THE RELATIONSHIP BETWEEN AN INDUSTRY AVERAGE BETA COEFFICIENT AND PRICE ELASTICITY OF DEMAND

THESIS

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

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Denton, Texas
December, 1986

The price elasticity of demand coefficient for a good or service is a measure of the sensitivity, or responsiveness, of the quantity demanded of a product to changes in the price of that product. The price elasticity of demand coefficients were generated for goods and services in nine different industries for the years 1972 to 1984. A simple linear demand function was employed, using the changes in the Consumer Price Index as a proxy for changes in price and Personal Consumption Expenditures, taken from the National Income and Product Accounts, as a proxy for quantity.

Beta measures the sensitivity, or responsiveness, of a stock to the market. An industry average beta coefficient was generated for each of the nine industries over the time period, using the beta coefficients published by Value Line for firms which met certain criteria.

In order to test the relationship between the price elasticity of demand and an industry average beta coefficient, a simple regression was performed using the beta coefficient as the dependent variable and the price elasticity of demand coefficient as the independent variable.
The results broke down into 3 basic categories: those industries for which there seemed to be no relationship, those industries where there was a fairly strong probability that a relationship exists and the price elasticity of demand explains at least part of the variation in beta coefficients, and those industries where there was a very high probability that a relationship does exist and the variation in the price elasticity of demand coefficients substantially explained the variation in the industry average beta coefficients. The first category includes the food at home, tobacco, and shoe industries. The second category includes the men's clothing, the women's clothing, and the alcoholic beverages industries, and the third includes the automobile, airline, and fast-food restaurant industries.
TABLE OF CONTENTS

LIST OF TABLES ........................................ iv

LIST OF FIGURES ....................................... v

Chapter

I. INTRODUCTION ..................................... 1

II. CALCULATING BETA COEFFICIENTS ................. 9

III. ESTIMATING THE PRICE ELASTICITY OF
    DEMAND COEFFICIENTS .......................... 19

IV. RESULTS OF SIMPLE REGRESSIONS .................. 23

V. CONCLUSIONS ...................................... 35

BIBLIOGRAPHY ......................................... 40
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Rates of Return on the Average Stock, a High Risk Stock, and a Low Risk Stock</td>
<td>11</td>
</tr>
<tr>
<td>II.</td>
<td>Average Beta Values By Industry (1972 - 1984)</td>
<td>16</td>
</tr>
<tr>
<td>III.</td>
<td>Price Elasticity of Demand Coefficients</td>
<td>22</td>
</tr>
<tr>
<td>IV.</td>
<td>Regression Results by Industry</td>
<td>26</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Graphic Representation of Beta</td>
<td>10</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

The price elasticity of demand coefficient measures the sensitivity, or responsiveness, of the quantity demanded of a product to changes in the price of that product. If the percentage change in quantity demanded in response to a change in price is greater than the percentage change in price, the demand for the product is said to be elastic and will have an absolute value greater than unity; if the percentage change in quantity demanded in response to a change in price is less than the percentage change in price, the absolute value of the price elasticity of demand coefficient will be less than unity and the demand for the product is said to be inelastic.

The value of a firm's stock beta coefficient is a measure of the sensitivity, or responsiveness, of its stock to the market and is a measure of systematic, or market, risk. "Systematic risk, as measured by beta, captures that aspect of investment risk that cannot be eliminated by diversification." (3, p.60) In particular, beta measures the return of a stock compared to that of the market where return is simply:
Return = appreciation + yield

and:

\[
\text{Appreciation} = \frac{\text{value of a stock at the end of the period} - \text{value of a stock at the beginning of the period}}{\text{value of a stock at the beginning of the period}}
\]

and:

\[
\text{Yield} = \frac{\text{dividends paid in the period}}{\text{value of the stock at the beginning of the period}}
\]

The "market" is represented by some average stock which moves exactly with the market and hence has a beta value of one. The New York Stock Exchange Composite Index, Standard & Poor's 500 Index, or the Dow Jones Industrials are typically used as a proxy measure of the average stock. A stock with a return greater than the market will have a beta coefficient of greater than one, implying that, for example, if the return of the market goes up by 5 per cent, the return of the stock in question will go up by greater than 5 per cent. A stock with returns that move less than the market will have a beta value less than 1.

The value of beta is indirectly affected by a diverse array of economic events, on both a micro and macro scale. Beta will be significantly affected by changes in the expected rate of inflation, interest rates, the growth rate
of real GNP, possible changes in tax law, and changes in public attitudes (3, p. 60). The hypothesis under investigation holds that economic events influence beta via the elasticity of demand.

The future beta value for a firm depends on the sensitivity of the demand for its products or services and of its costs to the economic factors about which there is the greatest uncertainty. (4, p. 279)

It has also been noted that "one might expect firms in industries characterized by highly cyclical demand and/or large fixed costs to have higher betas than those in industries with more stable demand and/or greater freedom to vary costs". (4, p. 279) It is expected, then, that a high correlation exists between the value of the elasticity of demand for a particular product and the value of beta for a firm or industry producing that product. A firm with a high beta coefficient for a given market period would be expected to be providing a product or service with a volatile elasticity of demand.

Methodology

Beta is estimated from past data by least-squares regression procedures which consist of fitting a linear relationship between the rates of return on a security and the rates of return on a market index. These estimations are published monthly by Merrill Lynch and by Value Line.
Merrill Lynch uses the Standard & Poor's 500 as the market index with 60 monthly observations. Value Line uses the New York Stock Exchange Composite Index and 260 weekly observations. Value Line's estimations are adjusted using a weighting pattern which gives only partial weight to past observations; the balance of the weight is placed on a beta value of one. According to a study by Marshall Blume, betas regress toward the grand mean of one (1). "Because beta need not be constant over time, it follows that estimating the average value of beta for a security in some past period is not the same problem as predicting the value of beta in some future period" (3, p. 65). The purpose of this adjustment process is to take into account the expected future trend. Therefore, these estimations more closely approximate the true beta for a firm. For this reason, an adjusted beta coefficient published by Value Line will be used. The determination of beta values will be discussed further in Chapter II.

The price elasticity of demand coefficients will be generated using a simple linear demand function in the form of:

\[ Q_i = a_0 + a_1 P_i \]

where \( Q_i \) is the quantity demanded of the \( i \)th product, \( a_0 \) is the intercept term, \( a_1 \) is the slope, and \( P_i \) is the price of the \( i \)th product. Changes in the Consumer Price Index were
used as a proxy for changes in price and Personal Consumption Expenditures taken from the National Income and GNP Accounts were used as a proxy for quantity. The actual procedure used to derive the elasticity coefficients will be explained in Chapter III.

In order to test the relationship between the price elasticity of demand and a firm or industry's beta coefficient, a simple regression will be performed using a linear model in the form of:

$$\beta = \nu_0 + \nu_1(\varepsilon_d) + \epsilon$$

where $\beta$ is the beta coefficient (dependent variable), $\nu_0$ is the intercept term, $\nu_1$ is the slope, $\varepsilon_d$ is the price elasticity of demand coefficient (independent variable), and $\epsilon$ is the error term. The results of this regression (discussed in Chapter IV) will show to what degree changes in price elasticity of demand explain the variation in beta coefficients.

Relevance of Study

Beta is a widely used measure of market risk in both financial management and investment analysis. Extended knowledge of the factors which determine beta facilitate more accurate prediction of beta. Using a purely historic beta to predict future beta values implicitly assumes that the future risk of a security is the same as its past risk. The
adjusted beta does take into account the probability of beta tending toward one as well as past performance. However, these predictions do not account for the volatility of the market or changing economic conditions in any real sense; the probability which is assigned to a bullish market versus a bearish market is subjective.

One of the main applications of beta is in the Capital Asset Pricing Model of Sharpe, Kantor, and Lintner where beta represents the risk premium demanded by investors. The Capital Asset Pricing Model assumes that stockholders regard market risk as the only relevant risk. Hence, the risk premium demanded by investors is assumed to be entirely based on the stock's beta coefficient as set forth the Security Market Line Equation:

\[ k_s = R_f + \beta_i (k_m - R_f) \]

where \( k_s \) is the risk premium demanded by investors, \( R_f \) is the risk-free rate, \( \beta_i \) is the beta coefficient for the ith firm, and \( k_m \) is the required rate of return on the market. Using an historic beta in this framework implies that the future risk associated with a firm's stock is the same as its past. However, the historic betas of individual firms are not very stable over time (2, p. 238) implying that risk changes and will not necessarily be the same in the future. Stocks are considered risky because they can go down. Investors, then, are concerned with the risk they must face in a bear market in
some future period and are concerned with future returns. The beta coefficient used should reflect volatility of a given stock versus the market in some future period. The Capital Asset Pricing Model is an ex ante model, and all variables represent expected values. The beta coefficient used, then, should reflect volatility of a given stock versus the market expected during some future period. ". . . if one could make an accurate prediction of future beta the portfolio, it would be an important ingredient in his investment decision making" (3, p. 65).

In a market economy such as that of the United States, changing economic conditions are reflected in changes in prices for goods and services. Any economic event, from a change in consumers' tastes and preferences to a change in the nation's money stock, eventually leads to a change in either relative or absolute prices. The price elasticity of demand is a measure of how consumers respond to these changes in prices and thus to changing economic conditions. If indeed a relationship between beta and price elasticity of demand is identified, then the link between beta and the economy may be used to predict nondiversifiable risk.
CHAPTER BIBLIOGRAPHY


CHAPTER II

CALCULATING BETA COEFFICIENTS

Beta is generally estimated from past data by least-squares regression procedures. The least-squares technique consists of fitting a linear relationship between the rates of return on a security and the rates of return on a market index so that the sum of squared differences between the security's actual returns and those implied by the relationship is minimized. (4, p. 1233)

If \( Y_t, t = 1, 2, \ldots, T \) is the series of rates of return on a security and \( X_t, t = 1, 2, \ldots, T \) is the series of rates of return on a market index, the least-squares estimates of the parameters \( \beta, \alpha, \sigma^2 \) in the simple linear regression process (4, p. 1233)

\[
Y_t = \alpha + \beta X_t + e_t, \quad t = 1, 2, \ldots, T \quad (1)
\]

are given as

\[
b = \frac{\sum(Y_t - Y)(X_t - X)}{\sum(X_t - X)^2} \quad (2)
\]

\[
\alpha = Y - bX \quad (3)
\]

\[
s^2 = \frac{1}{T - 2} \sum(Y_t - \alpha - bX_t)^2 \quad (4)
\]
respectively, and the variance of $b$ is estimated as

$$S_b^2 = \frac{s^2}{\sum(X_t - X)^2}$$  \hspace{1cm} (5)$$

These are the best linear unbiased estimates of the parameters $\alpha$, $\beta$, and $\sigma^2$ because the variance of the error term is minimized. (2)

Beta is the slope of the regression line relating return on a security to the return on the market. The procedure for estimating beta is graphically represented in Figure 1.

**FIGURE I**

**GRAPHIC REPRESENTATION OF BETA**

Return on Stock $i$ (%)  

Return on the Market (%)
The return on the average stock is by definition the same as the return on the market. Therefore, line A, representing the movement of the average stock, is a 45 degree line. Line B represents the movement of a high risk stock and line C represents the movement of a low risk stock.

**TABLE I**

**RATES OF RETURN ON THE AVERAGE STOCK, A HIGH RISK STOCK, AND A LOW RISK STOCK**

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Stock</th>
<th>High Risk Stock</th>
<th>Low Risk Stock</th>
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<tr>
<td>1</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>20%</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>0%</td>
<td>-10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

The return on the average stock, a high risk stock, and a low risk stock were all 10 per cent in Year 1. In Year 2, the market rose; the return on the average stock went up to 20 per cent while the returns on the high risk went up by greater than the market and the returns of the low risk stock went up by less than the market. In year 3, the market fell, and the returns on the high risk stock fell by twice the amount of the market decline while the returns on the low risk stock fell by only half as much as the market, or average stock. The average stock, which represents the market, has a beta value
of 1.0, while the high risk stock, whose returns rose and fell by twice that of the market has a beta value of 2.0 and the low risk stock has a beta value of 0.5.

The least-squares procedures described above generate a purely historic beta. For reasons cited in Chapter I, an adjusted beta coefficient was used in this study. Marshall Blume showed that betas tend toward the grand mean of 1.0. (1) The pure historic statistical beta is adjusted for the expected future movement toward 1.0. This adjustment produces a beta which will, on the average, be a better predictor of beta. (1, p. 284)

Formal procedures for making such estimates are employed by most firms that publish beta coefficients. The specific adjustments made typically differ from time to time and, in some cases, from stock to stock. (3, p. 276) The adjustment is performed according to a weighting pattern described in Chapter I. For example, historic betas may be given a weight of 65 per cent with the remaining weight of 35 per cent placed on beta value of 1.0. If the historic beta of a firm is .87, the adjusted beta is given by

\[
\text{Adjusted Beta} = (0.65 \times 0.87) + (0.35 \times 1.0) = 0.92
\]

Past forecast errors are evaluated in determining the relative weights of the historic beta and the beta value of 1.0. If the past forecast error was large, then a larger weight would be assigned to the beta value of 1.0.
Firm Selection Criteria

The beta coefficients used were those published by Value Line. An average beta value was calculated for each industry, each represented by a varying number of firms. The industries used and type of firms selected to represent each industry were:

- **Food at Home** - grocery store chains
- **Food away from Home** - fast food restaurants
- **Alcoholic Beverages** - brewers and distillers
- **Men's and Boy's Clothing** - retailers and manufacturers of men's and boy's apparel
- **Women's and Girl's Clothing** - retailers and manufacturers of women's and girl's apparel
- **Shoes** - retailers and manufacturers of footwear
- **New Domestic Automobile** - manufacturers of owner-operated passenger vehicles
- **Air Transportation** - commercial passenger airline companies
- **Tobacco** - tobacco product producers

The criteria used for selecting the firms representing each industry were: a) at least 70 per cent of total sales revenue of the firm was generated by the product or service category in question, b) the firm had not initiated Chapter Eleven Bankruptcy proceedings during the relevant period, and c) the common stock of each firm was publicly traded on the New York Stock Exchange.
The sales revenue criterion was established at 70 per cent by taking into account the trade off between a higher percentage, which would have eliminated the bulk of available firms, and a lower percentage, which would have introduced a bias. The more diversified the firm, the greater the possibility that the value of beta would be attributable to a division or product-line other than the one in question. To avoid the possibility of a firm's beta coefficient being adversely affected by the firm having filed for bankruptcy, only solvent firms were used; the purpose of this study is to establish the hypothesized relationship between the value of a firm's beta and the price elasticity of demand for its product, not between beta and other variables. Since Value Line uses the New York Stock Exchange Composite Index as a proxy for the average stock, the firms selected for the study must be traded on the New York Stock Exchange.

The number of firms used to represent each industry varied from four to thirteen due to the selection criteria employed. Some industries are more prone to diversification than others and hence few firms met the criteria while other industries, such as the domestic auto industry, are oligopolistic in nature. The men's and women's clothing industries tend to be more competitive, thus a greater number of firms were available to represent the industry.
Beta values were collected for the years 1972 - 1984 for each of the firms selected. Value Line began publishing beta values in 1972. The industry beta was generated by averaging the beta values for the individual firms representing each industry for each year in the survey period. The average was used to avoid loss of degrees of freedom in the few cases where there were missing values. Values were not published for every firm in each year.

Table II-A gives the industry average betas for food at home, food away from home, alcoholic beverages, men's and boy's clothing, and women's and girl's clothing. Table II-B is a continuation of Table II-A and gives the industry average betas for shoes, new domestic automobiles, air transportation, and tobacco. In the cases where there were missing values, the firm for which the value was missing was eliminated from the average for that particular year.
<table>
<thead>
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<th>Year</th>
<th>Food at Home</th>
<th>Food Away from Home</th>
<th>Alcoholic Beverages</th>
<th>Men's Clothes</th>
<th>Women's Clothes</th>
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<td>1.3133</td>
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<td>1.4067</td>
<td>0.9200</td>
<td>1.0436</td>
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<td>1.5500</td>
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<td>1.5833</td>
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<td>1977</td>
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CHAPTER BIBLIOGRAPHY


CHAPTER III

ESTIMATING THE PRICE-ELASTICITY OF DEMAND COEFFICIENTS

The purpose of this study is to determine if there is a relationship between the price-elasticity of demand for a good or service and the stock beta coefficient of an industry producing that good or service. To determine if there is a relationship, the simplest demand model possible is used. The price-elasticity of demand coefficients were generated using a linear demand function in the form of:

\[ Q_i = a_0 + a_1 P_i \]  

where \( Q_i \) is the quantity demanded of the \( i \)th product, \( a_0 \) is the intercept term, \( a_1 \) is the slope, and \( P_i \) is the price of the \( i \)th product. Price-elasticity of demand measures the change in quantity demanded in response to a change price so \( a_1 \), which is the slope term, is the price-elasticity of demand coefficient. The value of \( a_1 \) can be obtained by differentiating equation (1) with respect to price:

\[ \frac{\partial Q_i}{\partial P_i} = a_1 \]  

Changes in the Consumer Price Index were used as a proxy for changes in price. The most updated figures for each year were taken from the July issues of the Bureau of Labor Statistics Monthly Labor Review.
Equation (1) was not suitable for computational purposes due to a lack of available information on the dependent variable (quantity). Therefore, to confront the data, an expenditure function was used. Expenditures are price times quantity figures and equation (1) now becomes:

\[ M_i = (P_i)(Q_i) = a_{0i}P_i + a_{1i}P^2 \]  

where \( M_i \) is the expenditures on the ith product.

Differentiating equation (3) with respect to price to obtain the price elasticity of demand coefficient yields:

\[ \varepsilon_i = \frac{\partial Q_i/\partial P_i \cdot P_i}{Q_i} = \frac{a_{1i}P/a_{0i}}{a_{1i}P} \]

The expenditure data used was Personal Consumption Expenditures published in the July issues of the Survey of Current Business which comes from the National Income and GNP Accounts. The results of this model are shown in Table III.

All of the elasticities obtained from this model did vary over time. Each category also followed the law of demand in that the relationship between changes in price and quantity demanded was negative except in the case of women's clothing where a positive relationship was observed. This relationship could be due to many factors, such as changes in income or an increased number of women entering the labor force, which were not accounted for in this simple model.

The estimates of price elasticity of demand obtained from this model will suffer from simultaneous equation bias. The model itself is too broad and does not account for a lot of
interaction from other variables. In particular, this simple demand model does not directly deal the effects of changes in income.

However, the model does isolate the price effect which is of primary concern to this particular study. It also provides an elasticity coefficient that varies from period to period which is essential as the study is of a time series nature. Lastly, the simplicity of computation did provide the results needed to determine if further research on this topic will be worthwhile.
<table>
<thead>
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<th>Year</th>
<th>E2</th>
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<th>E7</th>
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<th>E9</th>
<th>E10</th>
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<td>-0.3129</td>
<td>-0.0806</td>
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<td>-0.2479</td>
<td>-0.5816</td>
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<td>-3.1731</td>
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CHAPTER IV

RESULTS OF SIMPLE REGRESSIONS

A simple regression was performed to test the relationship between the price elasticity of demand and the industry average beta coefficient. In every case except the alcoholic beverages industry there was a positive relationship between the movements in price elasticity of demand and beta coefficients. The degree to which changes in price elasticity of demand coefficients explained the variation in beta coefficients differed widely between industries.

The objective was not to develop a model which explained all of the variation of beta coefficients, but rather to establish whether or not a relationship exists between the price elasticity of demand and the industry average beta coefficient for a particular product or service. The main criteria to test this hypothesis was the probability that the parameter on price elasticity of demand was equal to zero. If this probability was relatively low, less than 0.05, then the chance of committing a Type I error was small enough to support the hypothesis that a relationship does indeed exist. As with any model, the true test of its strength or weakness is its predictive capabilities which is beyond the scope of
the present study. This is only the first step toward the development of a better predictor of beta.

The data for each of the nine industries for the period 1972 - 1984 was confronted with the following regression model:

$$\beta = v_0 + v_1 (\varepsilon_d) + e$$

where $\beta$ is the industry average beta coefficient (dependent variable), $v_0$ is the intercept term, $v_1$ is the slope, $\varepsilon_d$ is the price elasticity of demand coefficient (independent variable), and $e$ is the error term.

The relevant statistics are given for each industry in Table IV. Five statistics were of interest to this study. The model parameter estimates are listed in Columns 1 and 2. Column 1 lists the estimate of the intercept term ($v_0$) and Column 2 lists the estimate of the slope term ($v_1$) or the coefficient on the independent variable. The R-square, or coefficient of determination, is the square of the correlation coefficient for each model and is given in Column 3. The value for R-square implies, but does not prove, the causality between the independent (the price elasticity of demand coefficient) and the dependent (an industry average beta coefficient) variables. It can be regarded as a measure of linear association between the two variables or goodness of fit. The R-square gives a measure of how well the linear parameterized model explains the original variability in the
sample. In this study, it measures how well the variation in the price elasticity of demand coefficient explains the variation in an industry average beta coefficient.

Column 4 lists the probability of committing a Type I error, or rejecting that there is no relationship between the elasticity of demand coefficient and an industry average beta coefficient when in fact it is true. The final statistic listed in Column 5 is the Durbin-Watson statistic. Utilization of this statistic tests for the presence of first-order autocorrelation. Positive first-order autocorrelation is present when the error term in one time period is positively correlated with the error term in the previous time period. Positive first-order autocorrelation is common in time-series analysis and leads to downward-biased standard errors. (1, p. 183) Some level of positive autocorrelation was expected in this study as it is time-series in nature. The closer the Durbin-Watson is to a value of 2, the less the degree of autocorrelation. The presence of positive first-order autocorrelation was corrected for but the first lag was not found to be significant in any of the models. Other methods for correction will need to be employed in a further study. The regression results for each industry will be discussed in the next section.
<table>
<thead>
<tr>
<th>Industry</th>
<th>$\nu_0$</th>
<th>$\nu_1$</th>
<th>R-Square</th>
<th>Probability of Type I Error</th>
<th>Durbin-Watson</th>
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<tr>
<td>Food at Home</td>
<td>0.8704</td>
<td>0.0412</td>
<td>0.0144</td>
<td>0.6961</td>
<td>1.2437</td>
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<tr>
<td>Food Away from Home</td>
<td>1.6964</td>
<td>0.4951</td>
<td>0.7033</td>
<td>0.0003</td>
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<td>Alcohol</td>
<td>0.8517</td>
<td>-0.1616</td>
<td>0.2004</td>
<td>0.1251</td>
<td>1.0161</td>
</tr>
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<td>Men's Clothing</td>
<td>1.2459</td>
<td>2.5017</td>
<td>0.4434</td>
<td>0.0130</td>
<td>1.1733</td>
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<td>Women's Clothing</td>
<td>0.0033</td>
<td>0.6719</td>
<td>0.3244</td>
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<td>Shoes</td>
<td>0.9570</td>
<td>0.0342</td>
<td>0.0025</td>
<td>0.8702</td>
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<td>Autos</td>
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<td>0.1237</td>
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<td>0.0014</td>
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<tr>
<td>Airlines</td>
<td>1.5427</td>
<td>0.1273</td>
<td>0.8260</td>
<td>0.0001</td>
<td>0.8125</td>
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<tr>
<td>Tobacco</td>
<td>0.7745</td>
<td>0.0022</td>
<td>0.0002</td>
<td>0.9657</td>
<td>0.9923</td>
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</table>
Regression Results by Industry

The first regression was performed using the price elasticity of demand for food at home as the independent variable and an industry average of beta coefficients for grocery store chains as the dependent variable. The model yielded the following parameter estimates:

\[ \beta_2 = 0.8704 + 0.0412\varepsilon_2 \]

where the values in parantheses are the T-ratios. The model R-square was 0.0144 meaning that 1.44 per cent of the variation in the industry average beta coefficient was explained by the variation of price elasticity of demand. Apparently the elasticity of demand for food at home was not a major determinant of beta values for the grocery industry. The probability of the coefficient on \( \varepsilon_2 \) being equal to zero was very high at 69.61 per cent while the probability of the intercept term being zero was very low at 0.01 per cent. The intercept term obtained from the model was 0.8704 and the average beta for the industry over the time series was 0.8562 implying that the historic beta is most likely the best predictor of beta in the case of food purchased for home consumption. The small degree of variation (the standard deviation for the sample is 0.0216) present in the industry average beta values is responsible for this phenomenon.

The second regression was performed using the price
elasticity of demand for food away from home as the independent variable and an industry average of beta coefficients for fast food restaurants as the dependent variable. The model yielded the following parameter estimates:

\[ \beta_3 = 1.6964 + 0.4951\varepsilon_3 \]

\[
(21.54) \quad (5.106)
\]

where the values in parantheses are the T-ratios. The model R-square, or coefficient of determination, was 0.7033. In this case, 70.33 per cent of the variation in the industry average beta coefficient for selected fast food restaurants was explained by the variation in price elasticity of demand. The probability that the coefficient on \( \varepsilon_3 \) was zero was 0.03 per cent, or there is a very low probability of a Type I error. The intercept term was clearly significant at an alpha of 0.0001. There appears to be a strong relationship between the price elasticity of demand for food away from home and the beta coefficient for fast food restaurants. This could be partially a result of the small sample used. Only four firms were used to represent this industry due to the selection criteria discussed in Chapter II.

The third regression was performed using the price elasticity of demand for alcoholic beverages as the independent variable and an industry average of beta coefficients for brewers and distillers. The model yielded
the following parameter estimates:

\[ B_4 = 0.8517 + -0.1616v_4 \]
\[ (16.12) \] \[ (-1.660) \]

where the values in parantheses are the T-ratios. The coefficient of determination was 0.2004 and in this case 20 per cent of the variation in beta was explained by variation in the price elasticity of demand. The intercept term was significant but the probability of the parameter on the elasticity term being zero was 12.51 per cent and must be rejected at an \( \alpha = 0.05 \). The negative value could have been generated by a purely random process because the hypothesis that there is a relationship is rejected.

The fourth regression was performed using the price elasticity of demand for men's and boy's clothing as the independent variable and the industry average of beta coefficients for manufacturers and retailers of men's and boy's apparel as the dependent variable. The model yielded the following parameter estimates:

\[ B_5 = 1.2459 + 2.5017v_5 \]
\[ (13.55) \] \[ (2.960) \]

where the values in parantheses are the T-ratios. The model R-square was 0.4434 meaning that 44.34 per cent of the variation in the beta coefficient was explained by variation in the price elasticity of demand coefficient. In this case, the price elasticity of demand was a significant factor in the determination of beta. The probability that the relationship
between the price elasticity of demand for men's and boy's clothing and the industry average beta was not statistically significant is 0.0130. The intercept was statistically significant also with only a 0.01 per cent chance that it was in fact zero.

The fifth regression was performed using the price elasticity of demand for women's and girl's clothing as the independent variable and the industry average of beta coefficients for manufacturers and retailers of women's and girl's apparel as the dependent variable. The model yielded the following parameter estimates:

\[ \beta_6 = 0.0033 + 0.6719\varepsilon_6 \]

where the values in parantheses are the T-ratios. The coefficient of determination for the model was 0.3244 meaning that 32.44 per cent of the variation of the industry average beta was explained by variation in the price elasticity of demand. The probability of the intercept term being zero was 99.39 per cent, or the intercept term was statistically insignificant. In this case, the historic beta was not a good predictor of future beta. The probability that relationship between the beta coefficient and the price elasticity of demand coefficient was not statistically significant was 4.22 per cent.

The sixth regression was performed using the price elasticity of demand for shoes as the independent variable and
an industry average of beta coefficients for retailers and manufacturers of footwear as the dependent variable. The model yielded the following parameter estimates:

\[ \beta_7 = 0.9570 + 0.03416 e_7 \]

\[ (12.21) \quad (0.167) \]

where the values in parantheses are the T-ratios. The model R-square was 0.0025 implying that the price elasticity of demand was not a factor which determined the beta value for this industry. The intercept term was statistically significant but the probability there was not a relationship between the beta coefficient and price elasticity of demand was 0.8702.

The seventh regression was performed using the price elasticity of demand for new domestic automobiles as the independent variable and an industry average of beta coefficients for domestic automobile manufacturers as the dependent variable. The model yielded the following parameter estimates:

\[ \beta_8 = 1.1755 + 0.1237 e_8 \]

\[ (29.84) \quad (4.215) \]

where the values in parantheses are the T-ratios. The coefficient of determination for the model was 0.6176 meaning that 61.76 per cent of the variation in the industry average beta coefficient was explained by variation in the price elasticity of demand. The elasticity of demand for new cars appears to be a major determinant of beta values for the automobile industry. The probability of the coefficient on \( e_8 \)
being equal to zero was very low at 0.01 per cent and the chance that the intercept was statistically insignificant was also low at 0.014 per cent.

The eighth regression was performed using the price elasticity of demand coefficients for airline transportation as the independent variable and an industry average of beta coefficients for commercial airline passenger companies as the dependent variable. The model yielded the following parameter estimates:

\[ b_9 = 1.5427 + 0.1273\varepsilon_9 \]

\[
\begin{array}{l}
(62.19) \\
(7.225)
\end{array}
\]

where the values in parantheses are the T-ratios. The model R-square was 0.8260 or changes in the price elasticity of demand explained 82.60 per cent of the variation in beta coefficients. The probability of either the intercept or the coefficient the price elasticity of demand being zero was only 0.01 per cent. This model implies that there was a very strong relationship between the dependent and independent variables.

The tenth, and final, regression was performed using the price elasticity of demand coefficients for tobacco products as the independent variable and an industry average of beta coefficients for producers of tobacco products as the dependent variable. The model yielded the following parameter estimates:
\[ \beta_{10} = 0.7745 + 0.0022 \varepsilon_{10} \]

(18.01) (0.044)

where the values in parantheses are the T-ratios. The model R-square was 0.0002 implying that the elasticity of demand for tobacco products was not a determinant of the value of beta for the tobacco industry. The probability that the relationship between the price elasticity of demand and an industry average beta coefficient was not statistically significant was 96.57 per cent. Not only does it appear that \( \varepsilon_{10} \) does not explain \( \beta_{10} \), but it also appears that there is not a relationship between the two. The probability of the intercept being equal to zero was only 0.01 per cent.
CHAPTER V

CONCLUSIONS

The results of this study were very promising in some areas and very weak in others. The hypothesis that an identifiable relationship exists between the price elasticity of demand for a good or service and the value of the beta coefficient for a firm or industry providing that good or service cannot be accepted unequivocally. However, there did appear to be a strong relationship in several cases and the price elasticity of demand was a major determinant of the beta for the fast food restaurant industry, the airline industry, and the automobile industry.

The results can be broken down into three basic groups: those industries for which there seemed to be no relationship, those industries where there was a fairly strong probability that a relationship does exist and the price elasticity of demand explains at least part of the variation in beta coefficients, and those industries where there was a very high probability that a relationship does indeed exist and the variation in the price elasticity of demand coefficients substantially explained the variation in the industry average beta coefficients.
The first group includes food at home, shoes, and tobacco. In all three cases the probability of a relationship existing between the price elasticity of demand and the industry average beta coefficient was less than 31 per cent. The variation in the price elasticity of demand explained less than 2 per cent of the variation in the industry beta coefficients for each of the three industries. There are several possible reasons this. One reason could be the nature of the industries themselves. These three industries are ones represented by several strong and long standing corporations. The industry average beta values tended to be fairly stable over the time series while the price elasticity of demand coefficients were highly volatile. However, this could be due to failings in the elasticity model itself. According to accepted economic thinking, a relatively inelastic demand should be associated with each of these products and the demand would not be expected to vary drastically over time. A more explanatory demand model needs to be employed to determine if indeed there is no relationship between the elasticity and beta coefficients for these three industries.

The second group includes the alcoholic beverages, the men's and boy's clothing, and the women's and girl's clothing industries. In each case, the variation in the price elasticity of demand coefficient explained at least 20 per
cent of the variation in the industry average beta coefficient. The probability that the relationship between the two variables is not statistically significant was less than 12.5 per cent for these three industries. Both the men's and women's clothing industries are characterized by a very large number of highly competitive firms with a relatively easy access to entry into the industry. Better results may be obtained if those firms that leave the industry were included in the list of representative firms for the industry. Changing conditions in the economy may have an impact on the marginal firms in the industry that would be reflected in the beta coefficients for the industry. The firms chosen displayed relatively stable beta coefficients while once again the elasticity of demand coefficients were volatile, except in the case of women's and girl's clothing. Not only was the demand curve for women's clothing upward sloping but the demand coefficients obtained were much more stable over the time series for this particular industry than any of the other industries. While the results were not conclusive, they did indicate that further study would be worthwhile.

The third group includes food away from home, air transportation, and new domestic automobiles. In each case, the variation in the price elasticity of demand coefficient explained at least 61.76 per cent of the variation in the industry average beta coefficient. The probability that the
relationship between the two variables is not statistically significant was less than 0.03 per cent for these three industries. The industry average beta coefficients for this group were relatively volatile over the time series as were the price elasticity of demand coefficients. This is the extreme test of the hypothesis that a relationship exists between the price elasticity of demand and the beta coefficient. Statistically, the probability of a correlation between two volatile series of data randomly occurring is minimal. The fact that a strong relationship was observed in these industries supports the original hypothesis.

Directions for Further Study

The results of this study open up many avenues for further research. The first and most obvious path to follow would be to explore alternate demand models that meet the criteria of an elasticity of demand coefficient that varies over the time series. A more rigorous demand model that incorporated such variables as changes in income, the rate of inflation, and demographic factors such as population would possibly shed more light on the relationship between the price elasticity of demand and beta coefficients.

Another possibility would be to widen the scope of the study by collecting and employing data on a quarterly basis. The increased number of observations would not only increase
the degrees of freedom and lend credence to the results, but it would also make it possible to determine how quickly changes in elasticity affect beta values by using a lagged model. Additionally, running regressions on individual firm beta values rather than an industry average beta values would also broaden the scope of the study.

One of the major sources of bias in the model employed was the presence of autocorrelation in the error term. Techniques for correcting this bias should be applied in a future study.

**Major Implications of the Study**

Assuming that a predictable relationship exists between the price elasticity of demand for a good or service and the beta coefficient for a firm or industry providing that good or service, not only would the individual investor be in a better position to more accurately diversify his investment portfolio, but it may also aid in predicting overall stock market behavior which is an indicator of economic events.

In the past, beta has been forecasted based primarily on historic values. The incorporation of consumer behavior into the model extends explanatory power. It builds changing economic conditions into the determination of the level of risk associated with a given stock or industry relative to the market.
BIBLIOGRAPHY

Books


Articles


