An Econometric Model of a Firm's Financial Statements

Otávio Ribeiro de Medeiros*

ABSTRACT

This paper reports the construction and testing of an econometric model designed to represent a firm's financial statements. More specifically, the paper aims at showing how a firm's financial statements can be empirically explained by means of a simultaneous equations structural model connecting macro and microeconomic (market) variables with accounting variables. We also present forecasts for the financial statements. The firm to which the model is applied is a monopoly in the Brazilian domestic market for petroleum products and the largest Brazilian firm in operation. The results obtained are consistent with the expectations associated to the structural model. Applications stemming from the study include financial analysis, forecasting and planning, as well as firm valuation.

Key words: econometric model, accounting, financial statements, Brazilian firm.

1. Introduction

The relationship between economics and corporate finance is often recognized in the relevant literature. For instance, Ross et al. (1993) have argued that financial planning requires sales forecasts, but that it is impossible to make accurate forecasts since sales depend on the uncertain future behavior of the economy. It is added that, in order to reduce this uncertainty, firms can get help from consultants specialized in macroeconomic and industry sector forecasting. A consequence of this is that it should be possible to capture the impact of macroeconomic and industry sector or market variables on accounting variables such as sales revenues. Because other accounting variables such as current and fixed assets depend on sales, as argued by Van Horne (1972), the effect of economic variables must also be noticeable in balance sheets and income statements. The economic variables most likely to affect a firm's financial statements are the GDP, inflation, interest and exchange rates, and exogenous commodity prices.

There are some empirical studies explaining accounting relationships. One example is Stowe et al. (1980), with an empirical study using canonical correlation to analyze the relationships between the two sides of the balance sheet, based on the hypothesis that investment decisions are taken separately from financing decisions. Their major results indicate that the firms observed tend to adjust the maturity of their assets to that of their liabilities. In another example, Marsh (1982) has shown in a study carried out in the UK that the firms are strongly influenced by market conditions and by the history of stock prices, when choosing between equity and debt. It was found out that the firms seem to make their choice of financial instruments having in mind debt targets, which are established as a function of firm size, bankruptcy risk, and asset composition.

There is a different kind of empirical study focusing particular industry sectors or commodity markets, which are a long tradition in applied econometrics (Adams and Behrman, 1976; Banks, 1974; Fisher et al., 1972; Wickens, 1980). In general, these models

* Associate Professor, Universidade de Brasilia, Brazil.

show the relationships between exogenous economic variables, such as GDP, interest rates, exchange rates, and so on, and endogenous variables such as supply, demand and price, besides the interactions between these.

It seems there is a gap between those econometric market studies and empirical analyses on the behavior of accounting variables belonging to firms that operate in those markets. Nevertheless, we suppose that studies connecting economic market variables to a firm's accounting variables, together with the re lationships between the accounting variables, would be useful for explaining empirically a firm's financial statements. For these reasons, this paper is primarily concerned with providing an empirical explanation for the relationships between economic and accounting variables. A second purpose is to test empirically the causal relationships between variables inside the financial statements, as mentioned in the previous paragraph. Finally, there is also the objective to test the use of econometric models as instruments for the testing of hypothesis on accounting relationships and for financial forecasting.

To reach these purposes, a simultaneous equations model was developed, based on theoretical economic and accounting relationships. The model is divided into three interconnected subsystems or blocks. The first one refers to a commodity (petroleum) market; the second one refers to the income statement, and the third one to the balance sheet of a firm operating in that commodity market. In the income statement, there are three variables: gross revenues, total costs, and net earnings. The balance-sheet variables are aggregated into blocks. In the assets side, there are the current assets, long-term receivables, and fixed assets. In the liabilities side, there are the current liabilities, and the capital resources, composed by the long-term debt and equity. Balance sheet and income statement variables relate with each other and with the market variables demand, supply and price, which in turn are explained by exogenous economic variables: the country's GDP, the exchange rate, and the price of an important international commodity, petroleum.

The remaining sections of the paper present model specification, data description, empirical results, forecasts, and conclusion.

2. Model Specification

A structural simultaneous linear-equations model was developed, where the structural equations have the following general form:

$$Y_t = \mu_0 + \mu_1 X_{1t} + \mu_2 X_{2t} + \ldots + \mu_n X_{nt} + u_t \, , \qquad (2.1)$$

where Y_t is the dependent variable, X_{it} ($i = 1, \ldots, n$) are independent variables, u_t is the error term, μ_i ($i = 0, \ldots, n$) are coefficients, and the subscript t refers to time. Besides the structural equations, some other equations in the model are accounting identities or mathematical relationships.

The model is composed of three interlinked blocks: a block explaining how the market variables (demand, supply and price) interact and how they are affected by exogenous variables; a second block showing the determination of the income-statement variables (gross revenue, costs and net earnings); and a third block demonstrating how the balance-sheet variables are determined. After a procedure where alternative formulations were tested, the equations were finally specified as follows.

2.1. The Brazilian petroleum market

The market under analysis is the domestic market for petroleum products in a particular country, and the firm under study is a state-controlled monopoly within this market. The market variables are demand, supply, and the price of petroleum products.

The consumption or demand for petroleum products (*DEMAND*) was specified as a traditional demand function, determined according to theory by the price of the product, that is, the domestic average price of petroleum products (*DPRICE*) and by the country's income level, represented by Brazil's GDP. The demand function must be declining with respect to the price and ascending with respect to the *GDP*. Therefore

$$DEMAND_t = \alpha_0 + \alpha_1 \cdot DPRICE_t + \alpha_2 GDP_t + u_{1t}, \quad \alpha_1 < 0,\ \alpha_2 > 0 \qquad (2.2)$$

On the other market side, supply of petroleum products (*SUPPLY*) is assumed to be a function which increases with *DPRICE* and decreases with the variable resulting from the product *IPRICE* × *EXRATE*. *IPRICE* stands for the international price of petroleum and *EXRATE* for the exchange rate between the US dollar and the Real. The first economic reason for this formulation is that a monopolist firm faces a downward sloping demand curve and possesses an upward sloping supply curve, and it decides for the price × supply combination that maximizes its profit. The second is that the firm adjusts supply and/or the domestic price of petroleum products (*DPRICE*) according to movements in the international price of petroleum (*IPRICE*) and/or in the exchange rate (*EXRATE*):

$$SUPPLY_t = \beta_0 + \beta_1 \cdot DPRICE_t + \beta_2 \cdot (IPRICE_t \cdot EXRATE_t) + u_{2t},\ \beta_1 > 0,\ \beta_2 < 0. \qquad (2.3)$$

An identity is necessary for the equilibrium condition, where supply equals demand:

$$SUPPLY_t \equiv DEMAND_t \qquad (2.4)$$

This part of the model reproduces the basic relationships in a supply-demand market. This can be found abundantly in the economic and econometric literature (Wallis, 1973; Kmenta, 1971; Dhrymes, 1970; Greene, 2002), as well as in various empirical studies dedicated to specific commodities markets (Adams and Behrman, 1976; Banks, 1974; Fisher et al, 1972; Wickens, 1980). The determination of demand, supply, and price is the result of this block. These variables are essential for the determination of the income-statement and the balance-sheet accounts. The variables *DEMAND*, *SUPPLY* and *DPRICE* are endogenous, while *GDP*, *IPRICE* and *EXRATE* are exogenous.

2.2. Income Statement

The next step is to deal with variables and relationships that belong to the income statement. The gross revenues (*REVENUE*) result from the multiplication of the physical volume of sales (*SUPPLY*) times the local average sale price (*DPRICE*) of the product mix, that is, the average price of all the petroleum products consumed in the country each year:

$$REVENUE_t = DPRICE_t \cdot SUPPLY_t \qquad (2.5)$$

The variable *COST*, meaning total costs and expenses, is a function of the output (*SUPPLY*) and of the cost of the inputs. Given the impossibility of obtaining costs for the diverse inputs used in production, the price of the most relevant input, *i.e.* the international price of petroleum (*IPRICE*), was used as a proxy. This is obviously an exogenous variable. In view that such price has to be converted into the local currency, is necessary to multiply it by the real exchange rate (*EXRATE*), which is the exchange rate deflated by the general price index:

$$COST_t = \gamma_0 + \gamma_1 SUPPLY_t + \gamma_2 (IPRICE_t \cdot \ EXRATE_t) + u_{3t}, \ \ \gamma_1 > 0, \ \gamma_2 > 0. \quad (2.6)$$

Net earnings (*EARNINGS*) are obtained by subtracting total costs and expenditures (*COST*) from gross revenues (*REVENUE*).

$$EARNINGS_t \ = \ REVENUE_t - COST_t \qquad (2.7)$$

The variables in this block are *REVENUE*, *EARNINGS* and *COST*, which are endogenous, besides *IPRICE* and *EXRATE*, which are exogenous.

2.3. Balance sheet

With respect to the balance-sheet variables, *CURRENT ASSETS* are assumed to keep a direct and positive relationship with gross revenues (*REVENUE*), since the larger the revenue, the higher will be the investment in short-term assets (cash, inventories and accounts receivable, etc):

$$CURRENT\ ASSETS_t = \delta_0 + \delta_1 \cdot \ REVENUE_t + \ u_{4t}, \quad \ \delta_1 > 0. \qquad (2.8)$$

The specification of *FIXED ASSETS* is derived from the economic theory. More specifically, it comes from the theory of investment proposed by Jorgenson (1963), which is based on the neoclassical theory of optimal capital accumulation. In this work, the partial adjustment model is used in order to build a dynamic specification. The partial adjustment model was first applied in the mid-fifties by Cagan (1956), in his study of hyperinflation, and by Nerlove (1958), in connection with the dynamics of agricultural supply.

The partial adjustment hypothesis states that the real investment is a fraction of the investment necessary to reach the stock of desired capital. If the real investment is given by $I_t = K_t - K_{t-1}$, where K_t it is capital stock in period t, then

$$K_t - K_{t-1} = (1-\lambda) \cdot (K_t^* - K_{t-1}) \qquad (2.9)$$

where K_t^* it is the desired capital stock. Assuming that the capital-output relationship determines the desired capital stock, then

$$K_t^* = \alpha \cdot Y_t \qquad (2.10)$$

where α is the capital-output relation (constant) and Y_t is output. It stems from equations (2.9) and (2.10) that

$$K_t = \alpha \cdot (1-\lambda) \cdot Y_t + \lambda \cdot K_{t-1} \qquad (2.11)$$

where α and λ are constant parameters. Therefore, capital stock in a certain period is determined by the output level (supply) and by capital stock in the previous period. Translating into accounting terms, this means that *FIXED ASSETS* are an increasing function of the output (*SUPPLY*) and of lagged *FIXED ASSETS*. Thus, the equation that describes the determination of the fixed asset is:

$$FIXED\ ASSETS_t = \chi_0 + \chi_1 SUPPLY_t + \chi_2 FIXED\ ASSETS_{t-1} + u_{5t}, \chi_1 > 0\ ,\ \chi_2 > 0. \qquad (2.12)$$

Long-term receivables (*LT RECEIVABLES*) is the plug variable, being determined by the difference between total liabilities and current plus fixed assets.

With respect to the liabilities side, several authors (Gitman, 1994; Ross et al., 1993; Van Horne, 1972) have sustained that in general firms endeavor to match the maturity of their liabilities with that of their assets. This is called the hedging approach to financing, in which each asset should to be matched by a financing instrument with the same approximate maturity. Actually, the idea is that firms use long-term resources to finance not only their fixed assets but also the permanent portion of their working capital, *i.e.* their current assets minus their current liabilities. As mentioned previously, Stowe et al. (1980) have shown evidence that firms behave like this, in a study carried out in the US.

On the other hand, despite Modigliani and Miller's (1958) propositions, the static trade off theory and the pecking order theory, a final word on which is the best way to explain capital structure has not been reached yet. Regardless of this, firms certainly do not choose between equity and debt randomly, but in accordance to certain criteria. For simplicity, instead of trying to model equity and debt separately, we tried to explain the dependent variable *CAPITAL RESOURCES*, which is the sum of equity and long-term debt as:

$$\begin{aligned} &CAPITAL\ RESOURCES_t = \eta_0 + \eta_1 \cdot FIXED\ ASSETS_t + \\ &+\eta_2 \cdot CAPITAL\ RESOURCES_{t-1} + u_{6t}, \quad \eta_1 > 0,\ \eta_2 > 0. \end{aligned} \qquad (2.13)$$

For *CURRENT LIABILITIES*, the assumption adopted was that it is determined by *CURRENT ASSETS*, reflecting the hypothesis that the firm keeps a certain proportion between its short-term liabilities and its short-term assets:

$$CURRENT\ LIABILITIES_t = \phi_0 + \phi_1 \cdot CURRENT\ ASSETS_t + u_{7t},\ \phi_1 > 0 \qquad (2.14)$$

Besides the structural equations (2.8), (2.12), (2.13) and (2.14), there are inside the balance-sheet block the accounting identities below:

$$TOTAL\ ASSETS_t \equiv CURRENT\ ASSETS_t + LT\ ASSETS_t + FIXED\ ASSETS_t \qquad (2.15)$$

$$TOTAL\ LIABILITIES_t \equiv CURRENT\ LIABILITIES_t + CAPITAL\ RESOURCES_t \qquad (2.16)$$

$$TOTAL\ ASSETS_t \equiv TOTAL\ LIABILITIES_t \qquad (2.17)$$

LT ASSETS stands for the amount of long-term assets not belonging to fixed assets, and which is mainly made up of long-term receivables. It is a "plug" variable, determined by the difference between total liabilities and the sum of current assets and fixed assets.

The endogenous dependent variables in the balance-sheet block are *CURRENT ASSETS, FIXED ASSETS, LT ASSETS, TOTAL ASSETS, CURRENT LIABILITIES, CAPITAL RESOURCES,* and *TOTAL LIABILITIES.*

3. Data Description

The model was applied to Petrobras, a near monopolist firm in the Brazilian domestic market for petroleum products[1]. The data are annual and come from annual balance sheets and income statements from 1991 to 2001. These statements were obtained from Economatica's database[2]. The equations were estimated by two-stage least squares (2SLS), in order to prevent biased and inconsistent parameters due to endogenous explanatory variables. The data referring to the international price of petroleum is the Dubai price in US$/barrel, obtained from the British Petroleum's website. All the accounting data were deflated by the Brazilian general price index (IGP-DI) and transformed into index numbers (1991=100) prior to estimation. The estimated equations are in the following section.

4. Empirical Results

This section presents the results of the model estimation. Prior to estimating the system's equations, the ADF – Augmented Dickey-Fuller test for unit roots was applied to the series, with the null of a unit root being rejected for all series. The estimated equations are shown together with their R^2 coefficients and t-statistics, with the latter between parentheses below each estimated coefficient.

4.1. The market

The first equation in this system represents the national *DEMAND* for petroleum products:

$$DEMAND_t = \underset{(1.02)}{23.42} - \underset{(-4.67)}{0.33} \cdot DPRICE_t + \underset{(5.39)}{0.16} \cdot GDP_t, \qquad R^2 = 0.82 \qquad (4.1)$$

Equation (4.1) is in total agreement with the economic theory: the coefficient corresponding to *DPRICE* is negative whereas the one corresponding to *GDP* is positive. *DEMAND* is inelastic with respect to price and income, as shown by the average price-elasticity and income-elasticity of 0.334 and 0.157, respectively. This is an expected outcome, since petroleum products are essential goods. The expression (4.2) below is an equation representing the *SUPPLY* of petroleum products, with the sale price of those products as the dependent variable, such as in Wallis (1973). This is done to prevent multicollinearity resulting from a high correlation coefficient (0.87) between the explanatory variable *DPRICE* and (*IPRICE* x *EXRATE*), which would cause loss of precision in the estimation of the coefficients.

$$DPRICE_t = -\underset{(-1.46)}{152.38} + \underset{(1.67)}{1.15} \cdot SUPPLY_t + \underset{(4.68)}{1.62} \cdot (IPRICE_t . EXRATE_t), \qquad R^2 = 0.71 \qquad (4.2)$$

Equation (4.2) can be rearranged to have *SUPPLY* as the dependent variable:

$$SUPPLY_t = 132.5 + 0.87 DPRICE_t - 1.40 (IPRICE_t \cdot EXRATE_t) \qquad (4.3)$$

[1] Petrobras is the largest Brazilian firm and it is ranked 160 in the Fortune Global 500 (2001).
[2] Economatica is a Brazilian firm maintaining a large database of accounting corporate data.

Equation (4.3) also matches the underlying economic theory. *SUPPLY* changes in the same direction of the product price. Besides, an increase in the international price of petroleum or in the exchange rate causes an increase in the domestic price of petroleum products (*DPRICE*) or in a reduction of *SUPPLY*. The t-test null hypothesis that the parameter associated with *SUPPLY* is equal the zero is rejected at the level of 0.08. This implies that, although Petrobras is virtually a state-owned monopoly, its prices have not been controlled or fixed by the government, meaning that it operates as a private monopoly. Otherwise, if the hypothesis that the parameter referring to *SUPPLY* is equal to zero was accepted, then *DPRICE* would be predetermined for the firm, meaning that it had no monopoly power.

4.2. Income statement

The cost equation shows that the total cost increases according to the level of *SUPPLY* and to the international price of petroleum multiplied by the exchange rate, as expected.

$$COST_t = -165.9 + 1.54 SUPPLY + 1.35(IPRICE_t \cdot EXRATE_t), \qquad R^2 = 0.71 \qquad (4.4)$$

Equation (4.4) is the only one that needs to be estimated in this block, since gross revenues (*REVENUE*) is a result of *PRICE* multiplied by *SUPPLY*, and net earnings (*EARNINGS*) are obtained from *REVENUE* minus *COST*. A discussion is needed on the fact that the sign of the intercept is negative. As put forward by Belkaoui (1987), although it might be tempting to interpret the intercept as the total fixed cost, this is not correct, unless the sample contains data next to the level of zero output, since the linear regression fit changes as the used sample is altered. Moreover, as shown by Baumol (1977) and Horngren (1972), possibly the total cost curves are not actually linear. Thus, another explanation for the negative intercept is that by extending the estimated regression line towards the origin a false negative intercept is shown.

4.3. Balance sheet

The estimated equations relative to the balance sheet are shown below.

$$CURRENT\ ASSETS_t = \underset{(-1.89)}{-57.9} + \underset{(4.52)}{0.96} REVENUE_t, \qquad R^2 = 0.65 \qquad (4.5)$$

According to equation (4.5), *CURRENT ASSETS* can be explained by *REVENUE*, as previously specified.

$$FIXED\ ASSETS_t = \underset{(-1.75)}{-49.8} + \underset{(2.57)}{0.41} SUPPLY_t + \underset{(6.24)}{1.03} FIXED\ ASSETS_{t-1}, \qquad R^2 = 0.86 \qquad (4.6)$$

Equation (4.6) confirms the hypothesis that the capital stock in a certain period is explained by *SUPPLY* and by capital stock of the previous period, as supported by the applicable economic theory.

$$CURRENT\ LIABILITIES_t = \underset{(3.91)}{75.00} + \underset{(2.55)}{0.60} CURRENT\ ASSETS_t, \qquad R^2 = 0.48. \qquad (4.7)$$

Equation (4.7) shows that *CURRENT LIABILITIES* are determined by *CURRENT ASSETS*, plus a constant term. The problem here is that although the estimated coefficients are significantly different from zero by the t-test, the R^2 obtained is low, which could be indicating that one or more explanatory variables are missing. The introduction of a time-trend variable raises R^2 to 0.75, and produced a high value for the t-statistic (2.62), but this was disregarded, due to the lack of a consistent economic justification. Other variables were tested (lagged current assets and lagged current liabilities) without satisfactory results.

$$\begin{aligned} &CAPITAL\ RESOURCES_t = \underset{(-1.55)}{-20.71} + \underset{(1.82)}{0.43}\, FIXED\ ASSETS_t \ + \\ &+ \underset{(3,95)}{0.83}\, CAPITAL\ RESOURCES_{t\text{-}1}, \quad R^2 = 0.94. \end{aligned} \tag{4.8}$$

Equation (4.8) supports that the long-term capital resources used by the firm, *i.e.*, the sum of equity and debt, can be explained by *FIXED ASSETS* and lagged *CAPITAL RESOURCES*, which confirms the original specification.

As mentioned earlier, *LT ASSETS* is the "plug" variable, being determined by the difference between *TOTAL LIABILITIES* and the sum of *CURRENT ASSETS* and *FIXED ASSETS*.

5. Forecasts

An outcome of the regression results is the forecasting of the financial statements. Forecasts for the market variables (*DEMAND*, *SUPPLY* and *DPRICE*) are obtained through the solution of the supply-demand block. The determination of the other endogenous dependent variables occurs sequentially, according to the estimated equations shown in the previous section.

For carrying out the financial forecasts, projections of the exogenous variables are necessary. An economic scenario was adopted for the period 2002-2004. In this scenario, the international oil price (*IPRICE*) increases by 3% in 2002 and by 2% in the subsequent years, in US$. The domestic GDP grows by 1.5% in 2002, 2.5% in 2003, and 4.0% in 2004. The nominal exchange rate reaches 3.5 R$ per US$ in 2002, and rises by 5.0% in 2003, and by 2.0% in 2004, respectively, in real terms. By substituting these values into the proper equations, pro-forma balance sheet and income statement forecasts referring to 2002-2004 were obtained. Such forecasts are shown in Table 1, together with the 2001 actual data. Figures were converted into US$ at the exchange rate of 2.32, which refers to 12/31/2001.

6. Conclusion

The econometric model here specified and tested looks statistically significant and, in general, its results seem to be in accordance with the underlying economic and accounting theories. The relevant parameters obtained in the regressions are significant by the Student's t-test, and have the signs foreseen in the model specification. The R^2 coefficients are satisfactory, ranging from 0.48 to 0.94.

Therefore, the results seem to point out that it is possible to explain a firm's financial statements by means of the impact of macro and microeconomic variables, together with the interaction between the accounting variables. The study also shows that the firm analyzed seems to pursue a financial equilibrium situation, using long-term capital resources to finance its permanent assets. The main restriction to the study might be the degree of aggregation adopted. As seen, we have not aimed at explaining more detailed accounting variables inside the blocks. This was done deliberately for the sake of simplicity and to avoid dealing with a model that would be too large for handling and interpreting.

Balance Sheet	2001	2002	2003	2004
Assets				
Current Assets	14,696.55	15,079.45	16,163.80	17,742.79
Long-Term Assets	5,062.06	6,546.80	6,629.84	5,940.87
Fixed Assets	12,793.10	12,212.27	11,532.94	10,908.79
Total Assets	32,551.72	33,838.53	34,326.59	34,592.46
Liabilities				
Current Liabilities	9,469.39	10,144.87	10,559.92	11,164.31
Capital Resources	23,082.32	23,693.66	23,766.67	23,428.15
Total Liabilities	32,551.72	33,838.53	34,326.59	34,592.46
Income Statement				
Gross Revenues	34,607.75	35,765.56	37,669.42	40,441.74
Costs & Expenses	(30,334.48)	(33,404.79)	(35,475.60)	(37,428.36)
Net Earnings	4,273.27	2,360.77	2,193.81	3,013.38

Table 1: Financial statements: actual (2001) and forecasts (2002-2004) in US$ million.

It should also be taken into account that since the chosen firm is a monopoly, it has certain peculiarities, which make the study in question a singular case. Therefore, it becomes necessary, in due time, to expand and test the methodology using other kinds of firms, in order to achieve more generalized conclusions.

Finally, we expect that the results here obtained might inspire the development of further empirical research on the relationships between economics and accounting.

7. References

ADAMS, F. G and BEHRMAN, J.R. *Econometric Models of World Agricultural Commodity Markets*. Cambridge, Mass.: Ballinger, 1976.

BANKS, F.E. *An Econometric Analysis of the Copper Market*. Cambridge, Mass.: Ballinger, 1974.

BAUMOL, W. (1977). *Economic Theory and Operations Analysis*. Englewood Cliffs, NJ: Prentice-Hall, 1977.

BELKAOUI, A. (1987). *Quantitative Methods in Accounting*: *A Procedural Guide for Professionals*. New York: Quorum Books, 1987.

BRITISH PETROLEUM. www.bp.com/downloads/1086/bp_stats_history.xls.

CAGAN, P. (1956). The monetary dynamics of hyperinflation. In: FRIEDMAN, M. ed. *Studies in the quantity theory of money*. Chicago: The University of Chicago Press (1956).

DHRYMES P. J. *Econometrics*. New York: Harper, 1970.

ECONOMATICA. Brazilian corporate database. www.economatica.com.br.

FISHER, F. M., COOTNER, P. H. and BAILY, M. N. An Econometric Model of the World Copper Industry. *Bell Journal of Economics and Management Science*, 3(2), 568-609, 1972.

GITMAN, L. J. *Principles of Managerial Finance*. 7th Ed. New York: HarperCollins, 1994.

GREENE, W. H. *Econometric Analysis*. 5th Ed. Upper Saddle River: Prentice Hall, 2002.

HORNGREN, C. T. (1972). *Cost Accounting*. 3rd Ed. London: Prentice Hall International, 1972.

JORGENSON, D. W. Capital Theory and Investment Behavior. *American Economic Review*, 53, 247-259, May 1963.

KMENTA, J. *Elements of Econometrics*. New York: MacMillan, 1971.

MARSH, P. The Choice Between Equity and Debt: An Empirical Study. *The Journal of Finance*, Vol. XXXVII, No. 1, March 1982.

MODIGLIANI, F. and MILLER, M. H. The Cost of Capital, Corporation Finance, and the Theory of Investment", *The American Economic Review*, 48, 261-297, 1958.

NERLOVE, M. (1958). *Distributed Lags and Demand Analysis*. Washington, DC. US Department of Agriculture, Agriculture Handbook, No. 141, 1958.

ROSS S.A., WESTERFIELD R.W., and JAFFE, J.F. *Corporate Finance*, 3rd Ed. New York: McGraw-Hill, 1993.

STOWE, J. D., COLLIN, J. W., and ROBERTSON, T. D. Relationships between the Two Sides of the Balance Sheet: A Canonical Correlation Analysis, *The Journal of Finance*, vol. XXXV, No. 4, September 1980.

VAN HORNE, J.C. *Financial Management and Policy*. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall, 1972.

WALLIS, K. F. *Topics in Applied Econometrics*, London: Gray-Mills, 1973.

WICKENS, M. R. An Aggregate Econometric Model of the World Copper Market. *Metals and Mineral Research*. London, 1980.