

USING FINANCIAL DATA TO MEASURE EFFECTS OF REGULATION*

G. WILLIAM SCHWERT
University of Rochester

I. INTRODUCTION

THE positive analysis of government regulation—measuring the actual rather than the intended effects of regulation—is an increasingly popular topic of research. Often this analysis concentrates on the “wealth effects” of regulation. At one extreme the “public-interest” or consumer-protection hypothesis predicts that regulation confers net benefits on consumers at the expense of regulated firms. At another extreme the “capture” or producer-protection hypothesis predicts that regulated firms receive net benefits at the expense of consumers. Yet another possibility is that regulators themselves receive net benefits at the expense of both consumers and regulated firms. All of these hypotheses make predictions about the effects of regulation on the value of the regulated firm.¹ Nevertheless, very little of the empirical research on regulation incorporates the methodology which has been developed in finance to study the behavior of security values.

The efficient-markets/rational-expectations hypothesis² posits that security prices reflect all available information. Hence, unanticipated changes in regulation result in a current change in security prices, and the

* Many people have been very generous with their advice and encouragement, including Malcolm Burns, Guy Charest, Jim Ferguson, Robert Holthausen, Gregg Jarrell, Richard Leftwich, Ron Masulis, David Mayers, Sam Peltzman, Richard Ruback, Clifford Smith, Rex Thompson, Jerold Warner, Ross Watts, Jerold Zimmerman, and especially Michael Jensen. I would also like to thank the participants of workshops at Stanford, UCLA, Rochester, and Chicago for valuable criticism. The Center for Research in Government Policy and Business and the National Science Foundation provided support for this research.

¹ George J. Stigler, *The Theory of Economic Regulation*, 2 *Bell J. Econ. & Management Sci.* 3 (1971); Richard A. Posner, *Theories of Economic Regulation*, 5 *Bell J. Econ. & Management Sci.* 335 (1974); and Sam Peltzman, *Toward a More General Theory of Regulation*, 19 *J. Law & Econ.* 211 (1976), discuss some of the prominent hypotheses about government regulation.

² See John F. Muth, *Rational Expectations and the Theory of Price Movements*, 29 *Econometrica* 315 (1961); Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 *J. Finance* 383 (1970); and Eugene F. Fama, *Foundations of Finance* (1976), for an elaboration of the efficient-markets/rational-expectations hypothesis. Fama describes some of the evidence which supports the hypothesis.

price change is an unbiased estimate of the value of the change in future cash flows to the firm. This hypothesis underlies a variety of methods for estimating the effects of unanticipated regulatory change on shareholder wealth.

The efficient-markets/rational-expectations hypothesis also implies that it is impossible to test the effects of existing or anticipated regulation by using security returns. If regulation has implications for the value of securities, the effects of regulation are impounded into prices at the time when they are first anticipated. Subsequent security returns only reflect the equilibrium expected returns to assets of comparable risk, unless the actual effects of regulation deviate from the originally anticipated effects.

While it is not possible to use security *returns* to measure the effects of existing regulation, it may be possible to use security *prices* for this purpose. If the firm receives economic rents as a result of regulation (for example, because of artificial barriers to new entry), the value of these rents will be included along with the value of the productive assets in determining the value of the firm. One way to measure the value of the rents received by the firm is to estimate the replacement cost of the assets of the firm and subtract it from the value of the securities of the firm. Sometimes a more direct measure of the effect of existing regulation is available. If regulation creates and enforces a marketable license, such as a taxicab medallion, the price of this specialized factor of production (which has no value in any alternative use) is a direct measure of the value of the economic rents created by the artificial barrier to entry.

Section II discusses tests for the effects of unanticipated changes in the regulation of individual firms or industries. Section III discusses methods for measuring the effects of existing or anticipated regulation. Tests for the effects of changes in the regulation of securities markets are discussed in Section IV. Finally, Section V presents some concluding remarks. Each section of the paper is organized to stress three related areas: (1) methodological issues concerning the analysis and interpretation of security price data in the context of regulatory questions, (2) examples illustrating existing analyses of regulation or industrial organization issues using security price data, and (3) suggestions for future work where the techniques discussed in this paper would be fruitful. Additional examples and references are found in the footnotes.

II. TESTS OF CHANGES IN THE REGULATION OF INDIVIDUAL FIRMS OR INDUSTRIES

The main difficulty with measuring the effects of regulatory change on security prices is identifying when the market first anticipates the effects of the change on future profitability. In an efficient market any regulatory

change, including new regulation or different enforcement of existing regulations, that affects future cash flows will cause a change in asset prices as soon as the regulatory change is anticipated by the market.

The magnitude of the effect on asset prices depends on the time pattern of regulatory effects on future cash flows and on the discount rate. For example, let P_u , the price of asset i , be the discounted value of the future cash flows which are expected to accrue to the asset:

$$P_u = \sum_{k=1}^{\infty} \frac{d_{u+k}}{(1+r_i)^k}, \quad (1)$$

where d_{u+k} is the cash flow to asset i which is expected to occur in period $t+k$. The discount rate, r_i , is the opportunity cost of the cash flow given its perceived riskiness (which is assumed to be constant over time for convenience). Now, suppose that the expected future cash flows to the asset are affected by a change in regulation. The price of the asset will change by the present value of the changes in the expected future cash flows:

$$(P^*_u - P_u) = \sum_{k=1}^{\infty} \frac{(d^*_{u+k} - d_{u+k})}{(1+r_i)^k}, \quad (2)$$

where P^*_u and d^*_{u+k} are the equilibrium price and the expected net cash flow after the regulatory change, respectively. The price change in (2) will be larger: (a) the sooner the regulations affect profitability, and (b) the longer is the period over which the regulations are expected to affect profitability. Thus, a regulation that has a permanent effect on profitability will result in a magnified change in asset prices. A regulation that only affects profitability in the distant future will have very little impact on asset prices if the discount rate is sufficiently large.

Of course, public regulation can also affect the riskiness of an asset by changing the production-investment activities of the firm (for example, its pricing policies). If the expected values of the future cash flows are not affected, the price of the asset will change due to the change in the discount rate:

$$(P^*_u - P_u) = \sum_{k=1}^{\infty} d_{u+k} \left\{ \frac{1}{(1+r^*)_i^k} - \frac{1}{(1+r_i)^k} \right\}, \quad (3)$$

where r^*_i is the discount rate after the regulatory change. If the discount rate is increased because of increased risk, the price of the asset will fall due to the regulatory change.

In general, it is difficult to separate the effects of regulatory change on the expected value and the risk of future cash flows, especially if the discount rate is not the same for all future periods. Nevertheless, an efficient capital market sets the prices of assets equal to the present value

of the expected future cash flows, thus reflecting the total impact of regulatory change on shareholder wealth.

To estimate the effects of unanticipated changes in regulation it is necessary to measure the change in stock prices before and after the change in regulation. Unlike the stylized examples in (2) and (3), the before and after stock prices, P and P^* , cannot be measured at the same time. Instead, the effect of regulation is estimated by comparing the stock return over the measurement interval, $R_{it} = (P_{it} + d_{it} - P_{it-1})/P_{it-1}$, with a "normal" return to the stock which would be expected in the absence of the regulatory change. The "abnormal" return to the stock then measures the change in the stock price relative to the before-regulation stock price. The next section of the paper describes some models of "normal" stock returns which have been developed in the finance literature.

A. *Review of Capital Market Theory and Evidence*

A complete survey of the contemporary theory of financial markets is beyond the scope of this paper. Therefore, the subsequent discussion is limited to a brief description of the theories and evidence that are most relevant for testing hypotheses about regulatory effects. The emphasis is on the usefulness of financial models as tools of analysis. (Readers familiar with the contemporary finance literature are encouraged to skip on to the next section.)

1. *The Efficient-Markets/Rational-Expectations Hypothesis.* The assumption of capital market efficiency is analogous to the assumption of perfect competition in models which do not explicitly incorporate uncertainty. For example, both suppliers and demanders of securities are price takers. Market efficiency, or rational expectations, implies that asset prices are set to reflect all available relevant information; there is no opportunity to make economic profits by buying (selling) assets whose prices are too high (low).

Fama formalizes the efficient-markets model by stipulating that deviations of returns to asset i , \tilde{R}_{it} , from their equilibrium expected values, $E(\tilde{R}_{it} | \phi_{t-1})$, conditional on the information set available at time $t - 1$, ϕ_{t-1} , are not systematically different from zero.³ In other words, the "fair game" variable

$$\tilde{\epsilon}_{it} \equiv \tilde{R}_{it} - E(\tilde{R}_{it} | \phi_{t-1})$$

has a mean of zero. Given an economic model of equilibrium expected returns to assets, which might incorporate risk premia, term premia, or

³ Fama, *Efficient Capital Markets*, *supra* note 2. Tildes "" indicate random variables.

other differences among assets, market efficiency can be tested by examining the statistical properties of the fair-game variable, $\bar{\epsilon}_{it}$.

The "random-walk" hypothesis is a special case of the efficient-markets model in which expected returns are assumed to be constant over time for each asset, although expected returns can differ among assets. Voluminous empirical evidence supports the random-walk hypothesis for the prices of New York Stock Exchange (NYSE) common stocks. Rates of return to NYSE stocks seem to be serially uncorrelated from day to day, or month to month. In addition, Fama argues that monthly returns to NYSE stocks are approximately normally distributed, thus providing a statistical basis for deciding when observed returns are abnormally high or low in association with unanticipated regulatory changes.⁴

The "market model" posits that there is a common factor in the returns to all assets, which can be represented by the regression model

$$\bar{R}_{it} = \alpha_i + \beta_i \bar{R}_{mt} + \bar{\epsilon}_{it}, \quad (4)$$

where \bar{R}_{mt} is the return on a value-weighted portfolio of all marketable assets. Conditional on the information set, ϕ_{t-1} , and the contemporaneous return on the market portfolio, R_{mt} , the equilibrium expected return to asset i is

$$E(\bar{R}_{it} | \phi_{t-1}, R_{mt}) = \alpha_i + \beta_i R_{mt},$$

so that the disturbance $\bar{\epsilon}_{it}$ in (4) is a fair-game variable. This model has been used to analyze the effects of firm-specific events (such as stock splits, secondary distributions of securities, or announcements of accounting data) on the prices of the firm's securities. Using the market model (4) to control for the marketwide variation in returns to all assets yields more precise estimates of the firm-specific effects on asset returns. There is substantial evidence that the market model is a well-specified time-series regression model when monthly returns to NYSE stocks are analyzed.⁵ Thus, the market model provides a basis for measuring abnormal returns to securities which will generally be more precise than the estimates from the random-walk model.

2. *The Capital Asset Pricing Model.* Sharpe, Lintner, and others derive a model of capital market equilibrium that quantifies the trade-off between risk and expected return. Jensen surveys further developments of the theory and some tests of the capital asset pricing model (CAPM).⁶

⁴ Fama, *Foundations of Finance*, *supra* note 2, at 17.

⁵ *Id.* at 99.

⁶ William F. Sharpe, *Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk*, 19 J. Finance 425 (1964); John Lintner, *The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets*, 47 Rev. Econ. &

The CAPM predicts that the expected return to asset i is linearly related to the risk of the asset in the portfolio of all marketable assets:

$$E(\tilde{R}_{it}) = R_{ft} + \beta_i[E(\tilde{R}_{mt}) - R_{ft}], \quad (5)$$

where R_{ft} is the return on the risk-free asset, such as a treasury bill, $E(\tilde{R}_{mt})$ is the expected return on the value-weighted market portfolio, and $\beta_i = \text{cov}(\tilde{R}_{it}, \tilde{R}_{mt}) / \sigma^2(\tilde{R}_{mt})$ is interpreted as the risk of asset i relative to the risk of the market portfolio. The covariance of \tilde{R}_{it} with \tilde{R}_{mt} , $\text{cov}(\tilde{R}_{it}, \tilde{R}_{mt})$, measures the contribution of asset i to the variance of the return to the market portfolio, $\sigma^2(\tilde{R}_{mt})$. Thus, if portfolio risk is measured by the variance of the rate of return, β_i is a standardized measure of marginal risk. According to the CAPM, the only differences among the equilibrium expected returns to assets are attributable to differences in "systematic risk," β_i .

The market model in (4) and the CAPM in (5) are related. The slope coefficient, β_i , in the market model is equal to the systematic risk in the CAPM; therefore, the CAPM implies that the intercept of the market model is $\alpha_i = (1 - \beta_i)R_{ft}$. Thus, the economic model of capital market equilibrium (the CAPM) places a constraint on the parameters of the statistical model for returns (the market model). Empirical evidence generally supports the proposition that expected returns are linearly related to risk as measured by β_i , at least for NYSE common stock returns. However, the constraint on the intercept of the market model that is implied by the Sharpe-Lintner CAPM is rejected by the data when a portfolio of NYSE common stocks is used as a proxy for the market portfolio of all risky assets and a treasury bill is used as a proxy for the risk-free asset.⁷

Although there have been numerous refinements of the CAPM, the important result for the purpose of measuring the effects of regulation is that the CAPM provides an estimable relationship between risk and expected return. The CAPM can be viewed as a specific model of equilibrium expected returns which, along with market efficiency, can be used to

Statistics 13 (1965); Michael C. Jensen, *Capital Markets: Theory and Evidence*, 3 *Bell J. Econ. & Management Sci.* 357 (1972).

⁷ Fama, *Foundations of Finance*, *supra* note 4, at 320; and Richard Roll, *A Critique of the Asset Pricing Theory's Tests*, 4 *J. Financial Econ.* 129 (1977), provide detailed discussions of this evidence. It appears that data for monthly returns to NYSE common stocks can be described by a generalized form of the CAPM

$$E(\tilde{R}_{it}) = E(\tilde{R}_{zt}) + \beta_i[E(\tilde{R}_{mt}) - E(\tilde{R}_{zt})],$$

where $E(\tilde{R}_{zt})$ is the expected return to a portfolio which has zero covariance with the NYSE common stock portfolio, $\text{cov}(\tilde{R}_{zt}, \tilde{R}_{mt}) = 0$. Even though this zero covariance portfolio is made up of risky securities, and it would be risky if held alone (because $\sigma^2(\tilde{R}_{zt})$ is not zero), this portfolio is riskless within the NYSE common stock portfolio since $\beta_z = 0$. If the generalized CAPM is true, the intercept in the market model is $\alpha_i = (1 - \beta_i)E(\tilde{R}_{zt})$.

measure abnormal changes in asset values in association with unanticipated regulatory changes.

The CAPM can also be used to determine how regulation affects the risk of firms. If regulation changes the risk of the firm, it is possible to estimate the risk change by estimating the market model using samples from both before and after the regulatory change.⁸ In this way, it is possible to separate out the effects of regulation on the expected value and the risk of future cash flows.

3. *Cross-sectional Models.* The random-walk model, the market model (4), and the CAPM (5) all use past *ex post* returns to estimate future equilibrium expected returns. This is appropriate if expected returns and β_i are stationary over time (or if it is possible to predict how these parameters change over time). An alternative approach to measuring "normal" returns to assets uses cross-sectional models relating stock prices to variables such as dividends, earnings, and the growth rate of earnings to estimate the "cost of capital." The basis for these cross-sectional models is the well-known valuation model in (1) which expresses the value of the firm as the discounted value of the future net cash flows, where the discount rate is the cost of capital.

Miller and Modigliani pioneered modern efforts to estimate the cost of capital using data for 63 large regulated electric utilities for 1954, 1956, and 1957.⁹ They estimate cross-sectional regressions of the market value of the firm's securities on after-tax expected earnings and the growth rate of assets. In this work, and most of the subsequent studies that use similar cross-sectional methodologies, explicit assumptions are made about the relationship of past and current earnings or dividends to expected future earnings, and simplifying assumptions are made (such as the assumption that the cost of capital is constant over time and the same for all firms in the industry) which lead to the specific cross-sectional models that are estimated.¹⁰ After elaborate statistical analysis, Miller and Modigliani

⁸ For example, Peltzman, *supra* note 1, at 230, estimates the market model for railroad stocks using annual data before and after the initiation of regulation by the Interstate Commerce Commission (ICC) in 1887. These regressions indicate that ICC regulation led to a reduction in the risk of railroad stocks, although the reduction is not statistically significant by usual standards. A similar test for utility stocks shows an insignificant reduction in risk associated with the initiation of regulation. Stavros B. Thomadakis, *A Model of Market Power, Valuation and the Firm's Returns*, 7 Bell J. Econ. 150 (1976), uses a model with constant marginal costs to show that the risk of a monopolist will generally be different from the risk of a competitive firm with the same cost function.

⁹ Merton H. Miller & Franco Modigliani, *Some Estimates of the Cost of Capital to the Electric Utility Industry, 1954-57*, 56 Am. Econ. Rev. 333 (1966).

¹⁰ The most simple example would be the valuation equation in (1)

$$P_u = \sum_{k=1}^{\infty} \frac{d_{u+k}}{(1+r_i)^k},$$

conclude that the cost of capital for all electric utilities was slightly greater than the yield on long-term high-grade public utility bonds for each of the years they examine.¹¹

There was much debate about the Miller-Modigliani paper, but Robichek, McDonald, and Higgins provide the most telling criticism of the cross-sectional models of the cost of capital.¹² Robichek, McDonald, and Higgins use the Miller-Modigliani data definitions and models to estimate the cost of capital for each of the years from 1954 to 1964, inclusive. The coefficients of the cross-sectional regression models seem to vary substantially over time (more so than would be suggested by the standard errors of the coefficients which are estimated from any one cross section), and there seems to be a systematic pattern in the coefficients over time. This suggests that there is no stable function which relates the market value of the firm to accounting data, such as earnings or book value. If these cross-sectional models vary substantially over time, they are not likely to provide a useful basis for measuring the *ex ante* cost of capital.¹³

A similar conclusion arises from the work of Malkiel, who uses data from 1961-1967 to estimate the cross-sectional regression model

$$\frac{P}{NE} = \alpha_0 + \alpha_1 g_p + \alpha_2 \left(\frac{D}{NE} \right) + \alpha_3 \left(\frac{F}{E + F} \right) + \epsilon,$$

where P is the year-end price of common stock, NE is an estimate of

which specializes to

$$P_u = \frac{1}{r_t} \cdot d_u$$

when all future cash flows are expected to equal the current cash flow, d_u , and the discount rate, r_t , is constant over time. If the discount rate is the same for all firms, the cross-sectional regression of stock prices on the current cash flows for N firms in period t

$$P_u = \beta d_u + \epsilon_t, \quad i = 1, \dots, N,$$

will have a slope coefficient which can be used to estimate the cost of capital:

$$\hat{r} = 1/\hat{\beta}.$$

¹¹ Miller & Modigliani, *supra* note 9, at 387.

¹² Alexander A. Robichek, John G. McDonald, & Robert C. Higgins, Some Estimates of the Cost of Capital to the Electric Utility Industry, 1954-57: Comment, 57 Am. Econ. Rev. 1278 (1967).

¹³ There have been several attempts to generalize the assumptions of the valuation model to find a better cross-sectional regression specification (see, for example, Robert H. Litzenberger & Cherukuri Rao, Estimates of the Marginal Rate of Time Preference and Average Risk Aversion of Investors in Electric Utility Shares: 1960-66, 2 Bell J. Econ. & Management Sci. 265 (1971); and John G. McDonald, Required Return on Public Utility Equities: A National and Regional Analysis, 1958-69, 2 Bell J. Econ. & Management Sci. 503 (1971)). Nevertheless, none of these efforts has discovered a stable cross-sectional relationship which can be used to estimate the *ex ante* cost of capital.

"normal" earnings made by securities analysts, g_p is an estimate made by securities analysts of the growth rate of future earnings, D is the dividends paid per share, and $F/(E + F)$ is the ratio of fixed charges to earnings before fixed charges (a leverage measure).¹⁴ While this regression does not lead to a direct estimate of the cost of capital, it does illustrate one of the fundamental difficulties with such cross-sectional regression equations. Malkiel attempts to select "undervalued" securities using the estimate of his regression; for each of the years from 1962-1965 there is no significant relationship between Malkiel's dichotomization of under- and overvalued securities and returns which were subsequently realized on these securities. In other words, the deviations of P/NE from the fitted regression line are of no use in identifying stocks which will subsequently experience unusual price movements; rather, these deviations represent omitted variables or other model misspecifications.

Given the problem of finding a stable cross-sectional relationship between asset prices and accounting variables such as earnings, it seems unlikely that the measures of "normal" returns derived from such models will provide a reliable basis for measuring abnormal returns associated with regulatory change.

B. Changes in Regulation That Affect Firms Simultaneously

1. *Methodological Issues.* Many legislative regulations affect a large number of firms at the same point in time. Also, major legal precedents that change the enforcement of existing legislation can affect a large number of firms simultaneously. In such cases, the common effect of regulation on a set of firms can be measured by analyzing the returns to a portfolio of affected assets:

$$\bar{R}_{pt} = \sum_{i=1}^N x_i \bar{R}_{it}, \quad \sum_{i=1}^N x_i = 1,$$

where x_i is the proportion invested in asset i for each of the N affected assets. The portfolio return, \bar{R}_{pt} , measures the percentage change in the market value of the combination of firms from time $t - 1$ to t . For example, if the portfolio is "equally weighted," $x_i = 1/N$, and \bar{R}_{pt} is the average return on all of the assets in the portfolio. If the portfolio is "value weighted," x_i is the market value of asset i relative to the market value of the entire portfolio, and \bar{R}_{pt} is the percentage change in the market value of the assets in the portfolio.

In order to measure the full effect of an unanticipated regulatory change

¹⁴ Burton G. Malkiel, *The Valuation of Public Utility Equities*, 1 *Bell J. Econ. & Management Sci.* 143 (1970).

on the value of the regulated firm, it is necessary to measure the rates of return to all of the firm's securities. Because market price data are not readily available for most corporate debt securities, most studies to date have concentrated on common stock returns. Nevertheless, unless the regulatory change substantially alters the probability that the regulated firm will default on its debt commitments, it seems unlikely that the concentration on common stock returns causes misestimation of the effect on firm value (although the effect on firm value is usually understated when only analyzing stock returns).

There are important statistical reasons for using portfolio returns instead of analyzing the returns to each individual asset in association with a regulatory change. There is substantial evidence that returns to NYSE common stocks are contemporaneously correlated,¹⁵ and this is probably true for other assets as well. Thus, probability statements based on the analysis of several individual asset returns for the same time period are not independent, and there is no simple way to combine the single-asset tests into a joint probability statement about the entire set of assets. On the other hand, the portfolio return, \bar{R}_p , directly incorporates the cross-sectional dependence of its components, facilitating joint tests of significance.

For example, suppose that a proportional profits tax is unexpectedly imposed on a single industry. For simplicity, assume that all firms have NYSE-listed common stocks and no debt outstanding. In line with the random-walk hypothesis, assume that the equilibrium expected returns to these stocks are constant over time, so the abnormal return, $\bar{\epsilon}_u$, is the deviation of the actual return from the constant expected return

$$\bar{\epsilon}_u = \bar{R}_u - E(\bar{R}_u).$$

If the proportional tax is expected to persist for all future periods and the discount rate is unaffected, equation (2) indicates that each of the stocks in this industry should have an abnormal negative return equal to the tax rate τ in the period when this information first becomes available.¹⁶

Thus, the expected value of $\bar{\epsilon}_u$ is $-\tau$ once the tax is announced. However, there are many other uncertain factors which affect stock returns, so

¹⁵ See, for example, Benjamin King, *Market and Industry Factors in Stock Price Behavior*, 39 J. Business 139 (1966); or Fischer Black, Michael C. Jensen, & Myron Scholes, *The Capital Asset Pricing Model: Some Empirical Tests*, in *Studies in the Theory of Capital Markets* 79 (Michael C. Jensen ed. 1972).

¹⁶ Of course, this is a highly simplified example which assumes that everything else stays the same, that there is no tax avoidance or evasion, and that there are economic rents which can be used to pay the tax so that these firms don't leave the industry. In particular, it is likely that the risk of the industry will be affected by such a change in tax policy, so the discount rate would probably also change. From equation (2), the change in security prices caused by the unanticipated tax change is

the actual returns to these securities in the period of new regulation contains substantial sampling variability. The t -statistic

$$t_i = \frac{\epsilon_{it}}{S(\epsilon_i)} = \frac{(R_{it} - \bar{R}_i)}{S(R_i)} \frac{\sqrt{T}}{\sqrt{T+1}},$$

where R_{it} is the actual return to asset i in period t , \bar{R}_i is the historical average return to asset i , and $S(R_i)$ is the historical standard deviation of the returns to asset i based on T previous observations, provides a test of whether the new tax had a significant impact on the market value of asset i . However, since the returns to securities in the same industry are likely to be positively correlated, it is not correct to assess the impact of regulation on the industry by observing the frequency distribution of the individual asset t -statistics; if one t -statistic is large by chance, others are also likely to be large.

To test the hypothesis that all of the firms in this industry suffered a τ percent loss in value as a result of the new tax law, the portfolio test statistic

$$t_p = \frac{\epsilon_{pt}}{S(\epsilon_p)} = \frac{(R_{pt} - \bar{R}_p)}{S(R_p)} \frac{\sqrt{T}}{\sqrt{T+1}}$$

is an appropriate measure of the significance of the impact of the tax law on the market value of the industry. The abnormal return to the portfolio, ϵ_{pt} , is the weighted average of the abnormal returns to the individual assets

$$\epsilon_{pt} = \sum_{i=1}^N x_i \epsilon_{it},$$

but the standard deviation of the portfolio, $S(R_p)$, is less than or equal to the weighted combination of the individual-assets standard deviations

$$S(R_p) \leq \sum_{i=1}^N x_i S(R_i),$$

with equality only in the case where the individual asset returns are all

$$\begin{aligned} (P^*_u - P_u) &= \sum_{k=1}^{\infty} \frac{d^*_{u+k} - d_{u+k}}{(1+r_t)^k} \\ &= -\tau \sum_{k=1}^{\infty} \frac{d_{u+k}}{(1+r_t)^k} \\ &= -\tau P_u. \end{aligned}$$

Therefore, the percent change in price is equal to the negative of the tax rate,

$$\epsilon_u = \frac{P^*_u - P_u}{P_u} = -\tau.$$

perfectly positively correlated. Thus, the portfolio return will provide a more precise estimate of the effect of regulation when the abnormal return is the same for each security in the portfolio.

Of course, it is important to group securities into portfolios based on the similarity of the impact of regulation. For example, if a new regulation costlessly transfers wealth from one half of the industry to the other firms in the same industry, the return to the value-weighted portfolio of that industry would be unaffected by this change, even though individual securities within the portfolio experience large gains or losses. In this case, the impact of regulation should be measured by the returns to two portfolios, one composed of potential gainers and one composed of potential losers. The difference in the returns to these portfolios would measure the differential impact of the new regulation.

In general, to measure abnormal returns it may be desirable to use a model of equilibrium expected returns that is more sophisticated than the random-walk model. For example, either the market model (4) or the capital asset pricing model (5) can be used to control for marketwide changes in asset values that occur at the same time, but that are unrelated to the regulatory change. By controlling for variation in $\bar{\epsilon}_H$ that is unrelated to the regulatory change, it is possible to get a more precise estimate of the impact of regulation on shareholder wealth.

There is an important problem which has been glossed over in this stylized illustration: it is often difficult to determine when a regulatory change is first anticipated by the market. Many regulatory changes result from a series of public hearings, or a study, or some other prolonged process. The market will use this information to determine the probability that regulatory change will occur, and every time these probabilities are revised the market will adjust security prices accordingly. Hence, in many instances it is necessary to look at abnormal security returns many periods before the actual implementation of the regulatory change in order to measure the full effect of regulation. For example, in the hypothetical example above, if hearings were held during the six months prior to the imposition of the profits tax, it would be appropriate to measure the abnormal return to the affected securities over the entire six-month period. Of course, when the effects of regulation are spread over longer time intervals it becomes more difficult to measure them, because the random variability in security returns increases with the length of the measurement interval.¹⁷ Therefore, it is important to specify as accurately as possible the timing of changes in expectations about regulation.¹⁸

¹⁷ For example, the variance of the six-month return to the portfolio is six times as great as the variance of the one-month return. This means that the standard error increases by $\sqrt{6}$, thus reducing the precision of the estimate.

¹⁸ Peter Dodd, *Merger Proposals, Management Discretion and Stockholder Wealth*, 8 J.

Finally, it is important to note that the efficient-markets/rational-expectations hypothesis does not imply that investors have perfect foresight about the future effects of regulation (or anything else). Security prices change to reflect the most accurate unbiased prediction of what will happen in the future, but it is entirely possible that the actual effects of regulation will turn out to be very different from what was expected at the time of the regulatory change. In principle, it should be possible to determine whether the actual effects of regulation deviate substantially from the expected effects by measuring the returns to affected securities after the regulatory change. For example, if a sequence of identifiable events provides successively more information about the effects of a particular regulation, it would be necessary to sum the abnormal returns associated with all of these events in order to measure the actual impact of regulation.¹⁹

2. *Example.* Between 1907 and 1920, thirty-two states began to regulate electric utility prices. To measure the impact of this regulatory change, Stigler and Friedland compute the returns to the common stocks of twenty electric utilities from 1907 to 1920 and find no noticeable difference between regulated versus unregulated utilities.²⁰

There is a serious weakness in such a test. Even if there were a substantial effect on security prices at the time the regulatory change was first anticipated, this effect may not show up when it is averaged in with the rest of the price changes occurring over a thirteen-year time period. In other words, the normal variability of security returns will swamp any one-time change in security prices if the measurement interval is long enough.²¹

Financial Econ. 105 (1980), provides evidence that securities markets respond to information about merger negotiations on the day that it is first announced in the *Wall Street Journal*. His evidence shows that previous studies, such as Gershon Mandelker, Risk and Return: The Case of Merging Firms, 1 J. Financial Econ. 303 (1974), spread the estimated effect of the event out over a number of periods prior to the "event date" because they use the effective date of the merger as the "event date" instead of using the date when information first becomes available.

¹⁹ See Richard Leftwich, Evidence of the Impact of Mandatory Changes in Accounting Principles on Corporate Loan Agreements (June 1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.) for an example of this type of analysis.

²⁰ George J. Stigler & Claire Friedland, What Can the Regulators Regulate? The Case of Electricity, 5 J. Law & Econ. 1 (1962).

²¹ For example, suppose that the unanticipated initiation of electric utility regulation caused a 26% drop in the prices of the affected securities. When averaged over 13 years, it decreases the average annual return to the securities by 2%. If the annual standard deviation of these returns is 7% (which is probably an underestimate, since the annual standard deviation of the return to the NYSE market portfolio was about 7% during this period [see Fama, Foundations of Finance, *supra* note 4, at 16]), the standard error of the 13-year annual return would be 2%. Therefore, the effect of regulation would only be as large as the standard error of the estimate because such a long time interval is used.

Stigler and Friedland also compute the cross-sectional regression of the stock returns on the growth rate of sales and the number of years that the firm had been regulated as of 1920, although neither variable is significant by conventional standards. No attempt is made to control for different levels of risk. Assuming that the risks of regulated and unregulated utility stocks are the same, it is not surprising that the number of years of regulation is an insignificant variable. Only an unexpected change in the regulatory environment should have a differential impact on these stock returns; the longevity of existing regulation has a negligible effect.

The insignificance of the Stigler and Friedland results is notable because there are important econometric problems with such cross-sectional regressions that tend to bias such tests toward finding significant effects. First, it is plausible that the presence or absence of public regulation indicates different levels of risk. If regulation constrains the activities of the regulated firms, it probably affects the risk of the securities of the firm. Therefore, the securities of unregulated firms would probably have different average returns from those of regulated firms because of the different levels of risk.

Moreover, even if there is no important difference in risk associated with regulation, the returns to different securities in the same industry are likely to be correlated. Stigler and Friedland use the growth rate of sales to control for this correlation, but if there are other variables which also affect utilities' profitability (such as changes in factor prices), the residuals from the cross-sectional regression will be correlated. If the residuals are positively correlated, the estimated standard error of the regulatory dummy variable coefficient is biased downward,²² and the significance tests are biased toward rejection of the null hypothesis that there is no effect of regulation.

Thus, there are likely to be important statistical problems in cross-sectional regressions such as those used by Stigler and Friedland. Omitted variables, such as risk, will bias the estimates of the regression coefficients, and intercorrelated disturbances will bias the standard errors. Both biases are likely to cause a spuriously "significant" effect.

The portfolio methods described above could be used to provide an alternative measure of the effects of electric utility regulation. By concentrating on the periods when regulatory change was first anticipated, it would be possible to get a more precise estimate of the effect on stock prices.²³ By using the time series of portfolio returns to estimate the standard error of the abnormal returns, it would be possible to get an

²² See Henri Theil, *Principles of Econometrics* 254-57 (1971).

²³ It is possible that the initiation of regulation in the first few states caused investors to anticipate impending regulation in other states, so the relevant date for measuring stock price reactions would be the same for all subsequently regulated utilities. This would reduce

improved measure of the sampling variability of the estimate of regulatory effect.

3. *Suggested Future Work.* There are many other regulatory changes which could be analyzed using time-series portfolio methods. For example, the 1962 Drug Amendments which effectively reduced the rate of innovation in the pharmaceutical industry²⁴ may have had a substantial impact on the market value of pharmaceutical securities. By analyzing the returns to a portfolio of pharmaceutical securities before and after the Drug Amendments, it should be possible to estimate the wealth loss or gain due to new regulation, and to make a probability statement about the effect of this regulatory change.²⁵

Similarly, the ban of cigarette advertising on television may have affected the value of cigarette-industry securities. For example, well-established firms possibly received net benefits because new firms were substantially more hindered by the advertising ban. A test of the impact of the ban on a portfolio of cigarette producers' stocks would provide an estimate of the magnitude of this effect.

Also, Peltzman argues that the creation of the Federal Deposit Insurance Corporation restricted entry into the commercial banking industry.²⁶ If investors anticipated that this artificial barrier to entry enabled existing banks to earn rents, the market value of a portfolio of bank stocks should have increased abnormally at the time when this regulation was first anticipated.

Finally, it would be interesting to study the effect of Proposition 13 on the security prices of firms with plants in California. If Proposition 13 decreases the tax burden on commercial property, this should have a positive impact on the value of the firms with large fixed investments in the state of California.²⁷

the length of the measurement period, but it would not reduce the variability of the abnormal return due to cross-sectional correlation of contemporaneous stock returns. The more likely case is that the probability of regulation was increased when the first states made this decision, but the future course of state utility regulation could not be foreseen perfectly. In this case, the abnormal returns measured at different dates, when regulation was first anticipated, should not be correlated, so the variance of average abnormal returns would be further reduced. See the discussion in the following section for more details about this point.

²⁴ See Sam Peltzman, *An Evaluation of Consumer Protection Legislation: The 1962 Drug Amendments*, 81 J. Pol. Econ. 1049 (1973).

²⁵ I have recently seen Robert I. Chien & Roger B. Upson, *Returns to Drug Industry Common Stocks: An Alternative Measure of Economic Profitability* (1978) (unpublished manuscript, Univ. of Minnesota, Grad. Sch. of Bus.) which estimates that pharmaceutical industry stock prices fell unexpectedly by 11% in August 1962, the month that the Kefauver bill was rewritten to give the Food and Drug Administration the power to restrict new products (following the publicity about thalidomide).

²⁶ Sam Peltzman, *Entry in Commercial Banking*, 8 J. Law & Econ. 11 (1965).

²⁷ There are other interesting examples where the portfolio methodology could be useful:

C. Regulatory Changes That Affect Firms at Different Times

1. *Methodological Issues.* Some changes in public regulation occur through case law, or administrative law, or because of decisions by governmental regulatory agencies. In many instances a specific type of regulatory change will affect different firms at different times. For example, antitrust suits filed by the Justice Department or the Federal Trade Commission usually only affect the market value of the defendant firm. Even if every antitrust suit has the same impact on the defendant firm when it is filed, the impact of regulation occurs in different periods for different firms. This is beneficial because it randomizes the effects of other events which also affect security returns.

Fama, Fisher, Jensen, and Roll pioneered the analysis of abnormal security returns in "event time."²⁸ For example, the effect of filing an antitrust suit can be measured by averaging the abnormal returns to all defendant firms' securities in the period of the event

$$\bar{\epsilon}_t = \frac{1}{N} \sum_{i=1}^N \epsilon_{it}, \quad (6)$$

where the event time, t , will generally be a different calendar date for each firm in the sample. The pattern of effects can be analyzed by computing an average abnormal return for several periods before and after the event occurs. This is especially important if there is some doubt about the time when the regulatory change is first anticipated by the securities market,

George J. Stigler, *The Dominant Firm and the Inverted Umbrella*, 8 J. Law & Econ. 167 (1965), who studies the returns to U. S. Steel stock and the returns to a portfolio of its competitors' securities following the 1901 U. S. Steel merger; and George J. Stigler & Claire Friedland, *Profits of Defense Contractors*, 61 Am. Econ. Rev. 692 (1971), who study the returns to the securities of Defense Department contractors over the 1958-1968 period surrounding the Vietnam War. In fact, James Bicksler & Patrick J. Hess, *A Note on the Profits and Riskiness of Defense Contractors*, 49 J. Bus. 555 (1976), use a variant of the portfolio methodology to reanalyze the Stigler and Friedland results, and find no evidence that there were abnormal returns to Defense contractors' securities over the 1958-1968 period. Richard L. Smith, *The 1958 Automobile Information Disclosure Act: A Study of the Impact of Regulation* (February 1979) (unpublished manuscript, UCLA, Grad. Sch. of Mgmt.), analyzes an aspect of the regulation of the automobile industry. Finally, Michael T. Maloney & Robert E. McCormick, *Environmental Quality Regulation* (June 1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.), analyze the effects of the cotton-dust standard which was proposed by the National Institute of Occupational Safety and Health in September 1974 on the stock returns of textile manufacturers. They find that the stock returns to the 14 large textile manufacturers were abnormally positive during the year when this standard was being developed, and that these abnormal returns were positively related to the percentage of cotton fibre used in production of textiles by different firms. Thus, it seems that the environmental quality regulation increased the wealth of large textile manufacturers who use cotton as a primary input.

²⁸ Eugene F. Fama, Lawrence Fisher, Michael C. Jensen, & Richard Roll, *The Adjustment of Stock Prices to New Information*, 10 Int'l Econ. Rev. 1 (1969).

since some of the effects may occur before or after the designated event period. The total effect of the regulatory change can be measured by summing the average abnormal returns for the event dates when expectations were revised (Fama *et al.* refer to this as "cumulative average abnormal returns").

If all the firms in a particular sample have regulatory events on different calendar dates, the individual-firm abnormal returns should not be correlated, and the variance of the average abnormal return is proportional to the sum of the variances of the individual abnormal returns

$$\text{Var}(\bar{\epsilon}_t) = \frac{1}{N^2} \cdot \sum_{i=1}^N \text{Var}(\epsilon_{it}).$$

However, if some firms have regulatory events on the same date, it is more difficult to get a direct measure of the variability of the average abnormal return, because the returns that occur on the same date are likely to be correlated.

Another technique to analyze the impact of regulation that occurs at different times for different firms is to form a portfolio composed of all affected firms at each calendar date. This can be thought of as a trading strategy where the investment rule is to buy securities that are likely to be positively affected by regulation and to sell short those likely to be negatively affected. The return to this strategy, properly adjusted for risk, provides a measure of the impact of the regulatory change. The average of the time series of abnormal returns of the trading-strategy portfolio is conceptually similar to the cross-sectional average abnormal return in (6). In fact, if the trading-strategy portfolio never contains more than one security at any calendar date, the two measures will be identical. The trading-strategy portfolio method can be used to analyze anticipation or lag effects by including all firms with regulatory events in a span of several months either side of the event date.

There is one complication with the trading-strategy portfolio method: the securities in the portfolio are generally different for each calendar date; therefore, the variance of the portfolio return is different for each calendar date. This heteroscedasticity problem means that it is not possible to use the time series of abnormal trading strategy returns to estimate a standard error for the average abnormal return. Instead, Jaffe, Mandelker, and Ellert suggest the following generalized least squares procedure:²⁹

²⁹ Jeffrey F. Jaffe, *The Effect of Regulation Changes on Insider Trading*, 5 *Bell J. Econ. & Management Sci.* 93 (1974); Mandelker, *supra* note 18; and James Ellert, *Anti-Trust Enforcement and Stockholder Returns* (1975) (unpublished doctoral dissertation, Univ. of Chicago, Grad. Sch. of Bus.).

- (a) form the trading strategy portfolio for calendar date t and compute its abnormal return, ϵ_{pt} ;
- (b) compute abnormal returns to the same portfolio of securities for several previous periods in order to estimate the standard deviation of the abnormal trading strategy return for calendar date t , $S(\epsilon_{pt})$, from the time series of abnormal returns;
- (c) compute the ratio of the abnormal return to its standard deviation, $\epsilon_{pt}/S(\epsilon_{pt})$, which should have a student- t distribution if security returns have a normal distribution;
- (d) finally, the time series of standardized abnormal returns can be averaged to compute an overall test of significance based on a large sample normal distribution.

Since the standardized abnormal returns, $\epsilon_{pt}/S(\epsilon_{pt})$, should have a common standard deviation equal to one, this procedure eliminates the heteroscedasticity problem caused by the changing composition of the portfolio over time.

2. *Examples.* Probably the most comprehensive studies of the effect of public regulation on the market value of different firms at different times are Ellert's analyses of antitrust suits.³⁰ Using a large sample of antitrust litigation for the 1953-1971 period, Ellert analyzes (a) the effects of suits initiated by the Justice Department, the Federal Trade Commission, or a private party, and (b) the effects of different types of alleged antitrust law violations, among other things. He examines the effects which occur at important points during the litigation of the case, including the dates (1) when the case is filed, (2) when an initial decision is reached, and (3) when a final settlement is agreed upon. Ellert's methodology represents a variety of the most sophisticated techniques currently in use in the finance literature. He controls for the risk of defendant firms using the capital asset pricing model (5) and reports several different types of tests similar to those discussed above. Significantly, Ellert finds that suits which are likely to lead to substantial treble-damage liabilities have the largest impact on the market value of defendant firms. In particular, Justice Department suits that are successful in proving illegal horizontal conspiracy tend to be followed up by private suits seeking treble-damage relief, and the evidence indicates that these Justice Department suits have the greatest impact on the market value of defendant firms.

Ellert also analyzes the effects of divestiture decisions in a sample of 205 antitrust cases from the 1950-1972 period. These cases were brought by the Justice Department and the Federal Trade Commission under the

³⁰ Ellert, *supra* note 29.

antimerger provisions of Section 7 of the Clayton Act. He finds no significant effects of these divestiture cases on the defendant firm's security prices from the time that the suit was filed until it was settled. In fact, the evidence suggests that even the firms that were forced to divest previously acquired assets did not suffer a significant abnormal security return.³¹

Burns analyzes the effects of the major horizontal dissolution cases that occurred in the early 1900s under the Sherman Act.³² The *Standard Oil* case and the *American Tobacco/American Snuff* case both resulted in decisions on December 1, 1911, which caused previous mergers to be at least partially revoked. Burns analyzes the effects on stock prices at several stages of these suits using techniques like those described above. His main conclusion is that there was no major reduction in the market value of these firms due to the dissolution cases, although his estimates of regulatory effect are not very precise because he has a very small sample.³³

Kellogg analyzes the impact of suits under section 10(b) of the 1934 Securities and Exchange Act.³⁴ These private class-action suits hold firms and their managers liable for false or misleading statements that cause investors to lose money in the firm's securities. In a sample of sixty-seven

³¹ James C. Ellert, *Mergers, Anti-Trust Law Enforcement, and Stockholder Returns*, 31 J. Finance 715 (1976).

³² Malcolm R. Burns, *The Competitive Effects of Trust-Busting: A Portfolio Analysis*, 85 J. Pol. Econ. 717 (1977).

³³ There have been numerous related studies on the effects of mergers on shareholder wealth. Michael Gort & Thomas Hogarty, *New Evidence on Mergers*, 13 J. Law & Econ. 167 (1970); James H. Lorie & Paul Halpern, *Conglomerates: The Rhetoric and the Evidence*, 13 J. Law & Econ. 149 (1970); Mandelker, *supra* note 18; Ellert, *supra* note 31; and Dodd, *supra* note 18, among others, measure the returns to the stockholders of acquiring and acquired firms prior to the merger to determine whether the market value of the merged firm is greater than the value of the constituent firms. See Dennis C. Mueller, *The Effects of Conglomerate Mergers: A Survey of the Empirical Evidence*, 1 J. Banking & Finance 315 (1977), for a description of the evidence on conglomerate mergers. Peter Dodd & Richard Ruback, *Tender Offers and Shareholder Returns: An Empirical Analysis*, 5 J. Financial Econ. 351 (1977); and Michael Bradley, *Interfirm Tender Offers and the Market for Corporate Control*, 53 J. Business (1980), analyze the returns to acquiring and acquired firms for both successful and unsuccessful tender offers. All these studies find that merger activity generally leads to gains for the shareholders of one or both of the firms involved. Robert Stillman, *Examining the Antitrust Case against Horizontal Mergers* (1980) (unpublished manuscript, Univ. of Chicago, Grad. Sch. of Bus.); and Bjorn Espen Eckbo, *Assessing the Anti-Competitive Significance of Corporate Mergers* (1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.), examine the impact of mergers on returns to shareholders of other firms in the same industry, and on returns to shareholders of firms which sell inputs or buy outputs from the industry which includes the merging firms.

³⁴ Robert L. Kellogg, *An Empirical Investigation of Disclosure Error Civil Damage Lawsuits under the Federal Securities Laws* (1980) (unpublished doctoral dissertation, Univ. of Rochester, Grad. Sch. of Mgmt.).

cases, Kellogg finds an average decline in the market value of the defendant firm's securities of \$100 million from the time that the accounting error occurred through the date that it was discovered and publicized. Kellogg classifies cases into two groups: (a) cases where the errors resulted from a misestimation (for example, valuing a warehouse full of Nehru jackets), and (b) cases where the errors resulted from a misrepresentation (for example, where fraud is not discovered in an audited financial statement). Using the market model (4), Kellogg finds that misestimation cases have a more negative abnormal return than misrepresentation cases between the date when the error allegedly occurred and the date when it was discovered; however, misrepresentation cases have a more negative abnormal return between the discovery date and the date when the class-action suit is filed. This evidence is consistent with the fact that courts seem to dismiss misestimation cases more frequently, so that discovery of an error does not imply large additional losses to shareholders as a result of a class-action suit.

3. *Suggested Future Work.* It would be interesting to examine the effects of decisions by regulatory agencies, such as the Environmental Protection Agency, the Occupational Safety and Health Administration, or the Federal Trade Commission.³⁵ It should be possible, for example, to measure the costs imposed by a government-mandated recall of defective or unsafe products, since recall notices typically affect only one firm at a time. It would also be interesting to test whether such actions cause a revision of expectations about future regulatory events for other firms subject to similar actions. Similarly, state regulatory authorities generally adopt new rules or procedures at different times. For example, different state public utility commissions have adopted fuel-adjustment clauses at different times.³⁶

D. Using the Prices of Specialized Factors

1. *Methodological Issues.* The value of the firm, V_t , can be thought of as the value of specialized factors of production (attributable to economic

³⁵ Richard Ruback, *The Effect of Discretionary Price Control Decisions on Equity Values* (1980) (unpublished doctoral dissertation, Univ. of Rochester, Grad. Sch. of Mgmt.), examines the effects of the decisions of the Price Commission during Phase II of President Nixon's Economic Stabilization Program using daily stock returns. He finds that most of the decisions of the Price Commission had no impact on equity values, although violations of Phase II controls which were detected by the Price Commission resulted in losses to the shareholders of offending firms.

³⁶ Roger G. Clarke, *The Effect of Fuel Adjustment Clauses on the Systematic Risk and Market Values of Electric Utilities*, 35 J. Finance 347 (1980), shows that the adoption of fuel adjustment clauses (FACs) between 1965 and 1974 resulted in reduced risk, but no abnormal returns, for the shareholders of the regulated electric utilities. In his sample, Clarke had

rents) V_{St} , plus the value of the nonspecialized factors (equal to their opportunity cost) V_{Nt} ,

$$V_t = V_{St} + V_{Nt}.$$

A change in regulation which affects only a small part of the economy should affect only the value of the specialized factors, V_{St} . Thus, the wealth change associated with an unanticipated regulatory change could be measured by either the change in the value of the firm, $V_t - V_{t-1}$, or the change in the value of the specialized factors, $V_{St} - V_{St-1}$.

On the other hand, the percentage change in the value of the specialized factors,

$$R_{St} = \frac{V_{St} - V_{St-1}}{V_{St-1}},$$

can be much larger than the percentage change in the value of the firm,

$$\begin{aligned} R_t &= \frac{V_t - V_{t-1}}{V_{t-1}} = \frac{V_{St} - V_{St-1}}{V_{St-1} + V_{Nt-1}} \\ &= R_{St} \cdot \frac{V_{St-1}}{V_{St-1} + V_{Nt-1}}. \end{aligned}$$

Therefore, the rates of return to specialized factors of production will be more sensitive to regulatory changes than the rates of return to the securities of the firm.

2. *Example.* Schwert examines the impact of Securities and Exchange Commission (SEC) regulation on New York and American Stock Exchange seat (membership) prices.³⁷ Seat prices should reflect the profitability of brokerage activity in these markets, so unexpected changes in seat prices measure the impact of regulation on brokers' wealth. Using a time-series regression model (like the market model) to control for the influence of unexpected changes in stock prices and share-trading volume, Schwert finds that both New York and American Stock Exchange seat prices fell unexpectedly by about 50 per cent in March 1934, the month that the 1934 Securities and Exchange Act was first debated in Congress.³⁸ This reduction in stockbrokers' wealth is statistically highly

11 utilities with FACs in January 1965 and 50 utilities which had FACs in January 1974. As expected, the firms which used petroleum fuels were affected more than the firms which used coal as a primary input.

³⁷ G. William Schwert, *Public Regulation of National Securities Exchanges: A Test of the Capture Hypothesis*, 8 *Bell J. Econ.* 128 (1977).

³⁸ George J. Benston, *Required Disclosure and the Stock Market: An Evaluation of the Securities Exchange Act of 1934*, 63 *Am. Econ. Rev.* 132 (1973), observes that the 1934 Securities and Exchange Commission Act was an unusual piece of legislation in that it arose

significant. Schwert also finds that NYSE seat prices fell significantly when the SEC forced the NYSE to reduce brokerage commission rates during the period from 1968-1975.

3. *Suggested Future Work.* If the ban of cigarette advertising on television affected the cigarette industry, the price of tobacco acreage allotments should change by a larger percentage than the price of cigarette manufacturers' securities. This occurs because cigarette manufacturers' securities represent claims to many nonspecialized assets whose prices would probably not be affected by the advertising ban. Similarly, a change in the statutory drinking age in a given state should affect the value of liquor licenses in that state and in neighboring states. The main problem with tests such as these is to obtain reliable data on the value of specialized factors (acreage allotments or liquor licenses).³⁹ This problem will be discussed further in Section III.

Another recent regulatory issue is whether the organized stock exchanges and the over-the-counter market should be merged into one automated, centralized market. The SEC has been pushing the stock exchanges towards this merger, but it is not yet clear how the property rights in the new market system will be allocated, or how the current seat holders on the various exchanges will be compensated, if at all. An analysis of the behavior of seat prices on the various exchanges at the time of major announcements concerning the centralized market system would provide direct evidence concerning the impact of regulation on the wealth of stock exchange members.

A similar analysis could be carried out to analyze the impact of SEC restrictions on the trading of put and call options.⁴⁰ The SEC has limited the number of securities on which organized options exchanges can create and trade options, and it has rationed these rights among the competing exchanges. The behavior of prices of seats on the options exchanges around the time of changes in SEC policies, such as allowing one exchange to trade additional options, would measure the value to existing options traders of the restriction to new entry which is created and enforced by SEC regulation.

quite quickly in early 1934. There was no discussion of such a bill prior to that time. This is an important consideration in such tests because only unanticipated regulatory changes will have an effect on asset prices.

³⁹ Michael T. Maloney & Robert E. McCormick, *supra* note 27, at 14, discuss the fact that some licenses are legally tradable and others are not. Even when licenses are not legally tradable separate from other factors of production (for example, you must buy the land and the tobacco acreage allotment as a package), it is often possible to infer the value of the license as a part of the total purchase price. Maloney and McCormick suggest that restrictions on tradability may be a mechanism for enforcing output restrictions.

⁴⁰ A call (put) option gives the owner the right to buy (sell) 100 shares of a stock at a prespecified price at any time up to the expiration date of the contract.

III. TESTS OF EXISTING REGULATION

It is tempting to use returns to securities to measure whether a firm is receiving economic rents. In an efficient market, however, the present value of anticipated future rents is impounded into the level of security prices as part of the market value of the firm's assets. The realized returns to security holders will reflect only the riskiness of the securities and unanticipated events, not the existence of rents. This is analogous to Friedman's argument that rents will be capitalized into the prices of specialized factors of production.⁴¹ He points out that the long-run average cost of production, defined to include the "cost" of specialized factors, does not allow economic rents to show up in measured profits. Thus, there is no way to use security returns to test the impact of existing or anticipated regulation.

Nevertheless, since economic rents are included in the level of security prices, it may be possible in some instances to measure the value of the rents that are attributable to regulation.

A. *Using the Prices of Specialized Factors*

1. *Methodological Issues.* If there is some form of marketable barrier to entry created or certified by regulation, such as a taxicab medallion, the market value of this license provides a direct measure of the present value of the anticipated future rents which accrue to the license holder. Since the license is a specialized factor of production, the total price of the license represents rents.

In some cases, the barrier to entry created by regulation is not separately marketable. Licenses to operate radio or television stations, for example, are typically sold along with the physical assets of the station. Also, the license cannot be moved from one market to another market, so it is difficult to separate the value of the barrier to entry from the value of any "good will" which a station might accumulate in a particular location. In general, it would be necessary to measure the market value of each license separately in order to measure the aggregate impact of this barrier to entry within the United States.

In other cases, the barrier to entry may be marketable, but it may also represent ownership of tangible assets. For example, stock exchange seat holders own the assets of the stock exchange, such as the building and the land, so the prices of seats reflect both the value of the physical assets and the value of the rents that accrue to stock exchange members because of their access to trading at reduced costs.

Finally, part of the value of marketable licenses may be due to a physi-

⁴¹ Milton Friedman, *Price Theory: A Provisional Text* 139 (rev. ed. 1962).

cal constraint, such as a limit on the number of radio and television stations that can broadcast in the same geographic region without interference, or the number of taxicabs that can operate in a given community without causing congestion on the roads. From this viewpoint, the licenses assign property rights to a scarce resource; they are not an artificial barrier to entry. To interpret the value of licenses as a measure of the rents generated by regulation, it is necessary to decide whether regulation is solving a scarce-resource problem by assigning property rights, or whether it is artificially limiting entry to support cartel behavior on the part of the existing firms.

2. *Examples.* Kitch, Isaacson, and Kasper analyze the effect of regulation of taxicabs in Chicago. Based on market prices for taxicab medallions, they estimate that "the value of the monopoly created by regulation is the value of the license (\$15,000) times the number of licenses operated full time (2,739). This totals \$41,085,000."⁴² Since taxicab medallions can be used to operate a cab anywhere within the city of Chicago (not just in areas of congested traffic), and since they do not represent ownership of other assets (you need not own a vehicle to buy a medallion), these licenses provide an ideal basis for measuring the rents generated by the government-created barrier to entry.⁴³

Doede analyzes the level of New York Stock Exchange seat prices as a measure of discounted value of rents earned by seat holders.⁴⁴ Schwert notes that NYSE seats represent ownership of the assets of the Exchange, so part of the value of seats will reflect the value of nonspecialized factors.⁴⁵ There are 1,366 NYSE seats and in December 1968 they sold for \$515,000 each; therefore, in December 1968 the aggregate value of NYSE seats was \$703,490,000. In 1978, however, NYSE seats sold for about \$50,000, implying an aggregate market value of \$68,300,000. It is reasonable to speculate that much of this reduction in seat prices reflects the changing regulation of securities markets over the past decade, including the elimination of fixed commission rates, increasing competition from non-NYSE brokers in trading NYSE-listed securities, and the proposed central market system. However, the fall in seat prices from 1968 to 1978 overstates the impact of regulation because other asset values, such as NYSE-listed stocks, fell over this period and because the increased com-

⁴² Edmund W. Kitch, Marc Isaacson, & Daniel Kaspar, *The Regulation of Taxicabs in Chicago*, 14 J. Law & Econ. 285, 302 (1971).

⁴³ If there are political costs of obtaining medallions or maintaining the restriction on the number of medallions, these costs should be added to the value of the medallions to estimate the economic cost of the regulation.

⁴⁴ Robert Doede, *The Monopoly Power of the New York Stock Exchange*, (1967) (unpublished doctoral dissertation, Univ. of Chicago, Dept. of Econ.).

⁴⁵ Schwert, *supra* note 37, at 130.

petition from non-NYSE brokers was primarily due to technological change (the use of computers). In fact, Schwert estimates that the elimination of fixed commission rates had a significant negative effect on NYSE seat prices, but it is not as large as the difference between 1968 and 1978 seat prices.⁴⁶

It should be noted that government regulation did not create the barrier to entry in the form of a limited number of NYSE seats. The NYSE was a private cartel long before the SEC came into existence.⁴⁷ In fact, as noted in Section II, Schwert finds that New York and American Stock Exchange seat prices *fell* substantially when it first became apparent that the SEC would be created by Congress to regulate the securities industry, which means that the initiation of SEC regulation reduced the rents expected by NYSE seat owners.⁴⁸

Breen measures the prices of household-goods carrier operating certificates.⁴⁹ These certificates are sold separately from the assets of moving companies, but each of the 2,821 existing certificates is unique in allowing specific routes to be used. Based on a sample of 103 transactions during the January 1970–August 1973 period, Breen estimates the average value of these certificates to be \$10,387. However, 14 of the certificates allow carriers to operate in an unrestricted fashion within the continental United States, and these have never been sold. Therefore, Breen uses his sample of certificate prices to estimate that the aggregate value of the 2,807 restricted certificates is about \$29.2 million. Assuming that the 14 nationwide carriers account for 52 per cent of rents as well as 52 per cent of industry revenue, Breen estimates that the aggregate value of the 14 nationwide certificates is \$31.6 million. Thus, the aggregate value of rents in this industry is estimated to be \$60.8 million. Despite a prodigious effort to collect data on certificate prices, Breen's study illustrates the difficulties involved in measuring rents using license prices when the licenses are not perfect substitutes for each other.

3. *Suggested Future Work.* The impact of Federal Communications Commission (FCC) limitations on the number of radio or television stations in a given market area is reflected in the price of the license to operate. These licenses are only issued for a limited period of time before they must be renewed, and they are normally sold along with the rest of the assets of the radio or television station, but it should be possible to

⁴⁶ *Id.* at 143.

⁴⁷ See Robert Doede, *supra* note 44; or William F. Baxter, NYSE Commission Rates: A Private Cartel Goes Public, 22 Stan. L. Rev. 672 (1970), for a discussion of the history of the NYSE.

⁴⁸ Schwert, *supra* note 37, at 139.

⁴⁹ Denis A. Breen, The Monopoly Value of Household-Goods Carrier Operating Certificates, 20 J. Law & Econ. 153 (1977).

estimate the value of the license if enough data can be collected on the value of the physical assets of stations which are sold.

Similarly, the prices of state liquor licenses reflect the value of the restriction to entry created by state regulation. If license prices could be collected for states with different types of liquor regulation, they should provide a direct measure of the different levels of rents associated with different regulatory schemes. As with television and radio licenses, however, there is not a well-organized market for liquor licenses separate from the other assets of liquor stores. The task of estimating the prices of liquor licenses requires detailed data on the other assets involved in the sale of liquor stores.

In all these situations it is important to use prices for licenses that are determined from private transactions, not prices that are charged by public regulatory agencies. The prices charged by public agencies will not reflect the full value of the license if the regulator allocates licenses by some scheme other than a competitive market.

B. Combining Security Prices and Accounting Data

1. *Methodological Issues.* Another way to measure the effects of existing regulation is to compare the market value of the firm's securities with the economic replacement cost of the firm. If the economic replacement cost, B_t , measures the market value of the firm's assets in their most productive alternative use, the difference between the market value of the securities, M_t , and B_t represents the present value of the economic rents earned by the firm.

In most cases, however, B_t is measured by the accounting-book value of the firm, which is based on historical costs of assets. In an inflationary period, these costs tend to understate the opportunity cost of the firm and overstate the magnitude of rents implied by $(M_t - B_t)$. Also, to the extent that book depreciation follows tax depreciation, tax laws encourage the use of accelerated depreciation methods, and this can lead to an understatement of book value. Yet, if a firm perceives large political costs (such as legal costs of fighting government regulation) as a result of large accounting rates of return, there is an incentive to capitalize items that are not productive assets in order to inflate book value and reduce accounting rates of return.⁵⁰ Lindenberg and Ross illustrate methods of estimating B_t that avoid some of the problems with historical cost accounting.⁵¹

⁵⁰ Ross L. Watts & Jerold L. Zimmerman, Towards a Positive Theory of the Determination of Accounting Standards, 53 Accounting Rev. 112 (1978), argue that large firms will choose accounting techniques which reduce the reported earnings or the apparent size of the firm to avoid political costs.

⁵¹ Eric B. Lindenberg & Stephen A. Ross, Tobin's q Ratio and Industrial Organization, 54 J. Bus. 1 (1981).

It is important to note that there would be problems with using accounting measures of B_t , even if accountants used current market valuation of assets, rather than historical cost, as the basis for measuring book value. If all the factors of production could be purchased in competitive factor markets, the market value of the firm's securities would be equal to the market value of the factors of production owned by the firm. In other words, the market value of specialized factors of production, such as a license, would be included in B_t , so that the value of economic rents attributable to regulation would be impounded in both M_t and B_t .

When accountants use historical costs to compute book value, there is an additional problem. Firms in business when regulation first created the licenses would value their licenses at original cost, say zero. On the other hand, firms entering the industry at a later time and purchasing a license from an existing firm would value the license at the purchasing price, thus reflecting the value of the rents accruing to the firms in this industry. In this scenario, the difference $(M_t - B_t)$ would be higher for original firms than for new entrants, even though rents received by each firm are the same. The higher value of $(M_t - B_t)$ for original firms measures the subsidy received when regulation was initiated (because they didn't have to pay a competitive price for the license). Thus, many conceptual problems must be overcome before $(M_t - B_t)$ can be used to measure the value of the economic rents created by regulation.

2. *Examples.* Several studies have used the ratio of market to book value of equity, M_t/B_t , as a measure of regulatory stringency or, alternatively, as a measure of the existence of economic rents. Peltzman compares M_t/B_t for commercial banks as a function of size, earnings, dividends, and the stringency of new entry regulation.⁵² He argues that banks located in states that discourage new bank formations will earn rents. Peltzman concludes that cross-sectional regressions for 1962 confirm his hypothesis.

This is a case where there are relatively few problems with accounting data that measure the value of the equity in commercial banks, B_t . First, bank assets and liabilities are composed of homogeneous, marketable financial assets such as government securities, loans, and so forth. Second, the banking industry is subject to federal regulations through the Federal Reserve System and the FDIC, and this limits the variation of accounting practices across states.

Nevertheless, Peltzman's regressions do not unambiguously imply that restrictive entry regulation causes rents. What Peltzman's test shows is

⁵² Sam Peltzman, *Bank Stock Prices and the Effects of Regulation of the Banking Structure*, 41 J. Bus. 413 (1968).

that, *ceteris paribus*, banks in states with restrictive regulations have higher levels of economic rents as measured by M_t/B_t . This evidence is also consistent with the hypothesis that the rents *caused* the regulation. For example, if banks in some states have specialized factors of production and state regulators are concerned about the ability of these banks to earn economic rents, high values of M_t/B_t would lead to more stringent regulation.

One way to discriminate between these hypotheses would be to look at M_t/B_t in different states prior to the initiation of state regulation. If M_t/B_t increases subsequent to the initiation of stringent regulation, Peltzman's hypothesis that regulation causes rents would be supported. Otherwise, the hypothesis that the stringency of regulation is an endogenous response to other economic factors would be supported. In fact, Peltzman concludes that M_t/B_t declined from 1962 to 1965 when many states changed their regulations to allow more entry.⁵³ This supports his hypothesis that entry restrictions allowed existing banks to earn rents.

Stigler analyzes the relationship between measures of profitability and measures of concentration for 17 industries in the 1953-1957 period.⁵⁴ The rank correlation of M_t/B_t with the share of output produced by the four largest firms is .64; the rank correlation with the Herfindahl index is .73. These correlations are higher than for other measures of profitability such as the accounting rate of return on assets.

On the other hand, Ornstein also uses the ratio of market to book value of equity, M_t/B_t , to measure the relationship between "profitability" and concentration ratios.⁵⁵ He uses a sample of 131 large firms (over \$10 million in assets in 1957) in 33 four-digit industries for his tests. Based on cross-sectional regressions for 1950, 1955, and 1960, Ornstein concludes that there is no significant relationship between M_t/B_t and the four-firm concentration ratio, although there seems to be a significant positive relationship between M_t/B_t and economies of scale to production (measured as "the percentage of industry value of shipments accounted for by the average size plant of the largest 50 percent of plants").⁵⁶ Thus, it appears that the strong correlation between M_t/B_t and concentration found by Stigler may be due to the effect of economies of scale, not concentration.⁵⁷

⁵³ *Id.* at 427.

⁵⁴ George J. Stigler, A Theory of Oligopoly, 72 J. Pol. Econ. 44 (1964).

⁵⁵ Stanley I. Ornstein, Concentration and Profits, 45 J. Bus. 519 (1972).

⁵⁶ *Id.* at 526.

⁵⁷ Stavros B. Thomadakis, A Value Based Test of Profitability and Market Structure, 59 Rev. Econ. & Stat. 179 (1977), uses data on firms for the 1965-1968 period to estimate cross-sectional regressions of $(M_t - B_t)/S_t$, where S_t is annual sales, on measures of con-

Nevertheless, there are serious questions about the comparison of M_t/B_t across different industries because it is difficult to avoid systematic errors when using accounting-book values to measure the economic value of firms. In the oil industry, for example, larger firms tend to write off drilling expenses as they are incurred, whereas small firms capitalize drilling expenses and then depreciate them over the life of the oil field. This causes smaller firms to have relatively high book values of equity; hence, M_t/B_t would be lower for small firms.⁵⁸ This does *not* mean that larger firms are earning rents in the oil industry. Similarly, the problem of whether to capitalize advertising or research and development expenditures makes it difficult to compare accounting book values across a variety of industries.⁵⁹

3. *Suggestions for Future Work.* In general, the idea of combining accounting data and security price data to measure the effects of regulation seems appealing; however, on closer examination it seems unlikely that the problems with comparing the level of accounting numbers across firms or industries can be overcome except in very unusual circumstances. Since the choice of accounting techniques is endogenous, and since it is likely to be related to variables related to industrial organization or public regulation (such as size), the market to book value of equity ratio, M_t/B_t , should be used with extreme caution.

IV. TESTS OF CHANGES IN THE REGULATION OF CAPITAL MARKETS

A. Methodological Issues

Public regulation of securities markets has been a topic of active interest since the Special Study of the Securities Markets, the Institutional

centration and market share, as well as measures of risk and growth. He finds that both concentration and market share are positively related to $(M_t - B_t)/S_t$, which conflicts with Ornstein's results, *supra* note 55. However, there is a reason to doubt the validity of Thomadakis's results since his regression estimates are not stable across subsamples based on different levels of concentration. This instability of parameter estimates strongly suggests that there is no stable cross-sectional regression relationship that applies to such a wide variety of industries.

⁵⁸ Daniel W. Collins & Warren T. Dent, *The Proposed Elimination of Full Cost Accounting in the Extractive Petroleum Industry: An Empirical Assessment of the Market Consequences*, 1 J. Accounting & Econ. 3 (1979), discuss this issue in detail.

⁵⁹ See Harry Bloch, *Advertising and Profitability: A Reappraisal*, 82 J. Pol. Econ. 267 (1974); Michael E. Canes & Ross Watts, *Accounting and Market Measures of Abnormal Rates of Return with Application to the Defense Industry* (1976) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.); and Nicholas J. Gonedes & Nicholas Dopuch, *Economic Analysis and Accounting Techniques: Perspective and Proposals* (1976) (unpublished manuscript, Univ. of Chicago, Grad. Sch. of Bus.), for a more detailed discussion of these issues.

Investors Study, and the controversy over fixed brokerage commission rates.⁶⁰ It is more difficult, however, to design tests of whether such regulation has beneficial or detrimental effects using security price data, because all firms with traded securities are affected. For example, the hypothesis that the amount of fraud in organized securities markets was reduced by the Securities and Exchange Commission may imply a once-and-for-all increase in the value of securities traded on the regulated markets, but it is not clear whether expected returns or investment risk would be systematically affected. In general, it is probably necessary to compare the behavior of the prices of the regulated securities relative to the prices of assets not affected by the regulation, such as real estate or other nonfinancial assets, in order to measure the effects of security-market regulation.

An alternative strategy which has been followed by most analysts of securities regulation is to examine the statistical behavior of security returns before and after the advent of regulation. The null hypothesis for these tests is that the change in regulation has no impact on the pricing of securities. The disadvantage of these tests is that the alternative hypothesis is rarely specified; in other words, it is not clear how the tests should come out if regulation did have an impact. Therefore, it is difficult to determine the *power* of many of the tests of the effects of changes in the regulation of securities markets.

B. Examples

Stigler attempts to test the effects of the Securities Act of 1933, which established mandatory disclosure of information by firms prior to issuing new securities.⁶¹ Stigler examines the returns to purchasers of new issues of stocks for up to five years after the issue for both the 1923-1928 and 1949-1955 periods. Since the average returns to new issues are similar in the two periods before and after the 1933 Act, Stigler concludes that the regulation had no significant impact on shareholder welfare.

However, there are several problems with Stigler's tests. He compares the returns to new issues with the returns to a market portfolio of stocks, implicitly assuming that all new issues have the same risk as the market portfolio.⁶² Second, it is not clear that Stigler's test should show an effect

⁶⁰ U. S. Congress, House Comm. on Interstate and Foreign Commerce, Report of Special Study of the Securities Markets of the Securities and Exchange Commission, H. R. Doc. 95, 88th Cong., 1st Sess. (1963); U. S. Congress, House Comm. on Interstate and Foreign Commerce, Institutional Investor Study Report of the Securities and Exchange Commission, H. R. Doc. 64, 92d Cong., 1st Sess. (1971). See Baxter, *supra* note 47, for a discussion of the controversy over brokerage commission rates.

⁶¹ George J. Stigler, Public Regulation of the Securities Markets, 37 J. Bus. 117 (1964).

⁶² Evidence in Roger G. Ibbotson, Price Performance of Common Stock New Issues, 2 J.

of the 1933 Act, even if the probability of fraud had been reduced substantially as a result of the new regulation. If the new issues market was efficient prior to 1933, investors would make an unbiased assessment of the probability of fraud, and the average returns to new issues would simply reflect the equilibrium expected return to securities of comparable risk. If the 1933 Securities Act reduced the amount of fraud, the number of new issues with very negative returns would be reduced and the price that investors would be willing to pay for all new issues would be increased. These two effects would offset each other with no necessary implications for the average returns realized by purchasers of new issues of securities, although the cross-sectional variance of returns would be reduced, as Stigler observes in his data.

Since Stigler noticed that the variability of returns to new issues was lower in the post-SEC period than in the pre-SEC period, several people have tried to determine whether the SEC could have caused this reduction in variability through its regulation of information. Benston studies the means and variances of monthly market model residuals for almost 500 NYSE firms during the February 1934-June 1935 period when the SEC first came into existence.⁶³ He segregates his sample into firms that regularly reported sales data before the SEC required it and those that did not. There is no evidence that the abnormal returns (market model residuals) to either group behaved differently in the period of regulatory change than in the rest of the 1930-1938 period.

Officer studies the behavior of the variance of the monthly returns to a market portfolio of New York Stock Exchange stocks, $\sigma^2(R_m)$.⁶⁴ Among other things, Officer tests whether the initiation of SEC regulation in 1934 had an effect on this measure of the aggregate risk of stocks. Although $\sigma^2(R_m)$ fell substantially after 1932-1933, Officer concludes that the SEC was not responsible since the level of $\sigma^2(R_m)$ after 1938 is similar to the level prior to 1929. The 1930-1938 episode, known as the "Great Depression," was a period of abnormally high variability in many economic time series, including common stock returns. Thus, in combination with Benston's results, there is no evidence that the initiation of SEC regulation had any significant impact on the variability of NYSE stock returns.

Regulation of credit extended to customers by securities brokers, or

Financial Econ. 235 (1975), indicates that unseasoned new issues are substantially riskier than the NYSE market portfolio of seasoned securities. I have recently seen preliminary work in Gregg Jarrell, Economic Effects of S.E.C. Regulation of the Markets for New and Listed Securities (1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.), which indicates that many of the new issues in Stigler's sample were seasoned securities, and the systematic risk of these stocks was not substantially different from unity.

⁶³ Benston, *supra* note 38.

⁶⁴ Robert R. Officer, The Variability of the Market Factor of the New York Stock Exchange, 46 J. Bus. 434 (1973).

"margin requirements," have also been studied. For example, Moore tests whether the existence of margin requirements has reduced fluctuations in stock prices.⁶⁵ He compares the sample standard deviation of an index of NYSE stock prices before 1933 and after 1946 and finds no substantial differences. He also notes that the sample serial correlation of daily stock prices was close to 1.0 both before and after the initiation of margin requirements. Unfortunately, it is hard to interpret Moore's results since he works with the level of stock prices, rather than the rate of return to stocks.⁶⁶

Largay and West examine the daily rates of return to the portfolio of stocks contained in the Standard and Poor's composite index to test whether announcements of changes in margin requirements have an impact on stock prices.⁶⁷ Using a methodology similar to that of Fama *et al.*, Largay and West find no significant abnormal market returns following either increases or decreases in margin requirements. It does appear, however, that margin increases occur after an unusual increase in stock prices and margin decreases occur after an unusual decrease in stock prices. This probably indicates that the Federal Reserve Board uses movements in stock prices as an important input to its policy decisions, but there is no indication that margin changes have any impact on stock price behavior.⁶⁸

There are some types of regulations that affect only a part of security-

⁶⁵ Thomas G. Moore, Stock Market Margin Requirements, 74 J. Pol. Econ. 158 (1966).

⁶⁶ If stock prices follow a nonstationary random walk, the statistics Moore computes do not correspond to population parameters, so they are suggestive, at best. In other words, if price changes, $(P_t - P_{t-1})$, are serially independent random variables, the behavior of the sequence of price levels, P_t , will be composed of the common initial price, P_0 , and the accumulated sum of all the price changes to that time

$$P_t = P_0 + \sum_{i=1}^t (P_i - P_{i-1}).$$

Successive price levels will differ only by the most recent price change, so they will be highly correlated and they will yield unreliable parameter estimates and test statistics. G. U. Yule, Why Do We Sometimes Get Nonsense Correlations between Time Series? A Study in Sampling and the Nature of Time Series, 89 J. Royal Stat. Soc'y 1 (1926); C. W. J. Granger & Paul Newbold, Spurious Regressions in Econometrics, 2 J. Econometrics 111 (1974); and Charles I. Plosser & G. William Schwert, Money, Income, and Sunspots: Measuring Economic Relationships and the Effects of Differencing, 4 J. Monetary Econ. 637 (1978), provide more detailed analysis of the statistical problems with using nonstationary time series data.

⁶⁷ James Largay & Richard West, Margin Changes and Stock Price Behavior, 81 J. Pol. Econ. 328 (1973).

⁶⁸ In a related study, Roger N. Waud, Public Interpretation of Federal Reserve Discount Rate Changes: Evidence on the Announcement Effect, 38 Econometrica 231 (1970), analyzes the daily returns to the Standard and Poor's portfolio around the time of changes in the discount rate and finds similar increases in stock prices before a reduction in the discount rate.

market transactions. In these cases it is probably reasonable to use the behavior of aggregate stock prices as a benchmark for measuring regulatory effect, because the regulations do not have broad implications for the value of all securities simultaneously.

Jaffe tests whether major changes in case law had a significant impact on either the volume or the profitability of insider trading activity.⁶⁹ He identifies three major precedents in the early 1960s that substantially changed the liability of insiders who trade on information not publicly available. Using the capital asset pricing model to measure abnormal returns, Jaffe finds that insiders earned abnormal returns both before and after the change in case law. There is no evidence that either the volume or the profitability of insider trades was reduced by the change in regulation.

Jarrell and Bradley analyze the impact of the Williams Act and the parallel legislation by states since the Williams Act, which restricted the ability of firms to make tender offers for the shares of another firm.⁷⁰ They find that the premiums paid in tender offers increased significantly after the 1970 amendments to the Williams Act, and the frequency of offers decreased. It appears that the state legislation had more of an impact than the Williams Act, since the frequency of offers is most affected by the timing of state legislation. Based on this evidence, Jarrell and Bradley conclude that tender-offer legislation raised the cost of tender offers by imposing delays and information disclosure on offerors.

C. Suggested Future Work

Numerous regulatory activities of the Securities and Exchange Commission have more of an impact on some securities than on others.⁷¹ For example, the SEC defines the accounting standards that must be used in mandatory reporting statements. If the accounting standard affects only firms in one industry, for example, it should be possible to determine the effects of the regulatory change by measuring abnormal returns to the securities of the affected firms.⁷²

On the other hand, assessing the impact of regulations that affect the

⁶⁹ Jaffe, *supra* note 29.

⁷⁰ Gregg A. Jarrell & Michael Bradley, The Effects of Federal and State Regulations on the Market for Cash Tender Offers, 23 J. Law & Econ. 371 (1980).

⁷¹ See Section II-D *supra*, for a discussion of the impact of SEC regulation on NYSE seat prices.

⁷² Daniel W. Collins, S.E.C. Product-line Reporting and Market Efficiency, 2 J. Financial Econ. 125 (1975); Daniel W. Collins & Warren T. Dent, *supra* note 58; and Richard Leftwich, *supra* note 19, discuss the stock price behavior of affected firms in association with SEC-mandated changes in accounting standards.

majority of traded securities is difficult because of the problem of finding an appropriate benchmark. Without data on nonfinancial assets, or financial assets in different countries, it is difficult to determine unusual behavior of security prices that is attributable to regulation.

V. CONCLUSION

The theory of finance provides a basis for using security price data to measure the effects of public regulation on the profitability of affected firms. This basis is particularly important for tests of the "producer-protection" or "capture" hypothesis, which posits that regulated firms receive net benefits from government regulation. Security price data can also provide indirect evidence about the "consumer-protection" or "public-interest" hypothesis of regulation, since this generally implies that producers are hurt by government regulation.

Of course, it is not possible to use security returns to answer all the interesting questions about the effects of regulation. For example, if new regulation of an industry causes security prices to rise, indicating increased profitability and/or reduced risk, generally it is not possible to determine the separate effects of the regulation on the demand and cost curves of the industry. Similarly, it is not always possible to determine the effects on product prices or output from the information in security price movements (although security price behavior can provide important evidence to corroborate an analysis of demand and cost curves).

Nevertheless, the effect of regulation on shareholder wealth is an important question, since firms will seek regulation that increases security prices and try to avoid regulation that decreases security prices. Even though security price behavior cannot measure all regulatory effects, it can provide important evidence about the competing theories of regulation.

APPENDIX

ANNOTATED BIBLIOGRAPHY

Since one of the contributions of this paper is to survey parts of the finance and industrial organization literature which are relevant to measuring the effects of regulation, it seems worthwhile to gather in one place selected lists of references. Many of these papers are discussed in the text or footnotes, but additional references are also added to expand the scope of the survey. This is not meant to be an exhaustive summary of the relevant literature; rather, it includes a variety of papers which provide valuable background material and which suggest fruitful areas for future research.

A. *Financial Models*

The following references provide background information about financial models which can be used to measure abnormal security returns or changes in risk in association with regulatory changes.

- Black, Fischer; Jensen, Michael C.; & Scholes, Myron. The Capital Asset Pricing Model: Some Empirical Tests, in *Studies in the Theory of Capital Markets* 79 (M. C. Jensen ed. 1972).
- Fama, Eugene F. Efficient Capital Markets: A Review of Theory and Empirical Work, 25 *J. Finance* 383 (1970).
- Fama, Eugene F. *Foundations of Finance* (1976).
- Fama, Eugene F.; Fisher, Lawrence; Jensen, Michael; & Roll, Richard. The Adjustment of Stock Prices to New Information, 10 *Int'l Econ. Rev.* 1 (1969).
- Jensen, Michael C. Capital Markets: Theory and Evidence, 3 *Bell J. Econ. & Management Sci.* 357 (1972).
- Miller, Merton H. & Modigliani, Franco. Some Estimates of the Cost of Capital to the Electric Utility Industry, 1954-57, 56 *Am. Econ. Rev.* 333 (1966).
- Muth, John F. Rational Expectations and the Theory of Price Movements, 29 *Econometrica* 315 (1961).
- Robichek, Alexander A.; McDonald, John G.; & Higgins, Robert C. Some Estimates of the Cost of Capital to the Electric Utility Industry, 1954-57: Comment, 57 *Am. Econ. Rev.* 1278 (1967).
- Roll, Richard. A Critique of the Asset Pricing Theory's Tests; Part I: On Past and Potential Testability of the Theory, 4 *J. Financial Econ.* 129 (1977).

B. *Regulation of Individual Industries or Firms*

The following references contain studies which analyze the impact of industry-specific regulatory change on shareholder wealth. Many of these studies use the techniques discussed in this paper.

- Clarke, Roger G. The Effect of Fuel Adjustment Clauses on the Systematic Risk and Market Values of Electric Utilities, 35 *J. Finance* 347 (1980).
- Collins, Daniel W. & Dent, Warren T. The Proposed Elimination of Full Cost Accounting in the Extractive Petroleum Industry: An Empirical Assessment of the Market Consequences, 1 *J. Accounting & Econ.* 3 (1979).
- Maloney, Michael T., & McCormick, Robert E. Environmental Quality Regulation (June 1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.).
- Smith, Richard L. The 1958 Automobile Information Disclosure Act: A Study of the Impact of Regulation (February 1979) (unpublished manuscript, U.C.L.A., Grad. Sch. of Mgmt.).
- Stigler, George J. & Friedland, Claire. What Can the Regulators Regulate? The Case of Electricity, 5 *J. Law & Econ.* 1 (1962).

On the other hand, the next references study the effects of regulatory change on individual firms as a result of lawsuits or administrative decisions.

- Burns, Malcolm R. The Competitive Effects of Trust-Busting: A Portfolio Analysis, 85 *J. Pol. Econ.* 717 (1977).

- Ellert, James. *Anti-Trust Enforcement and the Behavior of Stock Prices* (1975) (unpublished doctoral dissertation, Univ. of Chicago, Grad. Sch. of Bus.).
- Ellert, James C. *Mergers, Anti-Trust Law Enforcement and Stockholder Returns*, 31 *J. Finance* 715 (1976).
- Kellogg, Robert L. *An Empirical Investigation of Disclosure Error Civil Damage Lawsuits under the Federal Securities Laws* (1980) (unpublished doctoral dissertation, Univ. of Rochester, Grad. Sch. of Mgmt.).
- Ruback, Richard. *The Effect of Discretionary Price Control Decisions on Equity Values* (1980) (unpublished doctoral dissertation, Univ. of Rochester, Grad. Sch. of Mgmt.).
- Stillman, Robert. *Examining the Antitrust Case against Horizontal Mergers* (1980) (unpublished manuscript, Univ. of Chicago, Grad. Sch. of Bus.).

C. Mergers and Takeovers

Mergers, tender offers, and other forms of corporate takeovers are of special interest because anti-trust policy is highly concerned with the implications of mergers for industrial organization. There have been a number of studies which examine the impact of mergers on shareholder wealth, including:

- Bradley, Michael. *Interfirm Tender Offers and the Market for Corporate Control*, 53 *J. Business* 345 (1980).
- Dodd, Peter. *Merger Proposals, Management Discretion, and Stockholder Wealth*, 8 *J. Financial Econ.* 105 (1980).
- Dodd, Peter, & Ruback, Richard. *Tender Offers and Shareholder Returns: An Empirical Analysis*, 5 *J. Financial Econ.* 351 (1977).
- Gort, Michael & Hogarty, Thomas. *New Evidence on Mergers*, 13 *J. Law & Econ.* 167 (1970).
- Jarrell, Gregg A. & Bradley, Michael. *The Effects of Federal and State Regulations on the Market for Cash Tender Offers*, 23 *J. Law & Econ.* 371 (1980).
- Lorie, James H. & Halpern, Paul. *Conglomerates: The Rhetoric and the Evidence*, 13 *J. Law & Econ.* 149 (1970).
- Mandelker, Gershon. *Risk and Return: The Case of Merging Firms*, 1 *J. Financial Econ.* 303 (1974).
- Mueller, Dennis C. *The Effects of Conglomerate Mergers: A Survey of the Empirical Evidence*, 1 *J. Banking & Finance* 315 (1977).
- Stigler, George J. *The Dominant Firm and the Inverted Umbrella*, 8 *J. Law & Econ.* 167 (1965).

D. Measuring the Value of Rents

The following papers discuss using the prices of licenses or the difference between the market value of the firm's securities and the economic replacement cost of the firm as a measure of economic rents.

- Breen, Denis A. *The Monopoly Value of Household-Goods Carrier Operating Certificates*, 20 *J. Law & Econ.* 153 (1977).
- Doede, Robert. *The Monopoly Power of the New York Stock Exchange* (1967) (unpublished doctoral dissertation, Univ. of Chicago, Dept. of Econ.).
- Kitch, Edmund W.; Isaacson, Marc; & Kasper, Daniel. *The Regulation of Taxicabs in Chicago*, 14 *J. Law & Econ.* 285 (1971).

- Lindenberg, Eric B., & Ross, Stephen A. Tobin's q Ratio and Industrial Organization, 54 J. Business 1 (1981).
 Ornstein, Stanley I. Concentration and Profits, 45 J. Business 519 (1972).
 Peltzman, Sam. Bank Stock Prices and the Effects of Regulation of the Banking Structure, 41 J. Business 413 (1968).

E. Regulation of Capital Markets

Several papers analyze the impact of securities regulation on the statistical behavior of stock returns, including:

- Benston, George J. Required Disclosure and the Stock Market: An Evaluation of the Securities Exchange Act of 1934, 63 Am. Econ. Rev. 132 (1973).
 Jarrell, Gregg A. Economic Effects of S.E.C. Regulation of the Markets for New and Listed Securities (1980) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.).
 Largay, James & West, Richard. Margin Changes and Stock Price Behavior, 81 J. Pol. Econ. 328 (1973).
 Moore, Thomas G. Stock Market Margin Requirements, 74 J. Pol. Econ. 158 (1966).
 Officer, Robert R. The Variability of the Market Factor of the New York Stock Exchange, 46 J. Business 434 (1973).
 Stigler, George J. Public Regulation of the Securities Markets, 37 J. Business 117 (1964).

The following papers analyze the effects of securities markets regulations which do not affect all firms simultaneously:

- Collins, Daniel W. S.E.C. Product-line Reporting and Market Efficiency, 2 J. Financial Econ. 125 (1975).
 Dodd, Peter, & Leftwich, Richard. The Market for Corporate Charters: "Unhealthy Competition" vs. Federal Regulation, 53 J. Business 259 (1980).
 Jaffe, Jeffrey F. The Effect of Regulation Changes on Insider Trading, 5 Bell J. Econ. & Management Sci. 93 (1974).
 Mackay, R. J.; Wicklund, G. A.; & Zecher, J. R. Stock Price Manipulation and the Birth of the SEC: A Preliminary Analysis of the Alleged American Commercial Alcohol Stock Price Manipulation Case in 1933, 5 Eastern Econ. J. (1979).

Finally, the impact of securities regulation on the profitability of securities brokers has been analyzed by the following:

- Baxter, William F. NYSE Commission Rates: A Private Cartel Goes Public, 22 Stanford L. Rev. 672 (1970).
 Schwert, G. William. Public Regulation of National Securities Exchanges: A Test of the Capture Hypothesis, 8 Bell J. Econ. 128 (1977).

F. Accounting Profits versus Stock Price Data

Given the length of this paper, some important questions about the use of security price data were omitted. Among the most important of the omitted topics is the relationship between accounting measures of profitability or rate of return

on capital and the measures of profitability available from security price data. These comparisons are alluded to in various sections of the paper, but the contrast between these alternative data sources is not explored thoroughly. Readers who are interested in further information about some of the systematic biases which occur in accounting measures of profitability should read some of the following papers:

- Canes, Michael E., & Watts, Ross. Accounting and Market Measures of Abnormal Rates of Return with Application to the Defense Industry (February 1976) (unpublished manuscript, Univ. of Rochester, Grad. Sch. of Mgmt.).
- Friedman, Milton. Price Theory: A Provisional Text 139-47 (rev. ed. 1962).
- Gonedes, Nicholas J. & Dopuch, Nicholas. Economic Analysis and Accounting Techniques: Perspective and Proposals (October 1976) (unpublished manuscript, Univ. of Chicago, Grad. Sch. of Bus.).
- Jarrell, Gregg A. Pro-Producer Regulation and Accounting for Assets: The Case of Electric Utilities, 1 J. Accounting & Econ. 93 (1979).
- Lorie, James H. & Hamilton, Mary T. The Stock Market: Theories and Evidence 142-56 (1973).
- Solomon, Ezra. Alternative Rate of Return Concepts and Their Implications for Utility Regulation, 1 Bell J. Econ. & Management Sci. 65 (1970).
- Stauffer, Thomas R. The Measurement of Corporate Rates of Return: A Generalized Formulation, 2 Bell J. Econ. & Management Sci. 434 (1971).
- Watts, Ross & Zimmerman, Jerold. Towards a Positive Theory of the Determination of Accounting Standards, 53 Accounting Rev. 112 (1978).