.68	1.8
1998	0.11	0.10	0.69	0.29	0.69	1.96	0.02	1.27	1.85	2.0
1999	0.12	0.10	0.83	0.60	0.77	2.19	0.04	1.42	1.72	1.0
2000	0.11	0.10	0.73	0.48	1.29	3.69	-0.11	2.40	3.29	3.5
2001	0.11	0.10	1.07	0.09	1.44	4.12	-0.05	2.68	2.51	17.8
2002	0.11	0.10	0.96	0.51	1.03	2.95	-0.01	1.92	1.99	1.9
2003	0.10	0.09	1.20	0.28	1.74	4.98	-0.07	3.24	2.70	7.3

--- Insufficient data points.

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2f, Col 4.
(5) Statistical Results.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-4.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread: Standard Deviations, [Column (9) - Column (4)] / Column (5).

Table D-5: Confidence Limits for Implicit Growth Rate of Oil Prices

1	2	3	4	5	6
		Variance of V Method		*Delta Method*	
Year	*Implicit Annual Growth Rate in Price (g)*	*Lower Bound*	*Upper Bound*	*Lower Bound*	*Upper Bound*
1982	0.12	0.05	0.16	0.06	0.17
1983	-0.17	-0.20	-0.15	-0.19	-0.14
1984	0.11	0.11	0.11	0.11	0.11
1985	0.11	-2.42	0.22	-0.12	0.35
1986	0.10	0.03	0.13	0.05	0.14
1987	0.05	-0.05	0.10	-0.02	0.11
1988	0.14	0.12	0.15	0.12	0.15
1989	0.06	-0.19	0.13	-0.05	0.17
1990	-0.05	-0.14	0.01	-0.12	0.02
1991	0.03	-0.01	0.06	0.00	0.07
1992	0.01	-0.09	0.06	-0.06	0.07
1993	-0.03	-1.29	0.00	-0.06	0.00
1994	-0.03	-0.26	0.05	-0.15	0.09
1995	0.00	-0.03	0.02	-0.03	0.03
1996	-0.07	-0.36	0.03	-0.21	0.07
1997	0.02	-0.01	0.04	-0.01	0.05
1998	-0.01	-0.36	0.06	-0.14	0.11
1999	-0.04	-0.15	0.02	-0.12	0.04
2000	-0.19	-2.29	0.01	-0.58	0.21
2001	-0.02	-0.12	0.03	-0.08	0.05
2002	-0.04	-0.09	0.00	-0.08	0.00
2003	0.00	-0.02	0.02	-0.02	0.02

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Implicit Annual Growth Rate in Price, Table D-1, Col 8.
(3) See text.
(4) See text.
(5) See text.
(6) See text.

The Scotia Group M&A Database, January 2004

Table D-6: Confidence Limits for Implicit Growth Rate of Natural Gas Prices

1	2	3	4	5	6
		Variance of V Method		Delta Method	
Year	*Implicit Annual Growth Rate in Price (g)*	*Lower Bound*	*Upper Bound*	*Lower Bound*	*Upper Bound*
1982	-0.02	-0.93	0.20	-0.58	0.55
1983	0.10	0.10	0.11	0.10	0.11
1984	0.17	0.17	0.17	0.17	0.17
1985	0.05	-0.93	0.21	-0.39	0.50
1986	0.13	0.12	0.14	0.12	0.14
1987	0.16	0.13	0.18	0.14	0.19
1988	0.17	0.16	0.17	0.16	0.17
1989	0.15	0.09	0.18	0.11	0.19
1990	0.15	0.13	0.16	0.13	0.16
1991	0.14	0.13	0.14	0.13	0.14
1992	0.11	0.08	0.12	0.08	0.13
1993	0.07	0.04	0.09	0.05	0.09
1994	0.08	0.07	0.10	0.07	0.10
1995	0.07	0.03	0.09	0.03	0.10
1996	0.02	0.00	0.04	0.00	0.05
1997	0.06	0.04	0.08	0.04	0.09
1998	0.00	-0.10	0.05	-0.07	0.06
1999	0.00	-0.08	0.05	-0.06	0.06
2000	-0.10	-0.26	-0.02	-0.21	0.00
2001	0.02	-0.04	0.05	-0.02	0.06
2002	-0.02	-0.08	0.01	-0.07	0.02
2003	-0.07	-0.10	-0.04	-0.10	-0.04

Note: A value of 0.00 implies negligible growth rates.

Sources:

(2) Implicit Annual Growth Rate in Price, Table D-3, Col 8.
(3) See text.
(4) See text.
(5) See text.
(6) See text.

The Scotia Group M&A Database, January 2004

Table D-7: Return to Holding Oil and Natural Gas, 1982-2003

1	2	3	4	5	6	7	8	9
Year	*Riskless Rate (1-yr TB)*	*Oil Value ($/bbl)*	*Return to Holding*	*Oil Achieved Risk Premium*	*Gas Value ($/mcf)*	*Return to Holding*	*Natural Gas Achieved Risk Premium*	*Required Risk Premium*
1982		7.13			0.36			
1983	0.096	3.37	-0.527	-0.623	0.64	0.800	0.704	0.111
1984	0.109	6.95	1.061	0.952	0.86	0.345	0.236	0.125
1985	0.084	7.74	0.114	0.030	0.52	-0.395	-0.479	0.106
1986	0.065	5.10	-0.341	-0.406	0.96	0.843	0.779	0.077
1987	0.068	4.40	-0.136	-0.204	1.02	0.062	-0.005	0.084
1988	0.077	5.69	0.292	0.215	0.99	-0.038	-0.114	0.089
1989	0.085	4.61	-0.189	-0.274	0.88	-0.111	-0.196	0.085
1990	0.079	3.64	-0.211	-0.290	0.90	0.026	-0.053	0.086
1991	0.059	4.44	0.219	0.160	0.87	-0.033	-0.092	0.079
1992	0.039	4.14	-0.067	-0.106	0.82	-0.054	-0.093	0.070
1993	0.034	3.54	-0.145	-0.179	0.87	0.060	0.026	0.059
1994	0.053	2.90	-0.180	-0.234	0.77	-0.121	-0.174	0.071
1995	0.059	3.81	0.315	0.255	0.60	-0.213	-0.272	0.066
1996	0.055	3.67	-0.036	-0.091	0.69	0.138	0.082	0.064
1997	0.056	5.01	0.362	0.306	0.93	0.356	0.300	0.064
1998	0.051	2.85	-0.431	-0.482	0.62	-0.337	-0.388	0.053
1999	0.051	3.59	0.260	0.209	0.67	0.092	0.041	0.057
2000	0.061	3.55	-0.010	-0.071	0.75	0.110	0.049	0.060
2001	0.035	5.75	0.618	0.584	1.45	0.940	0.905	0.050
2002	0.020	5.74	-0.001	-0.021	0.88	-0.395	-0.415	0.046
2003	0.012	8.17	0.424	0.412	1.19	0.354	0.342	0.040
Mean	0.059		0.048	-0.014		0.104	0.042	0.073
St.Dev.	0.022		0.373	0.371		0.385	0.382	0.021
St.Err.	0.005		0.083	0.083		0.086	0.085	0.005
Mn/Se	12.099		0.578	-0.163		1.206	0.493	15.622

Sources:

(2) Federal Reserve Board Historical Rates (http://www.federalreserve.gov/releases/h15/data/a/tcm1y.txt)
(3) Oil Reserve Price, Table B-2a, Col 3.
(4) Percentage Change, Col 3 (t)/Col 3 (t-1) - 1
(5) Oil Achieved Risk Premium, Col 4 - Col 2
(6) Natural Gas Reserve Price, Table B-2a, Col 5.
(7) Percentage Change, Col 8 (t)/Col 8 (t-1) - 1
(8) Natural Gas Achieved Risk Premium, Col 8 - Col 2
(9) Required Risk Premium, LTBR (http://www.federalreserve.gov/releases/h15/data/a/tcm10y.txt)

Table D-8: Levelized Oil Wellhead Prices

1	2	3	4	5	6	7	8	9
Year	*Required Risk Premium*	*P/R Ratio*	*R/Q Ratio*	*Reserve Price $/bbl*	*Decline Rate (a)*	*Discount Rate*	*Operating Cost (c) $/bbl*	*Levelized Wellhead Price*
1982	13.01	0.10	9.97	7.13	0.09	0.26	9.98	34.92
1983	11.10	0.11	9.22	3.37	0.10	0.22	9.17	19.08
1984	12.46	0.11	9.13	6.95	0.10	0.25	9.06	31.06
1985	10.62	0.11	9.32	7.74	0.10	0.21	8.43	30.66
1986	7.67	0.10	9.56	5.10	0.09	0.15	4.38	16.42
1987	8.39	0.11	9.36	4.40	0.10	0.17	5.39	16.24
1988	8.85	0.10	9.70	5.69	0.09	0.18	4.40	19.27
1989	8.49	0.10	10.37	4.61	0.09	0.17	5.55	17.85
1990	8.55	0.09	10.58	3.64	0.09	0.17	7.01	16.89
1991	7.86	0.10	10.45	4.44	0.09	0.16	5.79	17.09
1992	7.01	0.10	10.09	4.14	0.09	0.14	5.60	15.18
1993	5.87	0.10	10.15	3.54	0.09	0.12	4.99	12.39
1994	7.09	0.10	10.12	2.90	0.09	0.14	4.62	11.39
1995	6.57	0.10	10.15	3.81	0.09	0.13	5.12	13.64
1996	6.44	0.10	10.29	3.67	0.09	0.13	6.46	14.65
1997	6.35	0.10	10.30	5.01	0.09	0.13	6.03	17.10
1998	5.26	0.09	11.32	2.85	0.08	0.11	3.80	9.79
1999	5.65	0.09	10.78	3.59	0.08	0.11	5.45	13.07
2000	6.03	0.09	11.58	3.55	0.08	0.12	9.35	17.55
2001	5.02	0.09	11.51	5.75	0.08	0.10	7.64	19.53
2002	4.61	0.09	10.66	5.74	0.09	0.09	7.88	18.72
2003	4.01	0.08	12.08	8.17	0.08	0.08	9.65	25.06

Sources:

(2) Required Risk Premium, http://www.federalreserve.gov/releases/h15/data/a/tcm10y.txt.
(3) Production/Reserves Ratio, P/R, Table D-1, Col 2.
(4) Reserves/Initial Output Ratio, [Column (3)] ^-1.
(5) Reserve Price (b), Table D-1, Col 4.
(6) Adjusted Ratio (a), Table D-1, Col 3.
(7) Discount Rate, 0.02*Column (2).
(8) Operating Cost (c), Table D-1, Col 6.
(9) Levelized Wellhead Price, {Col (4) * Col (5) * [Col (6) + Col (7)]} + Col (8).

Table D-9: Levelized Gas Wellhead Prices

1	2	3	4	5	6	7	8	9
Year	*Required Risk Premium*	*P/R Ratio*	*R/Q Ratio*	*Reserve Price $/bbl*	*Decline Rate (a)*	*Discount Rate*	*Operating Cost (c) $/bbl*	*Levelized Wellhead Price*
1982	13.01	0.09	11.52	0.36	0.08	0.26	0.86	2.26
1983	11.10	0.08	12.76	0.64	0.07	0.22	0.91	3.32
1984	12.46	0.09	11.65	0.86	0.08	0.25	0.93	4.23
1985	10.62	0.08	12.35	0.52	0.07	0.21	0.88	2.73
1986	7.67	0.08	12.39	0.96	0.07	0.15	0.68	3.40
1987	8.39	0.08	11.89	1.02	0.08	0.17	0.58	3.57
1988	8.85	0.09	11.23	0.99	0.08	0.18	0.59	3.45
1989	8.49	0.10	9.89	0.88	0.09	0.17	0.59	2.85
1990	8.55	0.10	9.70	0.90	0.09	0.17	0.60	2.90
1991	7.86	0.10	9.84	0.87	0.09	0.16	0.57	2.70
1992	7.01	0.10	9.59	0.82	0.09	0.14	0.61	2.45
1993	5.87	0.11	9.28	0.87	0.10	0.12	0.71	2.44
1994	7.09	0.11	8.86	0.77	0.10	0.14	0.65	2.29
1995	6.57	0.11	9.12	0.60	0.10	0.13	0.54	1.80
1996	6.44	0.11	8.76	0.69	0.10	0.13	0.76	2.14
1997	6.35	0.12	8.67	0.93	0.10	0.13	0.81	2.66
1998	5.26	0.11	8.93	0.62	0.10	0.11	0.69	1.81
1999	5.65	0.12	8.67	0.67	0.10	0.11	0.77	2.02
2000	6.03	0.11	8.71	0.75	0.10	0.12	1.29	2.74
2001	5.02	0.11	8.97	1.45	0.10	0.10	1.44	4.04
2002	4.61	0.11	9.01	0.88	0.10	0.09	1.03	2.54
2003	4.01	0.10	9.62	1.19	0.09	0.08	1.74	3.73

Sources:

(2) Required Risk Premium, http://www.federalreserve.gov/releases/h15/data/a/tcm10y.txt.
(3) Production/Reserves Ratio, P/R, Table D-3, Col 2.
(4) Reserves/Initial Output Ratio, [Column (3)] ^-1.
(5) Reserve Price (b), Table D-3, Col 4.
(6) Adjusted Ratio (a), Table D-3, Col 3.
(7) Discount Rate, 0.02*Column (2).
(8) Operating Cost (c), Table D-3, Col 6.
(9) Levelized Wellhead Price, {Col (4) * Col (5) * [Col (6) + Col (7)]} + Col (8).

Table D-10:

1	2	3	4	5	6	7
	Oil ($/bbl)			Gas ($/mcf)		
Year	*Levelized Price*	*Field Price*	*Ratio*	*Levelized Price*	*Field Price*	*Ratio*
1982	34.92	28.52	1.22	2.26	2.46	0.92
1983	19.08	26.19	0.73	3.32	2.59	1.28
1984	31.06	25.88	1.20	4.23	2.66	1.59
1985	30.66	24.09	1.27	2.73	2.51	1.09
1986	16.42	12.51	1.31	3.40	1.94	1.75
1987	16.24	15.40	1.05	3.57	1.67	2.14
1988	19.27	12.58	1.53	3.45	1.69	2.04
1989	17.85	15.86	1.13	2.85	1.69	1.69
1990	16.89	20.03	0.84	2.90	1.71	1.69
1991	17.09	16.54	1.03	2.70	1.64	1.65
1992	15.18	15.99	0.95	2.45	1.74	1.41
1993	12.39	14.25	0.87	2.44	2.04	1.20
1994	11.39	13.19	0.86	2.29	1.85	1.24
1995	13.64	14.62	0.93	1.80	1.55	1.16
1996	14.65	18.46	0.79	2.14	2.17	0.99
1997	17.10	17.23	0.99	2.66	2.32	1.15
1998	9.79	10.87	0.90	1.81	1.96	0.93
1999	13.07	15.56	0.84	2.02	2.19	0.92
2000	17.55	26.72	0.66	2.74	3.69	0.74
2001	19.53	21.84	0.89	4.04	4.12	0.98
2002	18.72	22.51	0.83	2.54	2.95	0.86
2003	25.06	27.56	0.91	3.73	4.98	0.75

Sources:

(2) Levelized Oil Price, Table D-8, Col 9.
(3) Oil Field Price, Table C-4, Col 2.
(4) Ratio, Col 2 / Col 3
(5) Levelized Gas Price, Table D-9, Col 9.
(6) Gas Field Price, Table C-4, Col 5.
(7) Ratio, Col 5 / Col 6

Figure 5: Levelized Oil Wellhead Prices derived from Reserve Values and Field Prices, 1982-2003

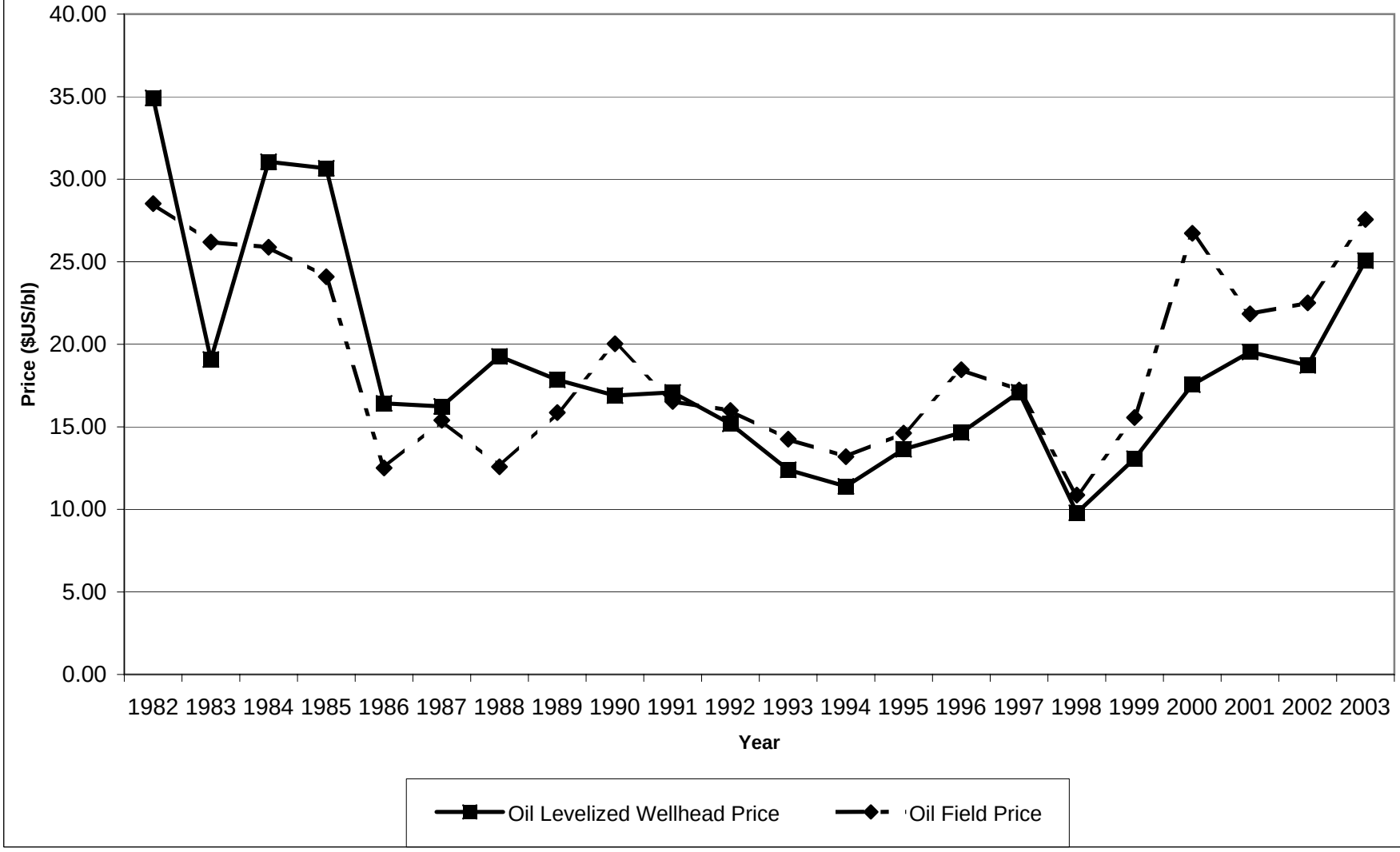

Figure 6: Levelized Wellhead Natural Gas Prices derived from Reserve Values, and Field Prices, 1982-2003

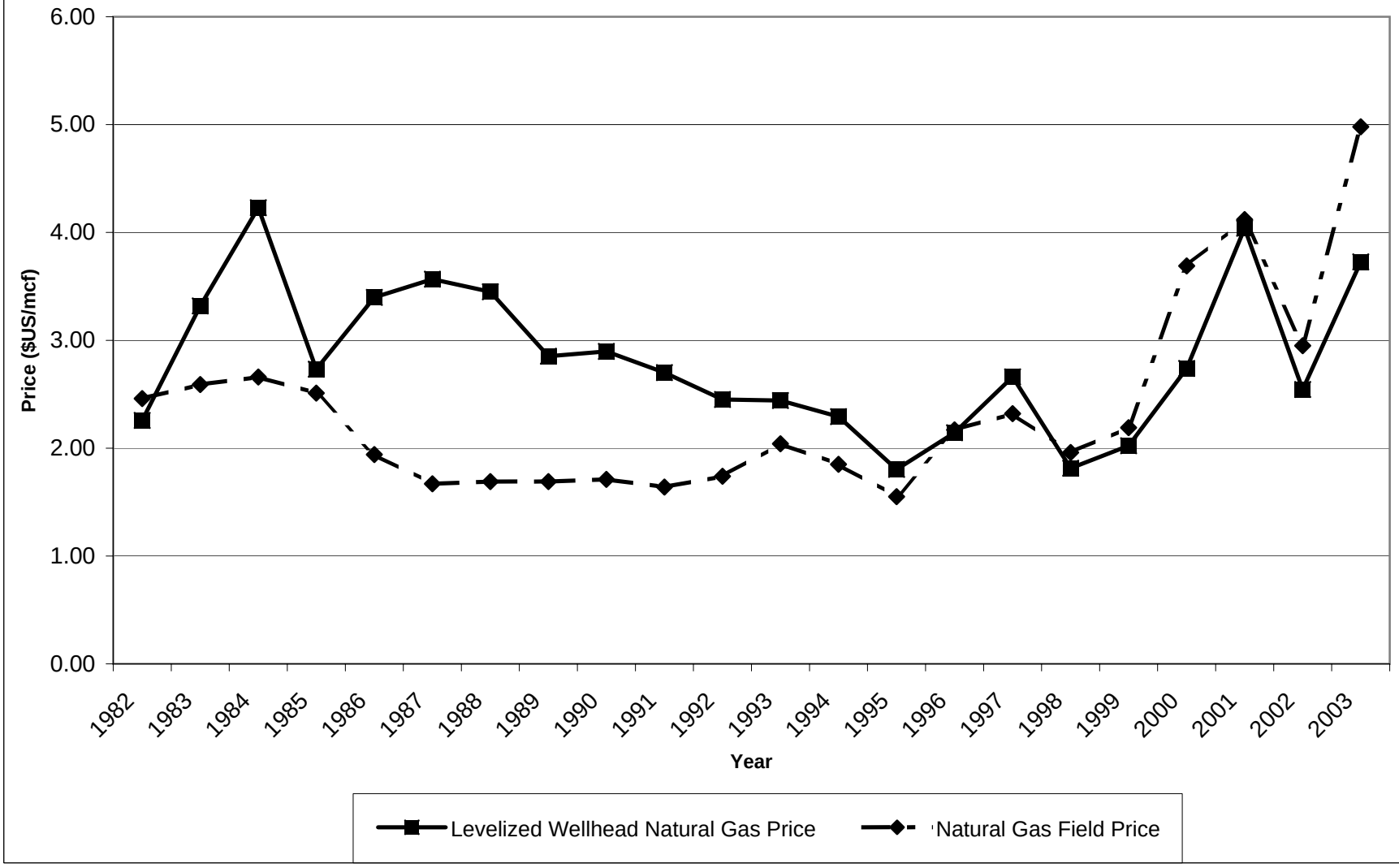

Table D-1a: Estimates of Hotelling Values and Price Expectations, All Oil

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/bbl*	*SE of Reserve Price $/bbl*	*Operating Cost (c) $/bbl*	*Field Price (p) $/bbl*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/bbl*	*Ratio of HV to Reserve Price*	*HV Spread $/bbl*
1982	0.10	0.09	5.58	0.78	9.98	28.52	0.05	18.54	3.32	16.67
1983	0.11	0.10	3.20	0.08	9.17	26.19	-0.20	17.02	5.32	163.45
1984	0.11	0.10	6.87	0.04	9.06	25.88	0.11	16.82	2.45	254.14
1985	0.11	0.10	0.55	4.66	8.43	24.09	-2.42	15.66	28.47	3.24
1986	0.10	0.09	3.57	0.77	4.38	12.51	0.03	8.13	2.28	5.96
1987	0.11	0.10	3.04	0.68	5.39	15.40	-0.05	10.01	3.29	10.25
1988	0.10	0.09	5.19	0.25	4.40	12.58	0.12	8.18	1.58	12.01
1989	0.10	0.09	2.02	1.30	5.55	15.86	-0.19	10.31	5.10	6.39
1990	0.09	0.09	2.84	0.40	7.01	20.03	-0.14	13.02	4.59	25.37
1991	0.10	0.09	3.72	0.36	5.79	16.54	-0.01	10.75	2.89	19.59
1992	0.10	0.09	2.95	0.60	5.60	15.99	-0.09	10.39	3.53	12.50
1993	0.10	0.09	0.55	0.24	4.99	14.25	-1.29	9.26	16.84	36.93
1994	0.10	0.09	1.56	0.67	4.62	13.19	-0.26	8.57	5.51	10.45
1995	0.10	0.09	3.36	0.23	5.12	14.62	-0.03	9.50	2.83	27.15
1996	0.10	0.09	1.83	0.92	6.46	18.46	-0.36	12.00	6.56	11.02
1997	0.10	0.09	4.30	0.35	6.03	17.23	-0.01	11.20	2.60	19.62
1998	0.09	0.08	1.04	0.90	3.80	10.87	-0.36	7.07	6.80	6.67
1999	0.09	0.08	2.45	0.57	5.45	15.56	-0.15	10.11	4.13	13.48
2000	0.09	0.08	0.55	1.81	9.35	26.72	-2.29	17.37	31.58	9.28
2001	0.09	0.08	3.81	0.97	7.64	21.84	-0.12	14.20	3.73	10.70
2002	0.09	0.09	4.61	0.56	7.88	22.51	-0.09	14.63	3.17	17.80
2003	0.08	0.08	7.26	0.46	9.65	27.56	-0.02	17.91	2.47	23.23

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1e.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2b.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-1a.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread, [Column (9) - Column (4)] / Column (5).

Table D-1a: Estimates of Hotelling Values and Price Expectations, All Oil

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/bbl*	*SE of Reserve Price $/bbl*	*Operating Cost (c) $/bbl*	*Field Price (p) $/bbl*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/bbl*	*Ratio of HV to Reserve Price*	*HV Spread $/bbl*
1982	0.10	0.09	8.69	0.78	9.98	28.52	0.16	18.54	2.13	12.67
1983	0.11	0.10	3.54	0.08	9.17	26.19	-0.15	17.02	4.81	159.45
1984	0.11	0.10	7.03	0.04	9.06	25.88	0.11	16.82	2.39	250.14
1985	0.11	0.10	17.06	4.66	8.43	24.09	0.22	15.66	0.92	-0.30
1986	0.10	0.09	6.63	0.77	4.38	12.51	0.13	8.13	1.23	1.96
1987	0.11	0.10	5.76	0.68	5.39	15.40	0.10	10.01	1.74	6.25
1988	0.10	0.09	6.19	0.25	4.40	12.58	0.15	8.18	1.32	8.01
1989	0.10	0.09	7.21	1.30	5.55	15.86	0.13	10.31	1.43	2.39
1990	0.09	0.09	4.44	0.40	7.01	20.03	0.01	13.02	2.93	21.37
1991	0.10	0.09	5.15	0.36	5.79	16.54	0.06	10.75	2.09	15.59
1992	0.10	0.09	5.33	0.60	5.60	15.99	0.06	10.39	1.95	8.50
1993	0.10	0.09	4.01	0.24	4.99	14.25	0.00	9.26	2.31	22.27
1994	0.10	0.09	4.24	0.67	4.62	13.19	0.05	8.57	2.02	6.45
1995	0.10	0.09	4.26	0.23	5.12	14.62	0.02	9.50	2.23	23.15
1996	0.10	0.09	5.52	0.92	6.46	18.46	0.03	12.00	2.17	7.02
1997	0.10	0.09	5.71	0.35	6.03	17.23	0.04	11.20	1.96	15.62
1998	0.09	0.08	4.66	0.90	3.80	10.87	0.06	7.07	1.52	2.67
1999	0.09	0.08	4.72	0.57	5.45	15.56	0.02	10.11	2.14	9.48
2000	0.09	0.08	7.17	1.81	9.35	26.72	0.01	17.37	2.42	5.63
2001	0.09	0.08	7.69	0.97	7.64	21.84	0.03	14.20	1.85	6.70
2002	0.09	0.09	6.87	0.56	7.88	22.51	0.00	14.63	2.13	13.80
2003	0.08	0.08	9.09	0.46	9.65	27.56	0.02	17.91	1.97	19.23

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1e.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2b.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-1a.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread, [Column (9) - Column (4)] / Column (5).

Table D-1c: Estimates of Hotelling Values and Price Expectations, All Gas

.

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/mcf*	*SE of Reserve Price $/mcf*	*Operating Cost (c) $/mcf*	*Field Price (p) $/mcf*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/mcf*	*Ratio of HV to Reserve Price*	*HV Spread*
1982	0.09	0.08	0.10	0.28	0.86	2.46	-0.93	1.60	15.99	5.29
1983	0.08	0.07	0.62	0.01	0.91	2.59	0.10	1.68	2.71	97.49
1984	0.09	0.08	0.85	0.00	0.93	2.66	0.17	1.73	2.02	175.68
1985	0.08	0.07	0.10	0.50	0.88	2.51	-0.93	1.63	16.32	3.07
1986	0.08	0.07	0.87	0.05	0.68	1.94	0.12	1.26	1.45	8.34
1987	0.08	0.08	0.73	0.15	0.58	1.67	0.13	1.09	1.49	2.41
1988	0.09	0.08	0.93	0.03	0.59	1.69	0.16	1.10	1.19	5.77
1989	0.10	0.09	0.57	0.15	0.59	1.69	0.09	1.10	1.92	3.46
1990	0.10	0.09	0.78	0.06	0.60	1.71	0.13	1.11	1.42	5.68
1991	0.10	0.09	0.81	0.03	0.57	1.64	0.13	1.07	1.31	8.70
1992	0.10	0.09	0.68	0.07	0.61	1.74	0.08	1.13	1.67	6.29
1993	0.11	0.10	0.74	0.06	0.71	2.04	0.04	1.33	1.79	9.00
1994	0.11	0.10	0.69	0.04	0.65	1.85	0.07	1.20	1.75	13.12
1995	0.11	0.10	0.48	0.06	0.54	1.55	0.03	1.01	2.09	8.64
1996	0.11	0.10	0.61	0.04	0.76	2.17	0.00	1.41	2.31	20.71
1997	0.12	0.10	0.81	0.06	0.81	2.32	0.04	1.51	1.86	11.61
1998	0.11	0.10	0.42	0.10	0.69	1.96	-0.10	1.27	3.02	8.74
1999	0.12	0.10	0.49	0.09	0.77	2.19	-0.08	1.42	2.90	10.22
2000	0.11	0.10	0.51	0.12	1.29	3.69	-0.26	2.40	4.74	15.61
2001	0.11	0.10	1.13	0.16	1.44	4.12	-0.04	2.68	2.38	9.53
2002	0.11	0.10	0.70	0.09	1.03	2.95	-0.08	1.92	2.75	13.46
2003	0.10	0.09	1.06	0.06	1.74	4.98	-0.10	3.24	3.05	33.87

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1e.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2b.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-1a.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread, [Column (9) - Column (4)] / Column (5).

Table D-1c: Estimates of Hotelling Values and Price Expectations, All Gas

.

1	2	3	4	5	6	7	8	9	10	11
Year	*P/R Ratio*	*Adjusted Ratio (a)*	*Reserve Price (b) $/mcf*	*SE of Reserve Price $/mcf*	*Operating Cost (c) $/mcf*	*Field Price (p) $/mcf*	*Implicit Annual Growth Rate in Price*	*Net Field Price: HV $/mcf*	*Ratio of HV to Reserve Price*	*HV Spread*
1982	0.09	0.08	0.92	0.28	0.86	2.46	0.20	1.60	1.73	2.39
1983	0.08	0.07	0.66	0.01	0.91	2.59	0.11	1.68	2.53	93.49
1984	0.09	0.08	0.87	0.00	0.93	2.66	0.17	1.73	1.98	171.68
1985	0.08	0.07	1.52	0.50	0.88	2.51	0.21	1.63	1.07	0.22
1986	0.08	0.07	1.06	0.05	0.68	1.94	0.14	1.26	1.19	4.34
1987	0.08	0.08	1.32	0.15	0.58	1.67	0.18	1.09	0.82	-1.59
1988	0.09	0.08	1.05	0.03	0.59	1.69	0.17	1.10	1.05	1.77
1989	0.10	0.09	1.18	0.15	0.59	1.69	0.18	1.10	0.93	-0.54
1990	0.10	0.09	1.01	0.06	0.60	1.71	0.16	1.11	1.10	1.68
1991	0.10	0.09	0.93	0.03	0.57	1.64	0.14	1.07	1.15	4.70
1992	0.10	0.09	0.97	0.07	0.61	1.74	0.12	1.13	1.17	2.29
1993	0.11	0.10	1.00	0.06	0.71	2.04	0.09	1.33	1.32	5.00
1994	0.11	0.10	0.85	0.04	0.65	1.85	0.10	1.20	1.42	9.12
1995	0.11	0.10	0.73	0.06	0.54	1.55	0.09	1.01	1.39	4.64
1996	0.11	0.10	0.76	0.04	0.76	2.17	0.04	1.41	1.85	16.71
1997	0.12	0.10	1.05	0.06	0.81	2.32	0.08	1.51	1.43	7.61
1998	0.11	0.10	0.81	0.10	0.69	1.96	0.05	1.27	1.57	4.74
1999	0.12	0.10	0.86	0.09	0.77	2.19	0.05	1.42	1.66	6.22
2000	0.11	0.10	0.99	0.12	1.29	3.69	-0.02	2.40	2.42	11.61
2001	0.11	0.10	1.78	0.16	1.44	4.12	0.05	2.68	1.51	5.53
2002	0.11	0.10	1.06	0.09	1.03	2.95	0.01	1.92	1.81	9.46
2003	0.10	0.09	1.32	0.06	1.74	4.98	-0.04	3.24	2.46	29.87

Sources:

(2) Production/Reserves Ratio, P/R, Table C-1e.
(3) Adjusted Ratio (a), see text.
(4) Reserve Price (b), Table B-2b.
(6) Operating Cost (c), 35% of field price.
(7) Field Price (p), Table C-1a.
(8) Implicit Annual Growth Rate in Price, see text.
(9) Net Field Price, p-c, Column (7) - Column (6).
(10) HV to Reserve Price, Column (9) / Column (4).
(11) HV Spread, [Column (9) - Column (4)] / Column (5).

Figure 1: Oil Reserve Prices for 1982-2003

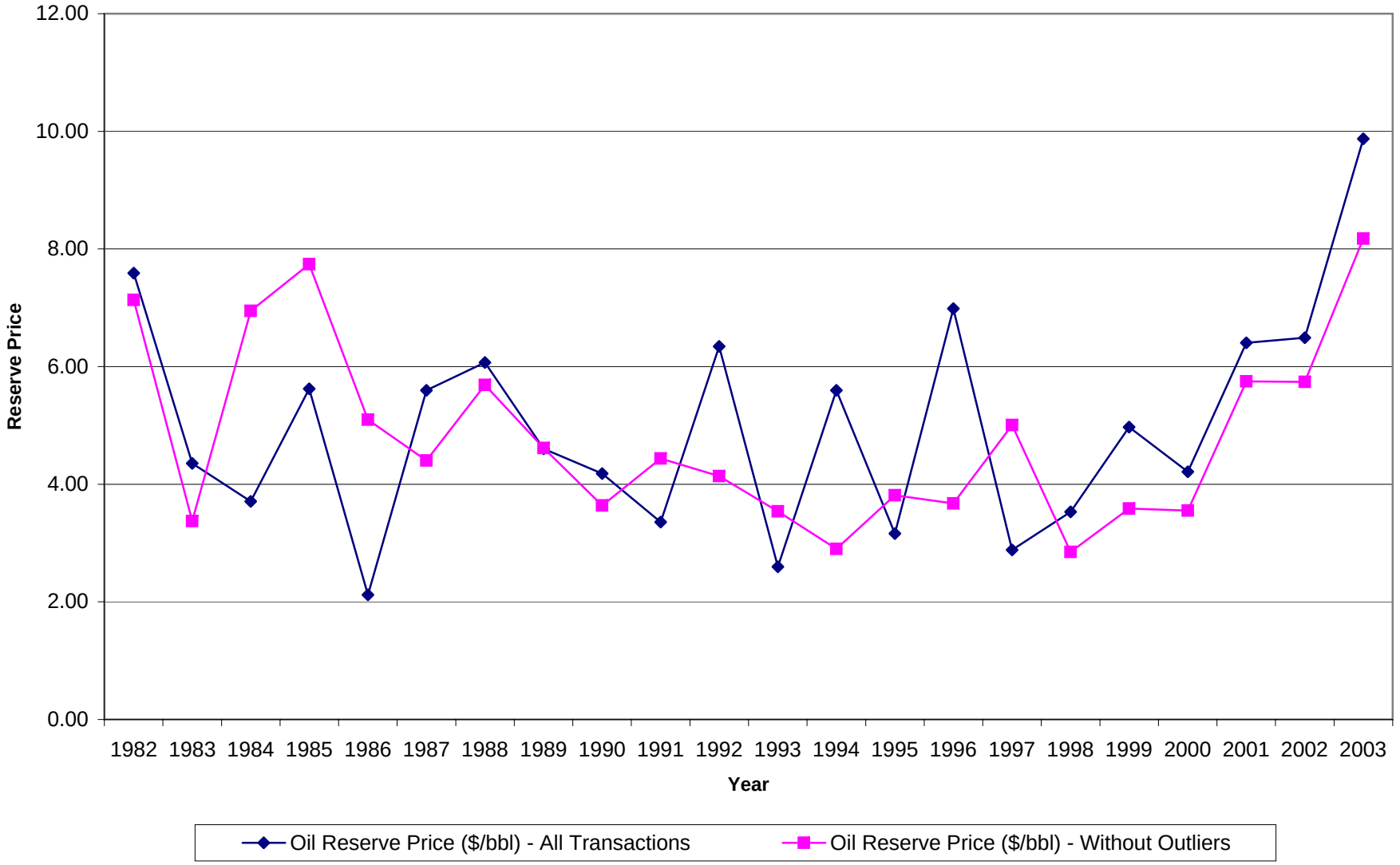

Figure 2: Natural Gas Reserve Prices for 1982-2003

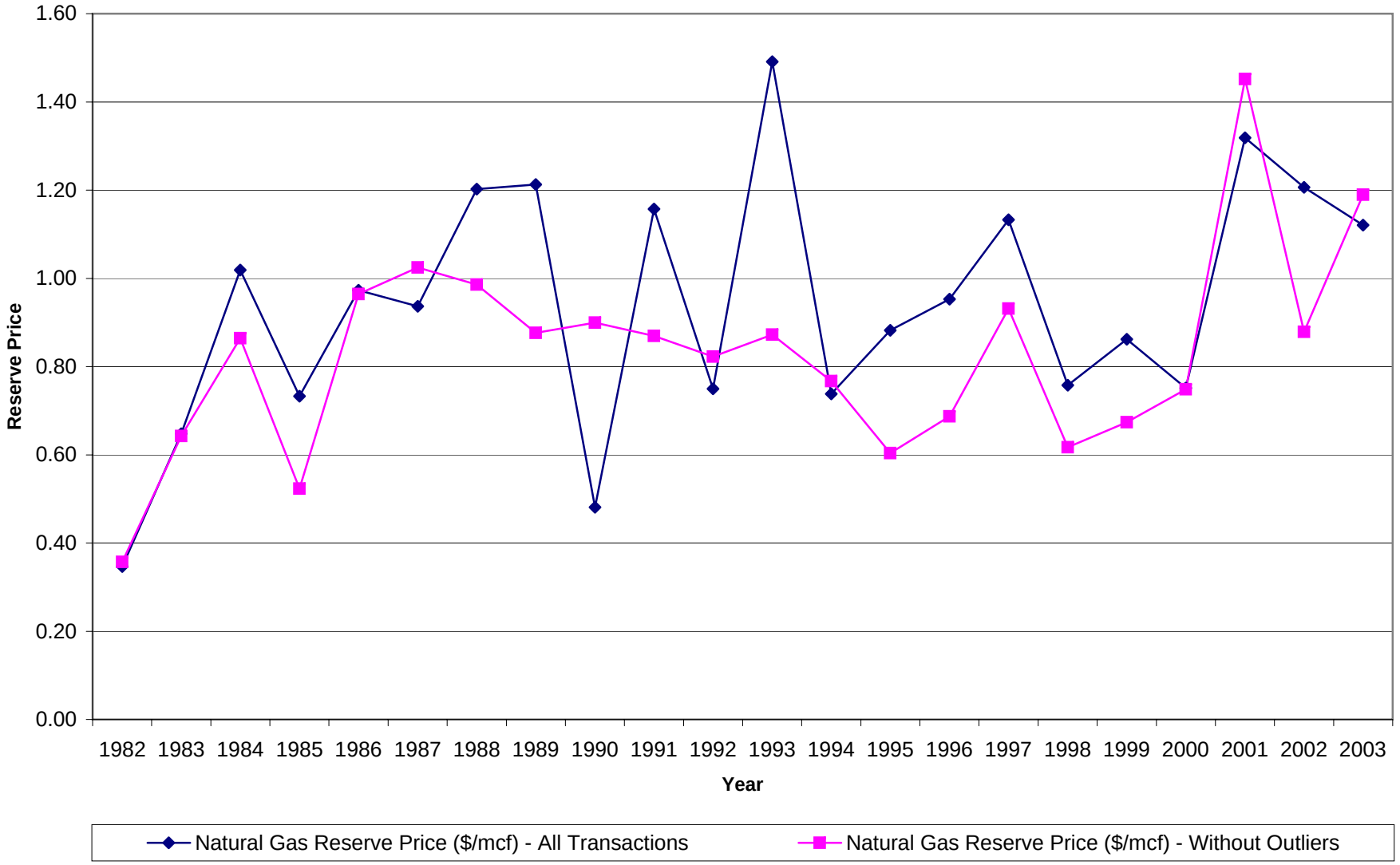

Figure 8: Levelized Oil and Gas Prices

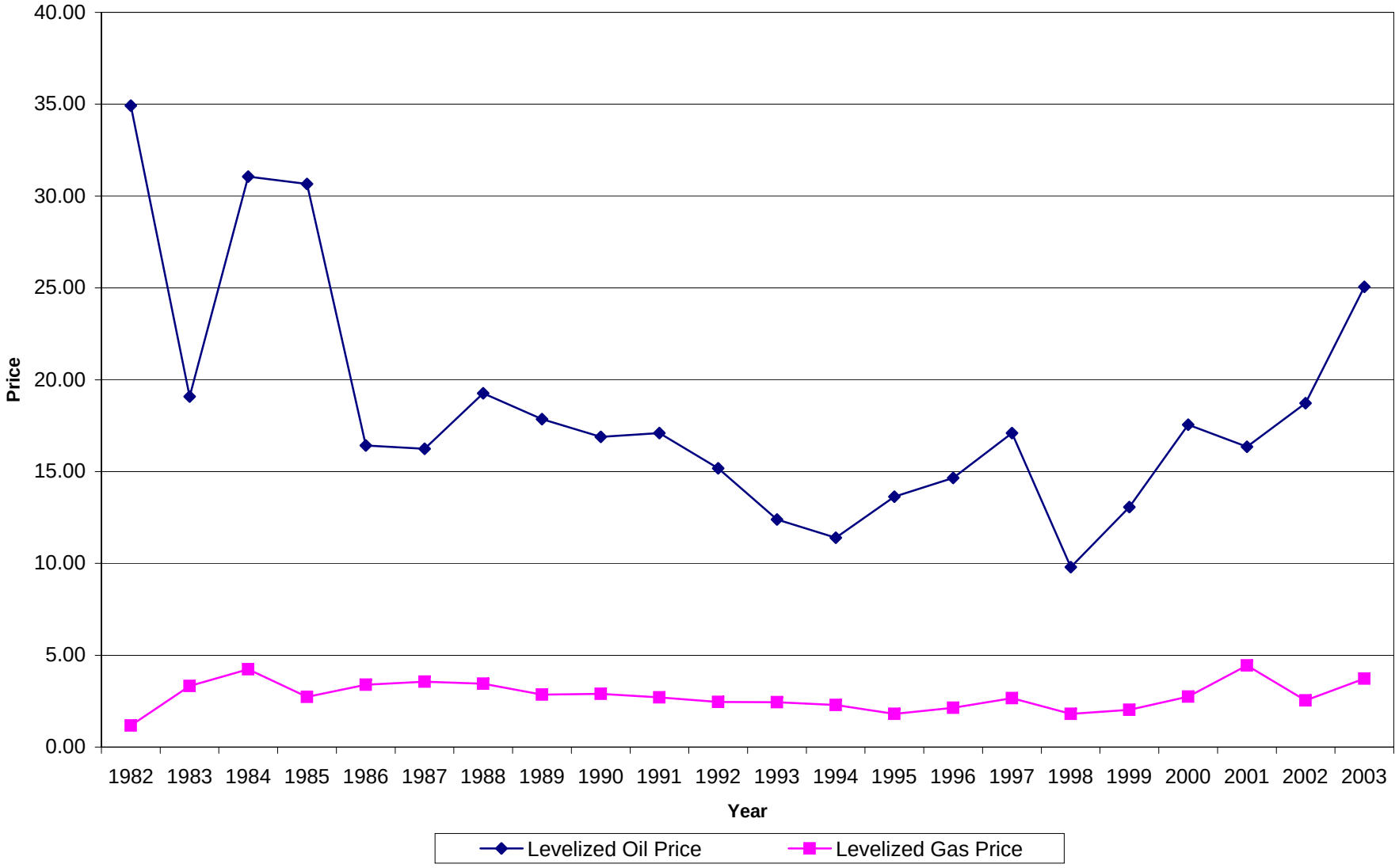

Figure 3: Estimates of Hotelling Values and Price Expectations, Oil

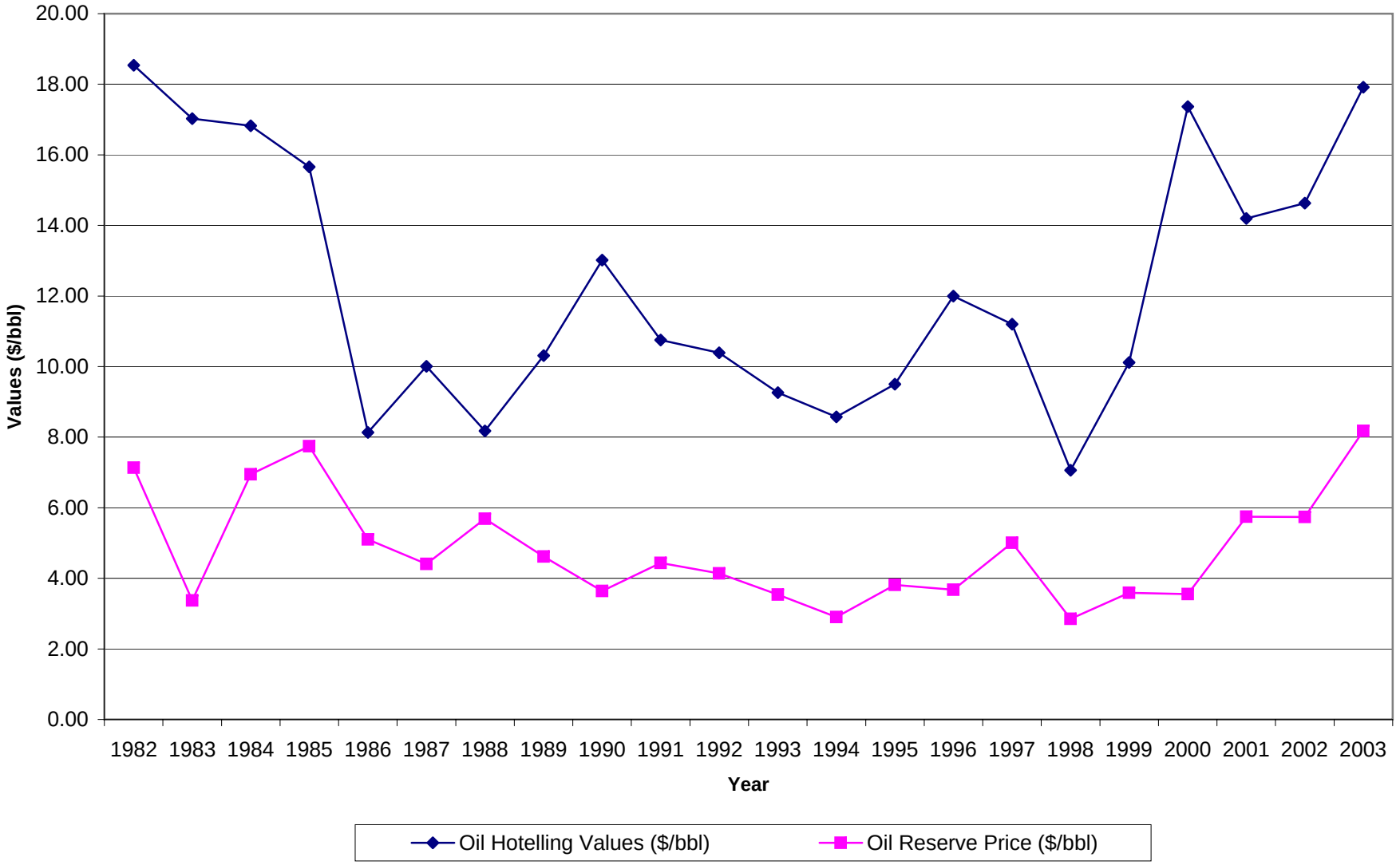

Figure 4: Estimates of Hotelling Values and Price Expectations, Natural Gas

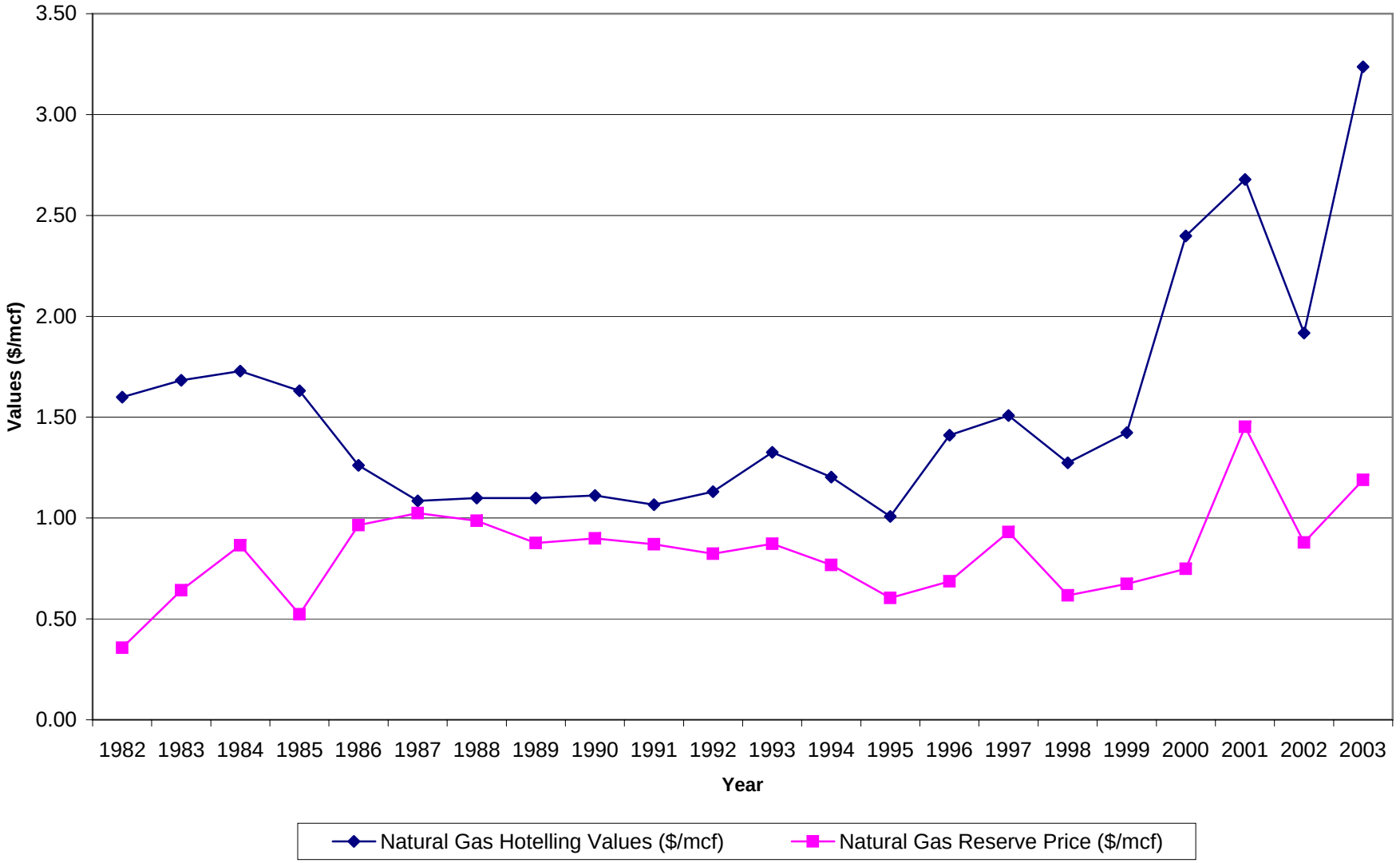

Figure 5a: Implicit Annual Growth Rates for Oil Prices, All Transactions

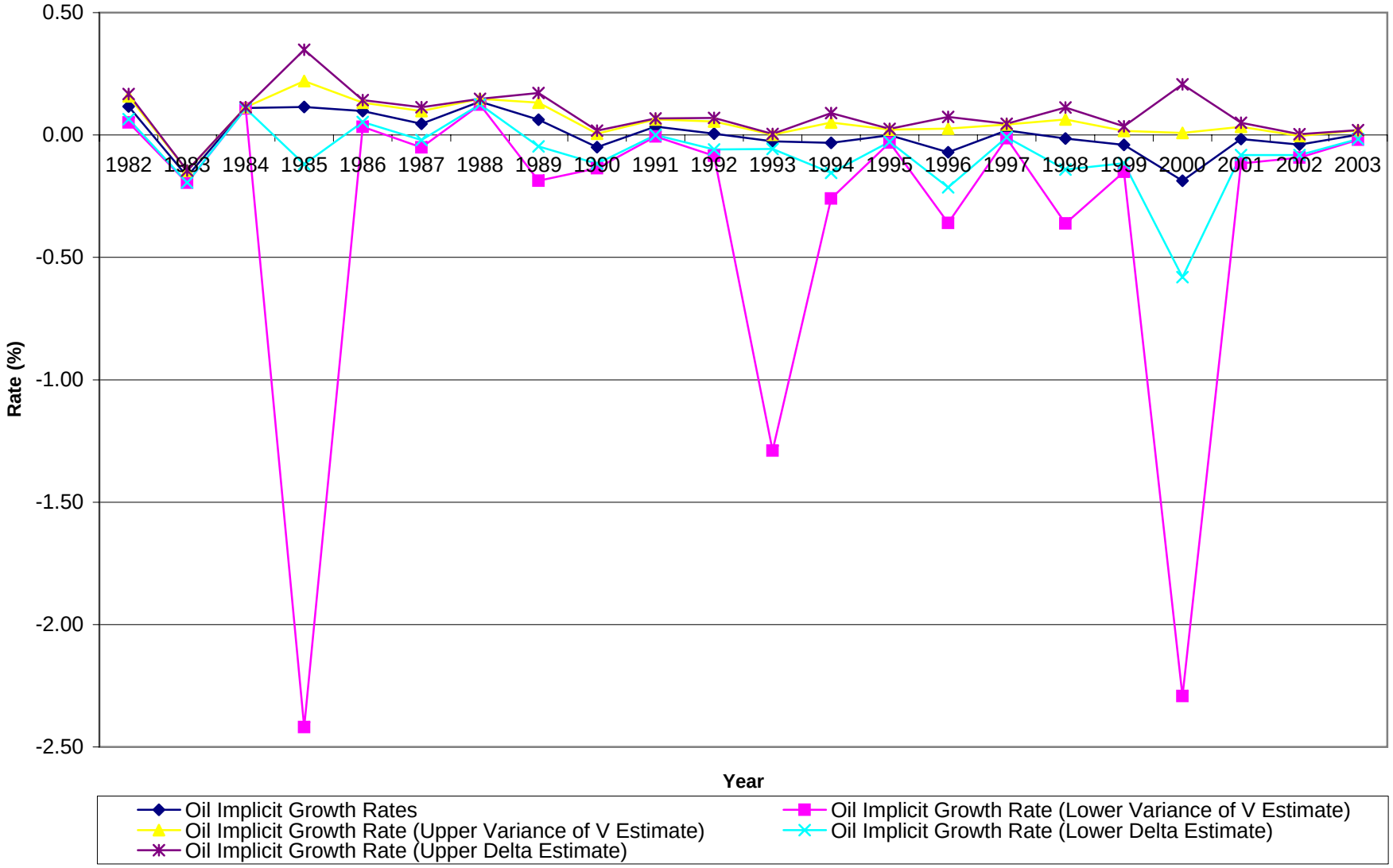

Figure 5b: Implicit Annual Growth Rates for Natural Gas Prices, All Transactions

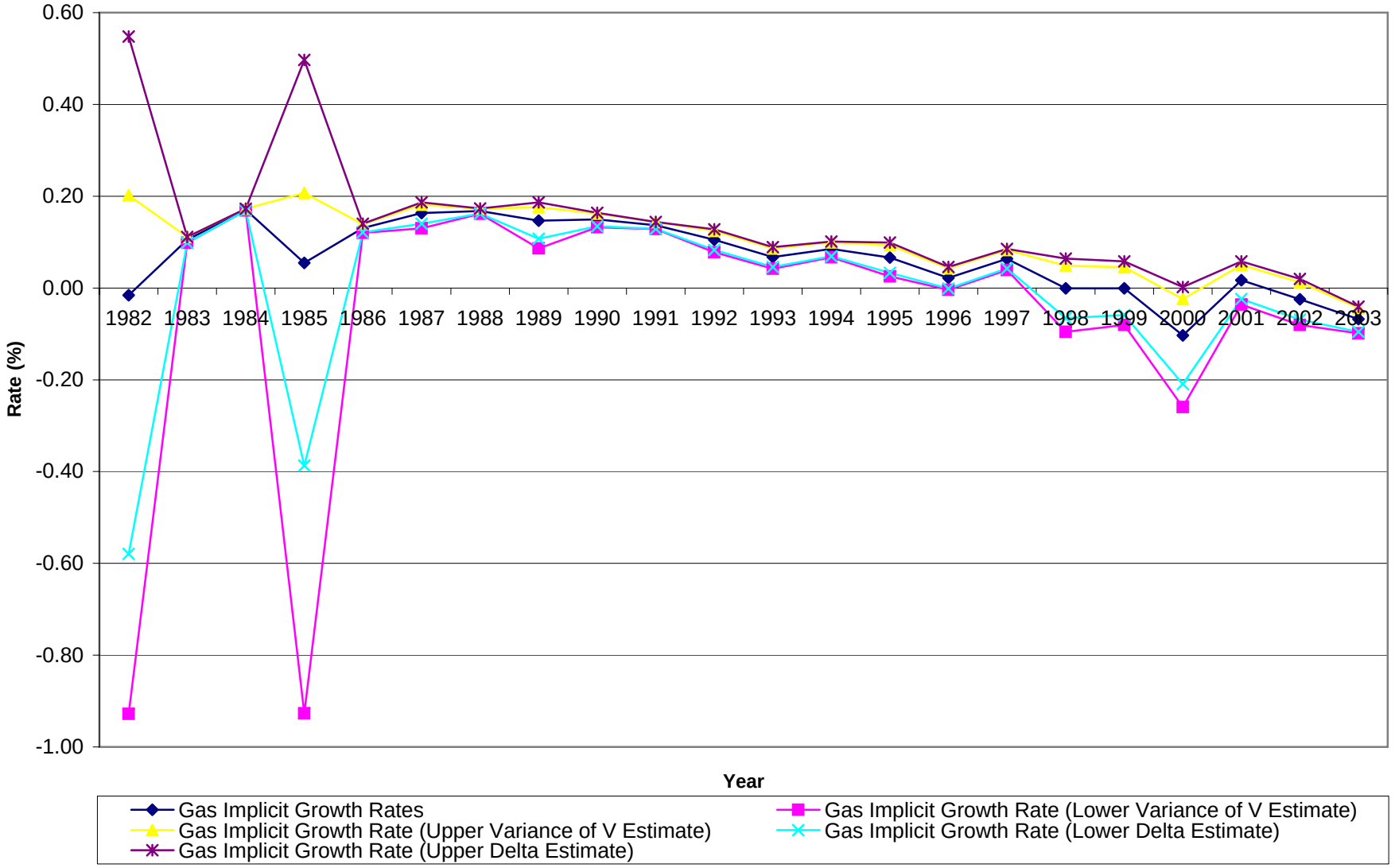

Figure 6: Implicit Annual Growth Rate for Oil and Natural Gas Prices, Pure Transactions

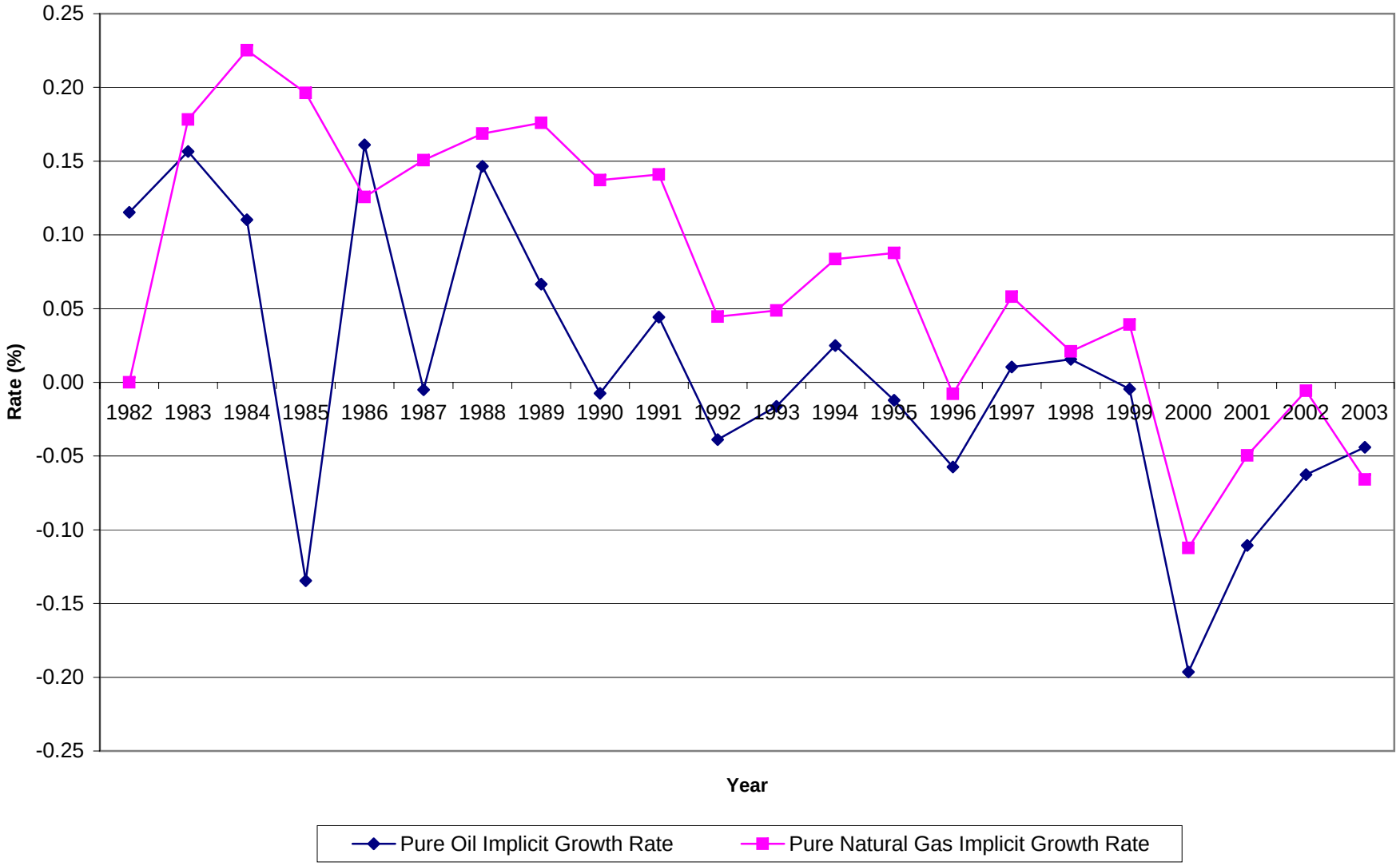

Figure 7: Returns to Holding Oil and Natural Gas Reserves