

**RISK AND RETURNS IN THE INTERSTATE
NATURAL GAS PIPELINE INDUSTRY**

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EXECUTIVE SUMMARY

Wellhead price controls and concomitant supply shortages resulted in the Natural Gas Policy Act of 1978 (NGPA). This act introduced a new pricing scheme for gas which, although retaining wellhead price controls, offered increased incentives for the development of gas supplies from newly discovered reserves. The seeds of another policy debate were sown with the enactment of the NGPA.

Wellhead price controls for some gas supplies were scheduled for elimination on January 1, 1985. Critics of partial decontrol feared that gas prices would "fly-up" after that date. Instead, prices declined. Soon a new debate was underway concerning the take-or-pay liabilities of interstate gas pipelines. It was alleged by some that these liabilities, incurred as a consequence of declining gas sales, could pose a financial threat to many pipeline companies. For this reason, some pipeline companies, as well as state regulators, have called for relief from take-or-pay liabilities in the form of federal government abrogation of past contracts.

However, despite claims of financial hardship, the interstate natural gas pipeline industry consistently has generated higher rates of return than other regulated industries as well as industrial aggregates such as the Value Line 900. A possible explanation for the higher returns of the gas pipeline industry is that the industry is riskier than other industries and therefore faces a higher cost of capital. If so, the industry must generate

higher than average rates of return if it is to attract socially efficient levels of investment.

This paper focuses on the measurement of risk of the interstate natural gas pipeline industry during the period 1982-1986. Three methods are used to measure risk. First is a measure based on the standard deviation of book returns. The standard deviation of industry book returns over time and the standard deviation of book returns across firms in 1986 are calculated and compared to corresponding standard deviations for other industries. By these measures of risk, the gas pipeline industry is less risky than average.

Second is a calculation of the "systematic" risk associated with investing in the gas pipeline industry. Systematic risk (measured by a beta coefficient) reflects the sensitivity of a stock's (or a portfolio of stocks) market returns to movements in the returns received on a broadly defined market portfolio. Systematic risk excludes "unique" or firm-specific risk which can be eliminated by diversifying one's investment; as such, it is a narrower concept of risk than total variance (or standard deviation) which includes both systematic risk and unique risk.

Most firms in the gas pipeline industry are subsidiaries of larger, diversified corporations. The market return data that are available pertain to the corporation rather than the pipeline company operations. Thus, it is impossible to directly measure the systematic risk of the gas pipeline industry. An alternative approach has been developed by finance economists to measure systematic risk when market data are not available. By using this

TABLE 1

Rate of Return on Common Equity for Natural Gas Pipelines
and Selected Industrial Groupings, 1970-1982

Year	Major Interstate Natural Gas Pipeline Companies	Major Electric Utilities	Telecommu- nication Companies	All Manufacturing
1970	13.5	11.9	11.3	9.3
1971	12.9	11.6	11.6	9.7
1972	13.2	11.9	12.3	10.6
1973	14.7	11.3	12.8	12.8
1974	16.2	11.4	12.5	14.9
1975	15.7	11.2	11.9	11.6
1976	17.2	11.8	12.9	13.9
1977	16.5	11.5	13.6	14.2
1978	16.6	11.7	14.9	15.0
1979	17.7	11.7	14.9	16.4
1980	18.5	11.7	13.9	13.9
1981	19.5	12.8	14.4	13.6
1982	18.1	13.5	14.1	9.2
1970-1982 Average	16.2	11.8	13.2	12.7

Sources: Energy Information Administration, Competition and Other Current Issues in the Natural Gas Market, Department of Energy, June 1984, p. 102.
Economic Report of the President, January 1987.

TABLE 2
Natural Gas Pipeline Industry
Profitability, 1982-1986

	P/L Return on Rate Base	Value Line 900
1982	12.85	10.30
1983	13.86	11.22
1984	14.68	12.73
1985	12.11	11.93
1986	12.27	10.55

Source: Natural Gas Supply Association,
Financial Performance of Major
U.S. Interstate Pipelines, Vol. I,
December 1987.

Take-or-pay provisions in long term gas contracts are mechanisms which apportion the cost of unsold gas between producers and pipelines. When pipeline purchases (or "takes") fall below some agreed to percentage of a well's deliverability, the pipeline is obligated to prepay for gas it was obligated to take.²

There are a number of alternative plausible explanations for the financial performance of gas pipelines. Gas pipeline companies may possess market power, or "regulatory failure" may have occurred.³ Another explanation is that the gas pipeline industry may be riskier than other industries on average. Assuming investors are risk averse, an industry which is riskier than average must generate higher than average rates of return in order to compensate investors if that industry is to raise sufficient levels of capital. A risky industry's cost of capital and its profitability are expected to be higher than average.

Investment in the gas pipeline industry might well be particularly risky, especially in recent years, given that gas

²Although pipelines use their nominal take-or-pay obligations as an indicator of the extent of the take-or-pay problem, the actual cost has been much lower due to the fact that much of their obligations have been relieved by one-time buyouts which have come at a fraction (10-20%) of the nominal liability or because they have gained relief via renegotiation of their contracts with producers. Further, it should be kept in mind that producers have borne the brunt of the total costs associated with gas which has gone unsold. For a discussion of the nature of take-or-pay provisions and the costs of unsold gas see Canes and Norman [1983].

³Regulatory failure includes the failure of a regulatory agency to implement policies which generate risk-adjusted returns for regulated firms equal to those earned by competitive firms in the private sector. Thus, if regulatory failure has occurred, regulated firms may earn abnormally high or low returns.

consumption has declined and take-or-pay obligations of some pipeline companies have risen to unprecedented levels. According to Braeutigam and Hubbard, "[s]ome pipelines confront the choice between contract abrogation and bankruptcy" as a consequence of take-or-pay obligations.⁴ There may be reason then to expect that investment in the gas pipeline is riskier than investment in an industry of average risk.

This paper employs several methods to measure the risk associated with the gas pipeline industry during the period 1982-1986. The first and simplest method--calculating the standard deviation of total book returns--is used in Section II. Section III adopts a method increasingly used in public utility rate cases to measure what is called systematic risk. The systematic risk of the pipeline industry is then compared with that of a range of industries. The gas pipeline industry's cost of capital is estimated and compared to actual book rates of return in Section IV. Pipeline company bond ratings are summarized and their determinants discussed in Section V. The issue here is whether the financial ratings of pipeline companies, as assessed by bond rating agencies, has deteriorated in the 1980s and, if so, why. Section VI contains concluding remarks.

⁴Ronald R. Braeutigam and R. Glenn Hubbard, "Natural Gas: The Regulatory Transition," in Leonard Weiss and Michael Klass, eds. Regulatory Reform: What Actually Happened, Little-Brown: Boston, 1986, p. 156.

II. The Variance of Book Returns

The simplest concept of risk at the firm level is associated with the variance (or the standard deviation) of a firm's earnings as measured by its book rate of return.⁵ At the industry level, risk can be measured in terms of the variance of an industry's average rate of return over time or as the variance of the rates of return reported by the firms within an industry for a particular accounting period, say one year. Fisher and Hall [1969] have argued that for firms already in the industry, the variance (or standard deviation) of returns over time is the relevant measure of risk. For potential entrants, the variance of returns across firms in an industry is the relevant measure of risk. The standard deviation of the pipeline industry's returns over time thus would seem to be the appropriate measure of risk for our purposes. Nonetheless, both the standard deviation of the industry's returns over time and the standard deviation of returns across firms are calculated.

To measure risk across industries, eighteen industries (excluding the gas pipeline industry) were chosen as representing a broad cross-section of U.S. industrial activity. Within each industry, a sample of companies was selected at random from those listed on the Standard and Poor's Compustat Company file. A total of 208 firms was included in the sample. The pool of firms from which companies were selected comprised those for which quarterly

⁵Standard deviation is equal to the square root of variance.

financial data were available starting from the first quarter of 1976. A listing of the companies and industries is presented in Appendix B.

Data on a number of items were taken from the Compustat file to measure risk both in this and in the next section. The data collected included the closing stock price in each month for every company and quarterly dividends. Quarterly dividends were converted to a monthly basis. Book data items also were collected, including net income, and net income available to common stockholders, interest expense, total common equity, total stockholders' equity, and total long-term debt. Similar data for the S&P 500 aggregate also were collected.

Data on average book returns for the interstate natural gas pipeline industry are from a study prepared by the Natural Gas Supply Association [1987]. The average returns are based on a group of 25 pipelines and are derived from annual pipeline company submissions to the Federal Energy Regulatory Commission and pertain to pipeline operations alone.⁶ These data were used because most pipeline companies are subsidiaries of larger, diversified corporations. The financial data reported by the parent companies typically are aggregated and include income from non-pipeline lines of business.

The standard deviation of average book returns on

⁶There are 26 firms in the NGSA study. One firm, Transco Gas Supply, was excluded from our industry average. From 1977 to 1986, Transco's return on equity ranged from 3580% to 51%.

TABLE 3

Time Series Standard Deviation of Industry
Rates of Return

	S.D. of Return on Equity	S.D. of Return on Capital
Metals Mining	18.58	10.91
Motor Vehicles	13.79	10.30
Blast Furnaces & Steel	16.40	10.21
Oil & Gas Production	14.59	7.00
Industrial Machinery	5.81	4.61
Petroleum Refining	5.41	4.11
Airlines	9.14	3.89
Apparel	4.54	3.53
Railroads	3.96	2.62
Paper & Allied Products	3.26	2.27
Chemicals	2.91	1.88
Telephones	3.21	1.73
Textile Mill Products	2.50	1.54
Electronic Components	1.22	1.36
Electric Utilities	1.58	1.17
Pharmaceuticals	1.06	.91
Retail Grocery	1.55	.89
Natural Gas Pipelines	1.46	.81
Food & Kindred Products	1.34	.74

Note: Standard deviations based on industry book
returns over the period 1977-1986.

stockholders' equity and on total capital over the period 1977-1986 was calculated for each of the 18 industries from the Compustat tape and for the interstate gas pipeline industry. The results appear in Table 3 where the industries are ranked on the basis of the standard deviation of returns on total capital. On the basis of the variability of book returns over time, the gas pipeline industry clearly is less risky than most industries.

The cross sectional standard deviations for 1986 are presented in Table 4. When riskiness is measured by the variability of returns across firms in an industry, the gas pipeline industry again is an industry of below average risk.⁷ In sum, measures of risk based on standard deviations of book returns portray the gas pipeline industry as an industry of less than average risk for firms already in the industry. For potential entrants, the industry is one of average risk.

III. Systematic Risk

A. Concept

The total variance (or standard deviation) measure includes risk attributable to all factors that impinge on a firm's or industry's fortunes. While this provides useful information, from

⁷If the industries had been ranked on the basis of the standard deviation of returns on equity rather than capital, the gas pipeline industry still would have been ranked well below average with respect to the time series standard deviations. The industry's cross sectional standard deviation of returns on equity was slightly below the average for the entire sample.

TABLE 4

Cross Sectional Standard Deviation of
Industry Rates of Return

	S.D. of Return on Equity	S.D. of Return on Capital
Oil & Gas Production	25.47	20.53
Petroleum Refining	20.92	17.45
Metals Mining	11.97	15.98
Pharmaceuticals	15.15	15.24
Apparel	12.20	15.20
Industrial Machinery	10.56	13.60
Telephones	19.06	11.08
Motor Vehicles	9.43	10.91
Retail Grocery	9.24	10.14
Blast Furnaces & Steel	19.60	10.02
Electronic Components	6.99	9.92
Railroads	10.65	9.72
Textile Mill Products	12.51	8.65
Food & Kindred Products	8.81	8.07
Chemicals	10.62	7.46
Airlines	8.36	6.97
Natural Gas Pipelines	10.68	6.15
Paper & Allied Products	5.63	5.95
Electric Utilities	1.84	1.97

Note: Based on 1986 book returns on Stockholders'
Equity and Total Capital

an investor's viewpoint the risk of greatest concern is that which cannot be eliminated by holding a diversified portfolio of investments.

Risk can be classified as systematic or unsystematic (or firm-specific). The former refers to variation in a firm's returns which are correlated with variation in returns to a large, diversified portfolio of investments. A proxy for the performance of this portfolio might be movements in the economy at large. During periods of economic growth, for example, most firms find that their financial performance improves. This reflects the relationship between rising real incomes and the demand for goods and services. Conversely, during downturns in the economy, the financial performance of most firms deteriorates. The degree to which a firm's returns are correlated with returns on a large diversified portfolio provides the measure of systematic risk.

Unsystematic risk is that associated with a particular firm (or industry). For example, the possibility that a firm would be sued and ordered to pay a large damages award (relative to its net worth) can be characterized as a risk of an unsystematic type. From an investor's viewpoint, however, this risk can be eliminated by holding a widely diversified portfolio; events specific to one firm which adversely affect that firm will tend to be offset by events (e.g., the discovery of some new manufacturing process which lowers production costs) which positively affect other firms in a diversified portfolio. Investors need not be compensated for bearing risk which can be eliminated by holding diversified

portfolios and hence risk of an unsystematic nature will not be associated with higher returns.⁸ However, risk of a systematic type does require a payment to investors for bearing it.

B. Measuring Systematic Risk

The systematic risk of a firm's stock is formally defined as the covariance of its returns with the returns to the "market portfolio", divided by variance of the returns to the market portfolio. In mathematical terms, the systematic risk of a firm --or its beta--can be expressed as:

$$\beta_j = \sigma(R_j, R_m) / \sigma^2(R_m)$$

where

$\sigma(R_j, R_m)$ = the covariance of the return on firm j's stock with the return on the market portfolio, and
 $\sigma^2(R_m)$ = the variance of the return on the market portfolio.

In principle, the market portfolio should be composed of all investments available to investors, including stamps, coins, gold,

⁸While systematic risk is the relevant risk facing diversified investors, total risk will be important to investors who prefer to concentrate their investments in a single stock. Nonetheless, the capital asset pricing model tells us that competition among diversified buyers and sellers of stocks will drive stock prices down until the expected return generated by stocks compensates investors for no more than systematic risk. According to Brigham [1985], however, some tests of the capital asset pricing model find that stock returns are positively related to unsystematic risk as well as systematic risk. Brigham (p. 242) states that the relationship between nonsystematic risk and returns may reflect statistical problems rather than the operation of capital markets and hence may be spurious.

and land as well as more traditional assets like debt and equity instruments. In practice, however, "the market portfolio" is limited to some aggregate like the Standard & Poors 500. Statistically, betas are estimated by regressing the percentage change in returns on a firm's stock against the percentage change in returns on the market portfolio:

$$R_j = \alpha + \beta_j R_m + \mu$$

where

- R_j = the percentage change in return on firm j's stock;
- R_m = the percentage change in return on the market portfolio; and
- μ = an error term.

Calculating betas for the gas pipeline industry is complicated by the fact that most gas pipeline companies are subsidiaries of larger, diversified corporations. As a result, the requisite market data for pipeline companies as stand-alone entities is lacking.⁹ The procedure employed here to estimate systematic risk

⁹Carpenter [1984] estimated systematic risk (the beta) for the natural gas pipeline industry using the traditional method of regressing the returns of gas pipeline companies against returns for a market aggregate and found that the gas pipeline industry was relatively risky. He recognized that many gas pipeline companies are subsidiaries of diversified corporations and thus restricted his sample to companies who generated at least 75% of their revenue from gas pipeline operations. This approach left him with just six companies.

The companies in the Carpenter study are not representative of the industry. For example, the coefficient of variation of rates of return for the 1977-1986 period for the six companies was 15.8%. In contrast, the coefficient of variation for 20 major companies in the NGSa study on pipeline profitability not included in the Carpenter study was just 8.9%. The NGSa study covered 26 major gas pipelines which accounted for the bulk of total interstate pipeline throughputs. Similarly, over the period 1977-

was devised for those occasions in which market data are unavailable. The details of this procedure are presented in Appendix A.

C. Natural Gas Pipeline Industry Betas

Two types of betas were calculated for the 18 industries in our sample and for the natural gas pipeline industry. The more common beta is the equity or levered beta. As discussed in Appendix A, equity betas reflect the impact of a firm's or an industry's capital structure. Industries with higher debt-equity ratios will have higher equity betas, *ceteris paribus*. Some analysts believe that differences in industry capital structures distort comparisons of systematic risk among industries and firms in that the financial risk generally associated with higher debt-equity ratios is reflected in equity betas. For this reason, some analysts prefer to calculate asset (or unlevered) betas in which the impact of an industry's capital structure is removed.

The case for using asset betas in order to compare the riskiness of the gas pipeline industry is open to challenge. Because regulation offers some degree of assurance that firms will earn a "fair" rate of return on their investment, the financial risk normally attributed to high debt-equity ratios may be greatly reduced.

1986, the six companies in the Carpenter study earned an average 11.7% on their rate base whereas the remaining companies in the NGSa study not included by Carpenter earned an average 13.1% on their rate base.

An industry of average risk is one with an equity beta equal to 1.0. The returns to an industry with average risk would move in lock-step with the return to the market portfolio. If the return to the market portfolio increased by 10%, then returns to an industry with a beta equal to 1.0 would be expected to increase by 10%. An industry with a beta greater than 1.0 would be riskier than average. For example, if the return on the market portfolio increased by 10%, the return to an industry with a beta equal to 1.2 would be expected to increase by 12%. Likewise, if the return on the market portfolio decreased by 10%, the return to an industry with a beta equal to 1.2 would be expected to fall by 12%. In contrast, an industry with an equity beta less than 1.0 is an industry of below average risk. For example, the returns to an industry with a beta equal to 0.70 would be expected to fall by just 7% if the return on the market portfolio declined by 10%.

The comparison of risk among industries on the basis of asset betas has a similar interpretation except that the concept of the "average" asset beta is based on average systematic and financial risk. An industry with an average amount of systematic risk and an average debt-equity ratio (and hence an average amount of financial risk) would have an asset beta of approximately 0.80.

The estimates of equity and asset betas for the 18 industries in the sample and for the natural gas pipeline industry are

TABLE 5

Industry Equity Betas, 1982-1986 :

Industry	1982	1983	1984	1985	1986	Average 1982-1986
1. Metals Mining	1.53	1.76	1.53	1.27	.96	1.41
2. Oil and Natural Gas Production	1.70	1.60	1.41	.97	.80	1.30
3. Railroads	1.26	1.34	1.35	1.21	1.17	1.27
4. Airlines	1.48	1.38	1.15	1.12	.96	1.22
5. Motor Vehicles	.96	1.09	1.10	1.21	1.24	1.12
6. Blast Furnaces & Steel	1.24	1.20	1.13	.99	1.04	1.12
7. Chemicals	1.01	1.06	1.05	1.06	1.16	1.07
8. Paper and Allied Products	1.13	1.06	1.11	1.05	.97	1.06
9. Petroleum Refining	1.27	1.26	1.16	.86	.73	1.06
10. Electronic Components	1.19	1.15	1.02	.93	.89	1.04
11. Textile Mill Products	1.01	.91	1.04	1.03	1.02	1.00
12. Industrial Machines & Equipment	1.06	1.02	.89	.80	.80	.91
13. Pharmaceutical Preparations	.92	.88	.84	.94	.97	.91
14. Natural Gas Pipelines	.83	.86	.86	.83	.82	.84
15. Apparel & Other Finished Products	.74	.80	.71	.80	.79	.77
16. Telephones	.62	.59	.57	.71	.81	.66
17. Retail Grocery	.74	.67	.60	.62	.57	.64
18. Food & Kindred Products	.63	.62	.57	.62	.73	.63
19. Electric Utilities	.38	.35	.31	.45	.51	.40
Average	1.04	1.03	.97	.92	.89	.97

TABLE 6

Industry Asset Betas, 1982-1986

Industry	1982	1983	1984	1985	1986	Average 1982-1986
1. Motor Vehicles	.86	2.20	1.08	1.25	.94	1.27
2. Metals Mining	1.18	1.32	1.12	.90	.65	1.03
3. Railroads	.94	1.07	1.06	.92	.85	.97
4. Blast Furnaces & Steel	.99	.98	.91	.87	.87	.92
5. Electronic Components	1.07	1.07	.91	.77	.73	.91
6. Chemicals	.84	.89	.90	.87	.83	.87
7. Paper and Allied Products	.89	.83	.89	.83	.77	.84
8. Petroleum Refining	1.07	1.04	.92	.63	.54	.84
9. Pharmaceutical Preparations	.82	.78	.75	.85	.86	.81
10. Industrial Machinery						
11. Textile Mill Products	.82	.74	.63	.68	.70	.71
12. Airlines	.84	.48	.41	.38	1.30	.68
13. Oil & Natural Gas Production	1.01	.82	.48	.35	.70	.67
14. Apparel & Other Finished Products	.67	.72	.61	.68	.67	.67
15. Natural Gas Pipelines	.66	.62	.62	.59	.58	.61
16. Food & Kindred Products	.52	.52	.47	.49	.56	.51
17. Retail Grocery	.56	.52	.48	.48	.43	.49
18. Telephones	.38	.36	.36	.46	.50	.41
19. Electric Utilities	.23	.22	.19	.28	.32	.25
Average	.80	.84	.71	.68	.71	.75