MARKET PERFORMANCE OF THE SÃO PAULO STOCK EXCHANGE

By

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ABSTRACT

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There were four main objectives of this research: (1) to build a machine-readable data base of security-price information for securities traded at the São Paulo Stock Exchange in the past decade; (2) to analyze the rates of return for common and preferred stocks traded for the period covered by the study; (3) to reproduce the tests of validity of the capital-asset-pricing model developed by Black, Jensen, and Scholes and by Fama and MacBeth with new data and to compare and contrast the findings; and (4) to determine the relationship between inflation and returns from risky assets in an indexed economy. Information about 395 stocks was collected from 203 companies for a 10-year period (1970-79).

From the comparison between a value-weighted index and an equally weighted index, the conclusion was reached that small companies did better than larger ones. The BOVESPA index, despite its construction bias, seemed to be a reasonable representation of the market.

Common stocks did better than preferred, as was exepcted, except during the bull market of 1971. An analysis of rates of

return for 210 investment strategies showed that investment in the stock market was not a good hedge against inflation.

The results of the test procedure of Black, Jensen, and Scholes did not show a linear relationship between risk and return. However, because of bias introduced in this test, it was not possible to conclude that the relationship between risk and return was not linear. Nor was it possible, from the results of the procedure of Fama and MacBeth, to reject the hypothesis that the relationship between risk and return was linear. Neither could the hypothesis be rejected that beta was a complete measure of risk. Despite the fact that the coefficients of beta were greater than zero, they were not statistically significant. Therefore, no statistically observable positive relationship between expected real return and risk was found. In addition, no statistically significant relationship was found between real return and anticipated inflation, unanticipated inflation, or total inflation as could be expected in an indexed economy.

Those friends who live share with me the happiness of this achievement. Therefore, this work is dedicated to the memory of my friend, Waldemar Rodrigues Alves.

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CHAPTER I

THE CAPITAL MARKET OF BRAZIL

Historical Background

The 1964 political revolution in Brazil caused deep alterations in the economy, particularly in the capital market. In order to give a background for this reorganization, a description of the market in the period before 1964 is presented below. The Brazilian economy grew very quickly after the Second World War. From 1947 to 1956, growth rates of the gross national product were about 6.4 percent per annum, and the industrial sector expanded about 8.2 percent per annum. After 1956, economic growth accelerated because of a policy of rapid industrialization in the sectors of consumer and capital goods. The gross national product showed a growth rate of more than 8 percent per annum from 1957 to 1961, and the industrial sector expanded by more than 10 percent per annum (see Table 1.1).[1]

Although the economy grew rapidly, lack of an adequate structure in the capital market provoked severe distortions. There were no savings-transference mechanisms between savers and investors. Inflation was quite high, though not as high as at the present time

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[1] Francisco Vidal Luna and Thomaz de Aquino Nogueira Neto, "Indexation and Capital Market" (paper presented by the São Paulo Stock Exchange to the Fifth General Assembly of the Ibero-American Federation of Stock Exchanges, Buenos Aires, Argentina, 1978).

(see Table 1.2). A usury law existed that forbade interest on savings of over 12 percent per annum. Therefore, real interest paid to savers was negative, provoking a severe disincentive to investing funds in fixed-income paper.

Table 1.1.--Gross national product.

Year	Value x 10^6 1964 Prices	Variation (in %)	Industrial Growth (in %)
1947	8,047	...	...
1948	8,657	7.5	...
1949	9,237	6.7	...
1950	9,831	6.4	11.3
1951	10,413	5.9	6.4
1952	11,327	8.8	5.0
1953	11,606	2.5	8.7
1954	12,780	10.1	8.6
1955	13,655	6.8	10.6
1956	14,092	3.2	6.9
1957	15,225	8.0	5.7
1958	16,397	7.7	16.2
1959	17,292	5.4	11.8
1960	18,952	9.6	9.6
1961	20,949	10.5	10.6
1962	22,049	5.2	7.8
1963	22,306	1.2	1.9
1964	23,055	3.3	5.1

SOURCE: Fundação Getúlio Vargas, Conjuntura Econômica 27 (December 1973).

Table 1.2.--General price-index variation.

Year	Variation (in %)
1947	11.89
1948	7.01
1949	7.09
1950	11.11
1951	16.51
1952	11.81
1953	14.79
1954	26.99
1955	16.42
1956	19.91
1957	14.19
1958	13.03
1959	37.08
1960	29.18
1961	37.05
1962	51.65
1963	75.36
1964	90.50

SOURCE: Fundação Getúlio Vargas, Conjuntura Econômica 27 (December 1973).

In this period, several ways of avoiding the usury law evolved such as the bill of exchange, which was sold at a discount. The bill of exchange was the sole paper issued by the private sector. It had a medium-term maturity. At this time, some federal and state

government papers were issued in the market in a compulsory way since there were no mechanisms for voluntary fund raising.[2]

The federal government resorted to printing money to finance its long-term investments. In the private sector, long-term financing was done mainly through self-financing (retained profits), rarely through external borrowing. Existing inflationary pressures, aggravated by this printing of money, led to a rate of price increases of 51 percent in 1962 and 75 percent in 1963. The average during the 1950s had been less than 20 percent.

This inflationary climate, together with a government inclined to the left, created an unbearable political situation. In 1964, the revolution brought into being a new government that proposed to reorganize the country, reinstate economic growth, and reduce inflation.

Reforms of the Capital Market

The most important changes in the capital market occurred under the first government after the 1964 revolution. To create a solid structure for the capital market, it was necessary to provide a real return to savers. Law 4.357 of June 16, 1964, created the indexed national treasury bonds, paper indexed as a function of variations in the currency-purchasing power.[3]

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[2]Francisco Vidal Luna, "Capital Market and the Brazilian Economy" (paper presented at the São Paulo Stock Exchange, 1979).

[3]As shown later, the indexed national treasury bonds were adjusted according to alterations in the purchasing power of the currency until the mid-1970s. From 1975 to 1981, adjustment was substantially lower.

Law 4.595 of December 31, 1964, the Bank Reform Law, introduced a complete reformulation of the national financial system. This law defined what was meant by the national financial system, specifying its components as follows: Conselho Monetario Nacional (CMN) (National Monetary Council), Banco Central da República do Brasil (BACEN) (Brazil Central Bank), Banco do Brasil (Bank of Brazil), Banco Nacional de Desenvolvimento Econômico (BNDE) (National Economic Development Bank), and other private and public financial institutions.

The National Monetary Council is the primary entity that formulates currency and credit policies. No executive function is assigned to the National Monetary Council. It follows directions of the president of Brazil.

The Banco Central do Brasil (Central Bank) is linked to the Ministerio da Fazenda (Finance Ministry). It is an executive entity and is responsible for fulfilling its legal requirements and the rules issued by the National Monetary Council. Among its functions are to issue currency, to control foreign capital, to control financial institutions, to buy and sell federal paper, and to represent Brazil with foreign financial institutions.

The Banco do Brazil (Bank of Brazil) has a double role. First, it is the federal government's finance agency and primary undertaker of the industrial and rural credit policies. Second, it acts as a commercial bank.

The Banco Nacional de Desenvolvimento Econômico (National Economic Development Bank) is a public corporation linked to the presidents' planning department (Secretaria de Planejamento da

Presidencia da Republica). It is the primary institution that carries out the federal government's investment policies. It offers support to strategic investment necessary to the country's development, particularly to strengthening national private companies.[4]

The Capital Market Law (Law 4.728 of July 16, 1965), which assigned to the National Monetary Council the regulation of the capital market and to the Central Bank its control, is another fundamental part of the organization of the financial system. This law created new agents, organized the capital-market distribution system, and determined the institutions that could act in this market. The market-distribution system was carried out by the stock exchanges, brokerage companies, over-the-counter dealers (distribuidoras), and investment banks. Some of these institutions already existed at that time, although in other forms. Up to that time, the stock markets were public institutions. Through this law, they became private institutions belonging to the recently created brokerage companies. Until that time there were only public-funds brokers, individuals who represented the public. According to this new law, the public-funds brokers had the right to turn themselves into brokerage companies (corporations or partnerships).

Other people were also allowed to constitute brokerage companies. One hundred thirty-four brokers' companies were created.

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[4]For more details regarding the functions of the national finance system components, see Introdução ao Mercado de Ações [Introduction to the Stock Market] (Comissão Nacional de Bolsas de Valores [National Commission of Stock Exchanges], 1979).

The main activities of these companies are to operate exclusively at the stock exchange of which they are members; to buy, sell, and distribute stocks and shares for third parties; to make new share issues; to administer investment portfolios; to undertake custody of investment paper; and to deal in the money market.

The other two institutions created by Law 4.728 are the investment banks and over-the-counter dealers (distribuidoras). Investment banks are private institutions specializing in equity or medium- or long-term financing through the investment of their own resources. They also specialize in raising, intermediation, and investment of third-party funds. Over-the-counter dealers (distribuidoras) are firms organized as corporations or limited-liability companies, or even as single-name firms whose authority to operate is given by the Central Bank. Their basic activities were determined by Act 76 of November 22, 1967, issued by the Central Bank. These activities include subscribing and intermediating placement of market issues, selling third-party paper, and dealing in the money market.

Over and above these alterations, an attempt was made to provide investments for the housing program. The Sistema Financeiro da Habitação (Housing Finance System) was started by Law 4.380 of August 1964. The system gave functions to the Banco Nacional da Habitação (BNH) (National Housing Bank), as the housing system's central bank. A real estate bill was issued that set up means for raising voluntary funds for the housing system. These instruments were indexed in accordance with the rate of inflation to provide a real return on capital. Funds were also raised through savings

accounts, which were regulated in 1968. These savings accounts are issued by representatives of the Sistema Financeiro da Habitação (Housing Finance System), which consists of savings institutions, savings and loan associations, and real estate credit societies. Thereafter, the Central Bank regulated the recently created capital market. In 1976, the Comissão de Valores Mobiliários (CVM) (Stock Exchange Commission) was created. It undertook most of the regulating functions of the stock market. The functions of the stock market are discussed in detail in later sections.

Thus the Brazilian capital market is made up of two subsystems: the normative subsystem composed of the National Monetary Council, the Stock Exchange Commission, the Central Bank, the Banco do Brasil, the National Economic Development Bank, and the National Housing Bank; and the operating subsystem composed of the financial institutions. The present organization of the national financial system is presented in Figure 1.1.

Reform Performance

As previously mentioned, the government that came to power in 1964 proposed to introduce an economic policy that would promote a decrease in inflationary rates and a return to economic growth. In the first years after 1964, inflation was reduced at the cost of a serious slowdown in economic growth. Although the inflation rate was reduced to levels lower than 40 percent per annum in 1965 and 1966 (see Table 1.3), the gross national product increased only 2.7 percent in 1965 and 3.8 percent in 1966 (see Table 1.4). During the period

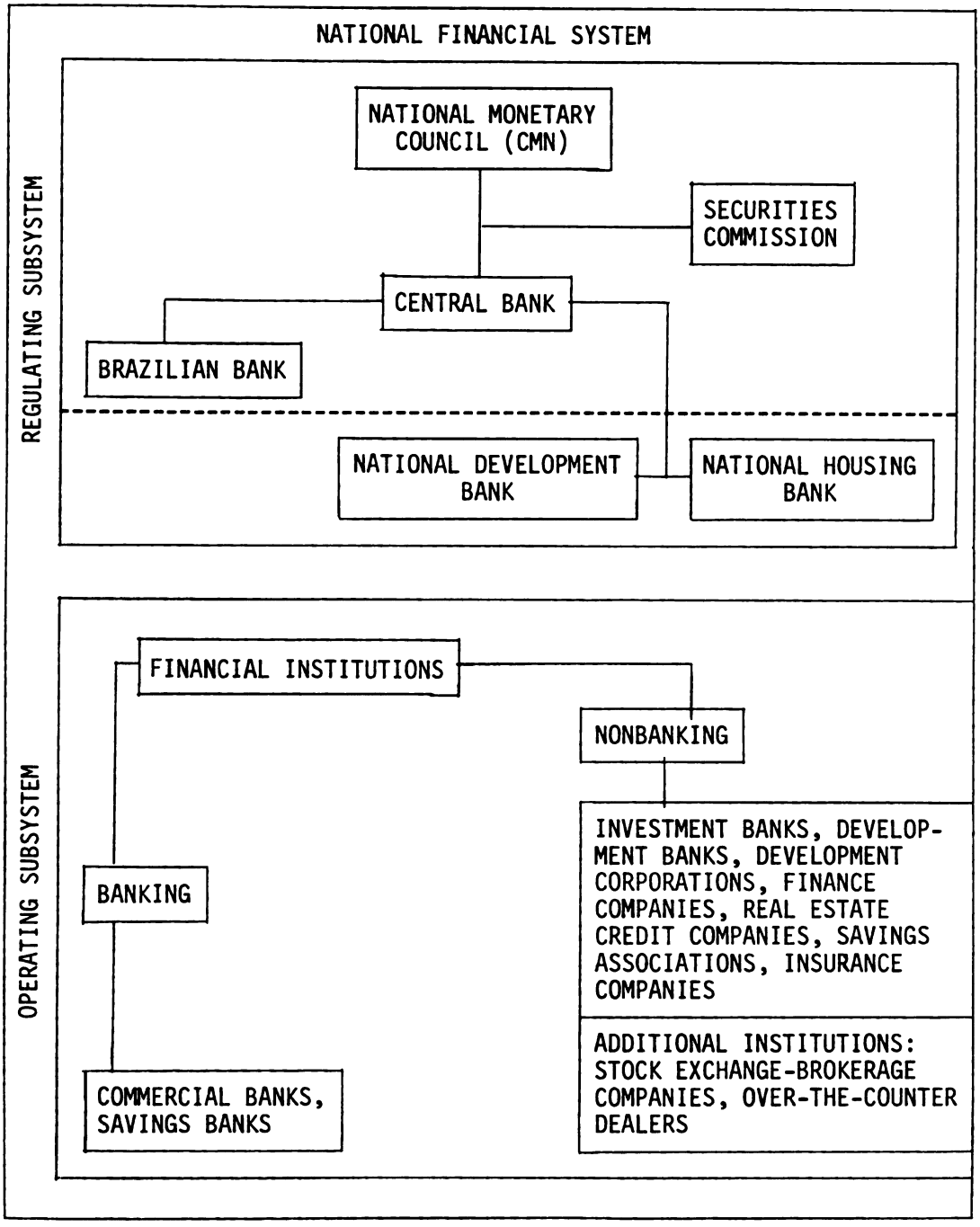

Figure 1.1.--The national financial system. (From Introdução ao Mercado de Ações [Introduction to the Stock Market], 2nd ed. (Comissão Nacional de Bolsas de Valores [National Commission of Stock Exchanges], 1980), p. 35.)

1964-66, the industrial sector was severely affected by the slowdown of activities. Therefore, in 1967 an industrial crisis of large proportions occurred.

Table 1.3.--General price-index variation.

Year	Variation (in %)
1964	90.5
1965	56.8
1966	38.0
1967	28.2
1968	24.2
1969	20.7
1970	19.8
1971	20.4
1972	17.0
1973	15.4
1974	28.7
1975	27.7
1976	41.3
1977	42.7
1978	40.8
1979	77.2
1980	110.2

SOURCE: Fundação Getúlio Vargas, Conjuntura Econômica, March 1981.

Table 1.4.--Growth in gross national product.

Year	Growth (in %)
1964	3.3
1965	2.7
1966	3.8
1967	4.8
1968	11.2
1969	10.0
1970	8.8
1971	13.3
1972	11.7
1973	14.0
1974	9.8
1975	5.6
1976	9.2
1977	4.6
1978	6.0
1979	6.4
1980	N/A

SOURCE: Fundação Getúlio Vargas, Conjuntura Econômica, March 1981.

In 1967, the revolution's second government came to power. It tried to stimulate the economy; reduction of inflation was a secondary target. Several fiscal incentives were developed, among them export incentives that included the use of a flexible exchange rate.[5] A price-control system was established through the organization of the

[5]The flexible exchange rate had as its objective cruzeiro devaluations occurring at shorter periods of time.

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Conselho Interministerial de Preços (CIP) (Interministerial Price Council). An energetic public investment plan was started.

The economic policy during 1967-68 aimed to create an effective demand as much through public investment as through renewal of private investment and export growth. Generally speaking, this economic policy marked the beginning of a period of fast economic growth that continued to 1973.

During the period 1967-73, the gross national product grew at an average annual rate of 10.5 percent. Inflationary rates were gradually contained, decreasing from 28.2 percent in 1967 to 15.4 percent in 1973 (see Tables 1.3 and 1.4). Exports went from US$1.7 billion in 1976 to US$6.2 billion in 1973, with favorable trade balances during five of these seven years (see Table 1.5).

The strong external pressures to increase prices, particularly because of the increase in oil prices, caused a return to the growth in inflation (see Table 1.3). By 1975, inflation was already 28.7 percent; it reached 110 percent in 1980. Together with this growth in inflation, Brazil was faced with a chronic deficit in its trade balance, particularly due to increases in the price of oil (see Table 1.5).

After 1973, economic growth continued, but at a slower rate (see Table 1.4).

Table 1.5.--Trade balance (in US$ billion).

Year	Exports	Imports	Balance
1964	1.430	1.086	344
1965	1.596	941	655
1966	1.741	1.303	438
1967	1.654	1.441	213
1968	1.881	1.855	26
1969	2.311	1.993	318
1970	2.739	2.507	232
1971	2.904	3.245	-341
1972	3.991	4.235	-244
1973	6.199	6.192	7
1974	7.951	12.641	-4.690
1975	8.670	12.210	-3.540
1976	10.128	12.348	-2.218
1977	9.264	9.016	248
1978	12.659	13.683	-1.024
1979	15.244	17.961	-2.717
1980	20.132	22.960	-2.828

SOURCE: Central Bank, Annual Report, 1980.

Indexation

Inflation and the orderly development of the capital market are said to be mutually exclusive phenomena. Inflation destroys confidence in economic agents and in the economy's future performance. Brazilian experience in the period prior to 1964 seems to confirm this statement. At that time, the capital market in Brazil did not go beyond short-term operations in the commercial bank area and an

atrophied long-term market. However, the Brazilian experience after 1964 seems to show that high inflation rates may be associated with an orderly development of the capital market. The compensating factor seems to be indexation.

The origin of indexation was in Law 4.357 of 1964, which, as mentioned above, created the indexed national treasury bonds and, a posteriori, institutionalized indexation. This same law applied the indexation principle to overdue fiscal debts and the correction of companies' fixed assets. Afterwards, through Law 4.380 of 1964, which created the Banco Nacional da Habitação (National Housing Bank), the concept of indexation, a posteriori, was extended to loans provided by the national housing system. This principle was then extended to several other sectors including savings, loans, debts, rents, insurance, interest, wages, the real estate sector, and the exchange rate.

Parallel to the above, a comprehensive system to fight high prices was organized based on the same indexation principle. From a financial point of view, indexation makes the economy extremely flexible. However, on the productive side, when a large variety of goods and services have their prices indexed, these prices cease to reflect relative scarcity and may jeopardize the effective allocation of economic resources.

In spite of the authorities' initial efforts, the private financial institutions did not work with indexed securities because of the risk involved, as when, expecting an increase in the

inflationary rate, borrowers and investors turn to different sectors.[6] On the part of investors, there is a massive transference of resources from nonindexed monetary or financial assets to indexed assets. On the other hand, borrowers try to obtain nonindexed liabilities.

To overcome this situation, prefixed monetary correction was created, which is in reality a nominal interest rate. It is administered by the Central Bank. This monetary correction enabled the formation of a wide capital market; however, its development was not independent of inflation. Thus it is necessary to clarify the relationship between the capital market and inflation. While inflation was decreasing in the country from 1964 to 1973, the mechanism of indexation accomplished its aim, making possible the compatibility of inflation with the capital market. The relationship between monetary and nonmonetary holdings, which was 2.7 in 1968, decreased to 0.76 in 1973. The majority of the nonmonetary holdings exhibited exceptional real growth in that period as did bills of exchange, fixed-term deposits, and savings accounts.[7]

However, after 1973, when inflation began to increase, savers began a massive transference of funds from nonindexed assets to those that included monetary correction. Initially, investors tried to reduce part of their balances in monetary assets, particularly in

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[6]Paul Beckerman, "The Trouble With Index-Linking: Notes on the Recent Brazilian Experience" (1978). (Mimeographed.)

[7]Luna and Nogueira Neto, Indexation and Capital Market.

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sight deposits, provoking a liquidity crisis in the banking system. They also transferred their funds from financial assets that were paid at a nominal prefixed rate, such as exchange bills and term deposits, to indexed assets.

Until 1973, those assets with no indexation or with prefixed indexation were remunerated at a higher rate than those assets with a posteriori indexation. This situation changed in 1974 when inflation began to increase, a tendency that was reinforced by regulations that, at the time, established ceilings for the remuneration of those assets with no a posteriori indexation.

Consequent to this movement of funds, which was already being felt by 1974, the private financial sector, which had not used indexation to any great extent, went into a severe liquidity crisis. As a result, several financial institutions went bankrupt. A similar crisis was felt by those companies that had borrowed indexed funds. The increase in the inflation rates was reflected by an increase in the companies' liabilities at a time when the funds were locked into investments. The companies were unable to generate cash in the same proportion as the increase in their corrected borrowings, and financial problems arose. To reduce the inflationary impact on borrowers' loans and to make savings in indexed assets less attractive, the formula used for the calculation of the index was modified so that only part of the effective inflation rate was indexed.

The state assumed control of a growing share of internal savings and the compulsory savings that it administers.[8] On the other hand, the state instituted a generalized system of subsidized credit through which it loaned the funds obtained. The Brazilian economy is thus in a situation in which the state controls an extremely high proportion of financial savings, taking in the funds through compulsory savings schemes or through assets yielding interest and subject to monetary adjustment. These assets offer some of the highest returns in the capital market with no risk and excellent liquidity. On the other hand, the state offers extensive credit lines at subsidized interest rates. In this way, the state operates with a negative spread, provoking income redistribution among various segments of society and creating serious distortions in the economy. The private financial sector remains unstable with funds being switched rapidly between indexed and nonindexed assets. As a result of inflation and government-guaranteed indexed assets, the activity of the equity market decreased because of lack of available voluntary funds.

The Stock Exchanges

The development of the Brazilian stock market is closely linked to the national financial system that was implemented in 1964. To understand how the stock market operates, it is necessary to

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[8]The two largest sources of compulsory savings administered by the state are Fundo de Garantia por Tempo de Serviço (FGTS) (Fund to Guarantee the Time of Work), a kind of unemployment insurance, through which every company is required to deposit monthly 8 percent of its wage bill, and the Programa de Integração Social (PIS) (Program of Social Integration), through which companies have to deposit 0.5 percent of their sales.

clarify certain factors. In terms of funding, the state agencies hold more than 60 percent of the domestic financial savings, of which a substantial part are compulsory. Thus the state agencies have much influence in the application of these funds. The agencies have, on the whole, invested the funds in loans to the private sector through an ample and intricate system of selective credit, usually at subsidized rates.[9] In this way, the most important financial agents work with a negative spread that imposes limits on the growth of the stock market.

In terms of demand for stocks, it is clear that investors usually prefer an investment with a real return and with low risk compared to one with high risk and poor liquidity. On the supply side, a company usually prefers to go into debt at subsidized interest rather than offer an issue of new shares to the market.

There are other factors that impair the growth of the stock market. The larger national private companies, which should provide the rationale for the stock markets, are often family owned and generally look to the state for funds and guidance in their investment programs. On the other hand, the Brazilian industrial sector is dominated by state and multinational companies.

One asks oneself how it is, then, that the stock market has remained alive; the answer, once again, lies with the state.

The most important incentive to the equity market arose as a result of Law 157 of 1967, which instituted the so-called fiscal

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[9] In 1980 the government sought a return to economic reality and substantially reduced its loans at subsidized rates.

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mutual funds. Law 157 came at a time of extreme corporate difficulty caused by the recession through which the country was going. With this new law, the government attempted to channel funds to companies as well as to develop among individuals the habit of making equity investments, at that time an unusual choice of investment.

The mechanism of the fiscal mutual funds in their original form can be explained as follows.[10] The private, individual taxpayer was allowed to put 10 percent of his income-tax bill toward the purchase of quotas in the fiscal funds (sometimes called 157 funds). Corporate taxpayers were also, initially, benefited by a 5 percent reduction in their income-tax bills through a similar investment plan. Shortly afterward, this benefit was denied to corporate taxpayers. Those financial institutions authorized to deal in the stock market were able to create fiscal mutual funds and sell quotas, placing the funds raised in diversified stock portfolios. The shares purchased had to come from the primary market, in other words, from new stock issues. Companies, to obtain the funds raised, had to invest them in working capital and thus to improve the ratio of their equity to their total liabilities.

Thus the basic objective of Law 157, in its original form, was to strengthen the capital structure of companies, directing the funds to the primary market. This philosophy suffered innumerable changes

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[10]Francisco Vidal Luna, "El Papel de la Bolsa en la Capitalizacion de la Empresa Privada: El Caso Brasileiro" [The Effect of the Stock Exchange on Capitalization of Private Enterprise: The Brazilian Case] (paper presented by the São Paulo Stock Exchange at the Seventh General Assembly of the Ibero-American Federation of Stock Exchanges, Santiago, Chile, 1980).

over the years. The secondary market was benefited when the fiscal funds were allowed to acquire part of the shares in their portfolios through the secondary market by buying shares through the stock exchanges. The companies authorized to raise equity through the fiscal funds have also varied over the years. It is only since 1974 that the fiscal funds achieved a relative stability in terms of their objectives. These objectives are strengthening national private companies, developing the equity market, and educating individuals to invest in the stock market.

At present, individual taxpayers may deduct from 12 to 24 percent of their tax bills (depending on their gross incomes) and invest this money in the purchase of fiscal-fund quotas. The administration of these funds may be carried out by banks or brokerage companies. The proceeds obtained by the funds are invested in diversified portfolios that must obey rigorous norms:

1. Eighty percent of the value of the fund must be invested in national listed companies.

2. The total invested in any one company may not exceed 4 percent of the fund's worth.

3. No more than 10 percent of the voting stock of any company may be held by the fund.

Taxpayers may only realize their investment after five years. At this time, 50 percent may be sold; after the sixth year, the balance may be sold.

The fiscal funds, by reason of the volume and constancy of the resources that they operate, are among the most important investors

in the equity market. However, one of the most serious problems of the fiscal-fund system is the concentration of a large volume of stocks with relatively few institutions. This can impair the efficiency of the market.

Other important institutional investors in the market are insurance companies, which are required by specific legislation to maintain part of their reserves invested in the stock market; private pension funds;[11] and mutual funds.

Thus the Brazilian equity market is of recent origin and as such is still maturing.

The São Paulo Stock Exchange

This research is specifically concerned with the behavior of share prices on the São Paulo Stock Exchange. Thus it is necessary to describe the characteristics of this institution. As a result of the initiative of Emilio Rangel Pestana on August 23, 1890, a Free Exchange was created in São Paulo for the negotiation of stocks and other papers by public auction following the standards of the European exchanges.

At that time, the town of São Paulo was of little significance within the young republic and was far from having the economic activity capable of sustaining a market for stocks. However, a number of businessmen, with the lucidity and vision characteristic of all pioneers, foresaw the future development of the city that is today the country's

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[11] These funds normally complement the government-benefits scheme available to all workers.

economic capital. Against incomprehension and indifference, they maintained their efforts to convince the state government to give official recognition to the embryonic Free Exchange.

On January 25, 1895, the city's anniversary, the Syndicate of Brokers of São Paulo was formed with the support of the Commercial Association. In the same year the Free Exchange was transformed, by an act of the state government, into the Official Exchange for Bills in São Paulo, which was to operate in accordance with public laws and regulations.

At the start of this century, due to the development of the growth of coffee, São Paulo began to appear on the economic map of the country. The exchange kept pace with this growth, raising funds for new enterprises and gradually transforming its own administrative and functional roles. In 1935, the exchange, renamed the Official Stock Exchange of São Paulo, was considered a semiautonomous entity, directly subordinate to the São Paulo State Secretary for Finances.

The exchange remained unchanged until new legislation was passed to regulate the capital market and to provide for its development. On March 7, 1967, by an Extraordinary General Meeting, the Official Stock Exchange became the present Bolsa de Valores de São Paulo, a civil, nonprofit association.

The stock exchange has over one hundred brokerage companies as members, who, in the form of a General Assembly of Associates, constitute the exchange's highest deliberative authority. The Administrative Council, responsible for operational and social policies, consists of eight officials; six of these are elected from among the

owners or directors of member brokerage companies, one represents the companies whose stocks are registered in the exchange, and one is the general superintendent.

The president of the council is chosen from among the representatives of the brokerage companies and has the support of technical and communication assessors who deal with the press and publish information to the public as a whole. The general superintendent, who is named by the Administrative Council, is responsible to the council for the implementation of the policies established by it. The general superintendency has reporting to it the executive superintendencies: operations, systems, administration, and finance. (See Figure 1.2.)

Research Objectives

The objectives of this research are as follows:

1. To build a machine-readable data base of security-price information for securities traded at the São Paulo Stock Exchange in the past decade;

2. To analyze the rates of return for common and preferred stocks traded at the São Paulo Stock Exchange for the period covered by the study;

3. To reproduce the tests developed by Black, Jensen, and Scholes and by Fama and MacBeth with a new data base and to compare and contrast the findings;[12]

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[12]F. Black, M. C. Jensen, and M. Scholes, "The Capital Asset Pricing Model: Some Empirical Tests," in Studies in the Theory of Capital Markets, ed. Michael Jensen (New York: Praeger, 1972);

[illegible]

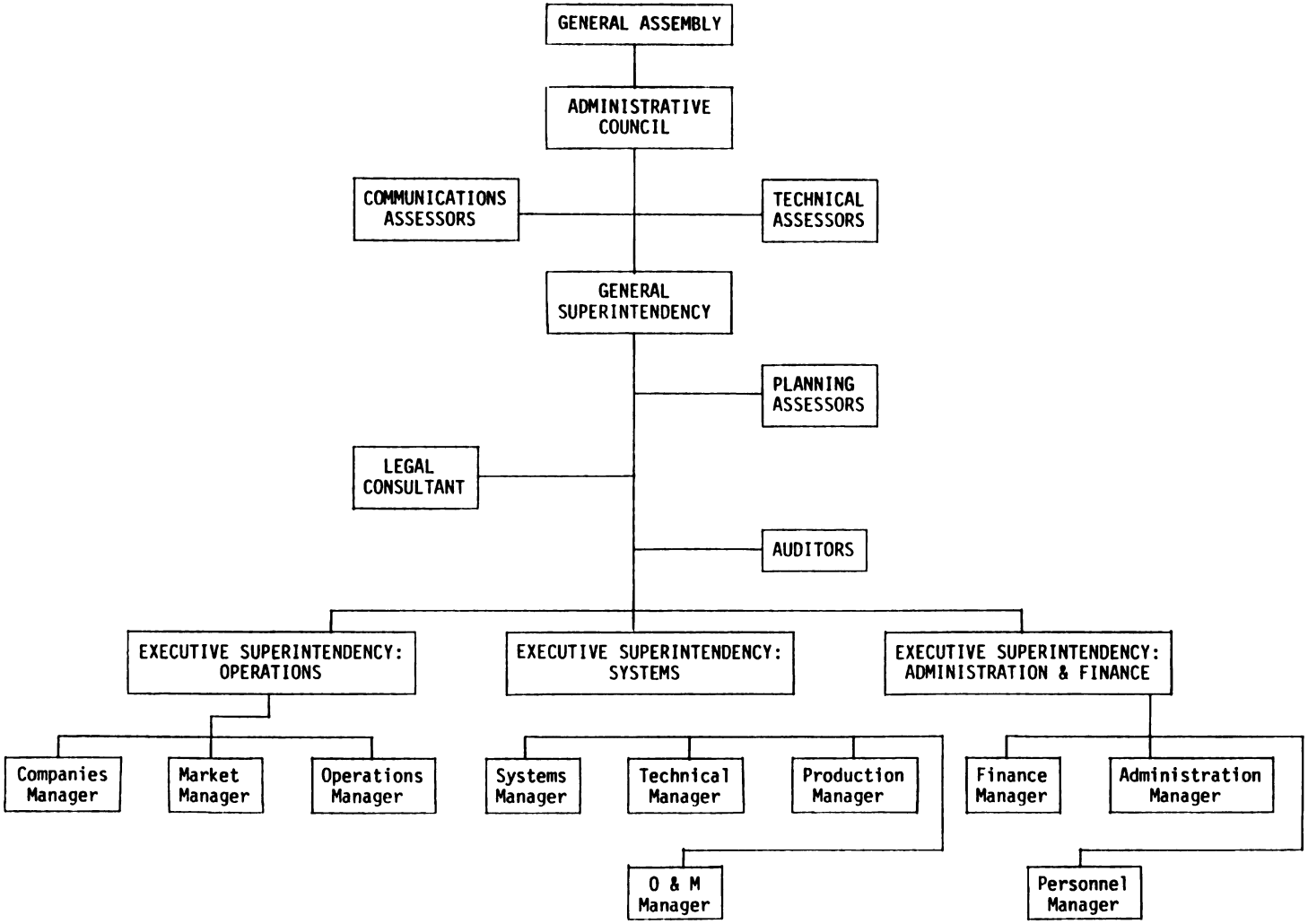

Figure 1.2.--Organization of the São Paulo Stock Exchange.

4. To determine the relationship between inflation and returns from risky assets in an indexed economy.

The most important work about the São Paulo Stock Exchange was written by Wladimir Antonio Puggina in his dissertation, "Analysis of Rates of Return and Risk for Common and Preferred Stocks: The Brazilian Experience."[13] Puggina analyzed the annual rates of return of the Brazilian stock market during the period 1968-72. His basic conclusions were as follows:

1. Investment in the security market was a hedge against inflation.

2. There was a linear relationship between risk and return.

3. The actual market index BOVESPA was biased.

4. Smaller companies have done better than larger ones.

Organization of the Study

This study is composed of six chapters in addition to this introduction. In Chapter II, the data files are described. In Chapter III, a review of the literature is presented. In Chapter IV, the methodology for analyzing the performance of the market is shown. The tests of the capital-asset-pricing model, which were developed in the United States, were applied to the São Paulo Stock Exchange.

E. F. Fama and J. D. MacBeth, "Risk, Return and Equilibrium: Empirical Tests," Journal of Political Economy 81 (May-June 1973): 607-36.

[13]Wladimir Antonio Puggina, "Analysis of Rates of Return and Risk for Common and Preferred Stocks: The Brazilian Experience" (Ph.D. dissertation, Michigan State University, 1974).

The results of these tests are presented in Chapter V. The relationship between inflation and rates of return of the market is presented in Chapter VI. Finally, in Chapter VII, a summary and conclusion are presented.

CHAPTER II

THE DATA FILES

In this chapter, the methodology for collecting the data is presented. In addition, the structure of the tapes containing the information about security prices is described. The procedures of the Center for Research in Security Prices (CRSP) and of Lawrence Fisher and James Lorie were followed.[1] The data files developed for this study are simpler than the CRSP data files; however, these data files may be enlarged in the future. The files provided information to compute time-weighted rates of return; these rates of return were compounded rates. Lorie and Fisher stated: "For interest rates (or rates of return) to be comparable they must be stated as compound interest and the compounding periods must be the same."[2]

Period Covered in This Study

In the previous chapter, the structures of the Brazilian capital market and the security exchanges were discussed. The

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[1] CRSP Master File (Chicago: Center for Research in Security Prices, Graduate School of Business, University of Chicago, March 1979); Lawrence Fisher and James H. Lorie, "Rates of Return on Investments in Common Stocks: The Year by Year Records, 1926-65," Journal of Business of the University of Chicago 39 (January 1966); and A Half Century of Returns on Stocks and Bonds (Chicago: Graduate School of Business, University of Chicago, 1977).

[2] Fisher and Lorie, A Half Century of Returns on Stocks and Bonds, pp. 18-19.

Capital Market Law of 1965 was the base for this structure. However, it was not until 1968 that the significance of this law became apparent. In that year, the market started to have adequate liquidity and to trade a sufficient number of securities to attract a great number of investors.

In addition, only after 1970 did the São Paulo Stock Exchange's files regarding stock prices and events such as stock splits, stock dividends, issue of new shares, and dividends become relatively organized. For these reasons, the period covered by this study is from January 1970 to December 1979. Therefore, there are data collected on each stock and monthly returns computed for listed securities since January 1970.

Sample Size

Puggina concluded that, in research on the behavior of the stock market, an entire population should be studied and that sampling is not a valid procedure.[3] Thus, the total universe of securities traded on the São Paulo Stock Exchange was searched, but with the following qualifications:

1. Stocks not actively traded were eliminated. A stock was considered as actively traded if it had at least one trading operation per month.

2. If it was not possible to find all the pertinent information about a stock necessary for computing its return, the stock was deleted from the data file.

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[3]Puggina, "Analysis of Rates of Return and Risk," pp. 37-38.

This was the approach used by Fisher and Lorie.[4] It provided a more complete set of data.

Computation of Monthly Security Returns

An index for each security traded on the São Paulo Stock Exchange was computed. For stocks traded since January 1, 1970, it was assumed that an ideal investor bought Cr$1,000 of each security. So, for each security, he bought the following number of shares:

$$No = \frac{1000}{Po} \qquad (1)$$

where:

No = Number of shares bought
Po = Initial market price

For stocks that were initially traded after January 1, 1970, it was assumed that the ideal investor also bought Cr$1,000 of these shares on the first day of the month following the first trading month.

The following adjustments were made for dividends, rights, stock dividends, stock splits, and for all possible combinations of these events:

1. Dividends

It was assumed that the ideal investor received dividends and reinvested them in the same security, buying shares quoted ex dividend. The new number of shares was expressed as:

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[4]Fisher and Lorie, "Rates of Return on Investments in Common Stocks."

$$N_d = N_{bd} \left[1 + \frac{d}{P_{exd}} \right] \tag{2}$$

where:

N_d = New number of shares after dividends
N_{bd} = Number of shares held before dividends
P_{exd} = Price ex dividend
d = Dividend per share

The following expression represented the dividend factor:

$$\left[1 + \frac{P}{P_{exd}} \right] = F_d \tag{3}$$

2. Rights of subscription of new shares

The owner of stocks has the opportunity to subscribe new shares whenever the corporation decides to raise equity capital. Normally, the subscription price is below the market price, and, as a consequence, these rights have value.

It was assumed that the ideal investor subscribed all shares corresponding to his rights and immediately sold the exact number of stocks quoted ex subscription rights necessary to recover the amount spent with this hypothetical subscription. The adjustment made was as follows:

$$N_r = N_{br} + N_{br} \frac{S}{100} - \frac{N_{br} \frac{S}{100} \times P_s}{P_{exs}} \tag{4}$$

or, rearranging the terms:

$$N_r = N_{br} + N_{br} \frac{S}{100} \left[1 - \frac{P_s}{P_{exs}} \right] \tag{5}$$

where:

N_r = New number of shares after rights
N_{br} = Number of shares held before rights
S = Percentage of subscription
P_s = Subscription price
P_{exs} = Price ex subscription rights

Equation 5 may be rewritten as:

$$N_r = N_{br} \left[1 + \frac{S}{100} \left(1 - \frac{P_s}{P_{exs}} \right) \right] \tag{6}$$

The following expression represented the right-of-subscription factor:

$$\left[1 + \frac{S}{100} \left(1 - \frac{P_s}{P_{exs}} \right) = F_r \right] \tag{7}$$

3. Stock dividends and stock splits

The Brazilian commercial law requires that the amount of certain reserve accounts cannot exceed a fixed percentage of a company's equity. The two most important reserve accounts subject to this regulation are retained earnings and reserve from price-level adjustment.

Retained earnings have the same significance as in the United States. The reserve from the price-level adjustment originates from the mandatory price-level adjustment due to inflation. Because the inflation in Brazil has been very high in the past decade, stock dividends or stock splits have been very frequent. Usually, every company declares at least one stock split (or stock dividend) per year. This fact made the process of data collection more difficult

because every stock had to be searched for these events for every year.

The adjustment made for stock splits or stock dividends was:

$$N_s = N_{bs} \left[1 + \frac{SS}{100} \right] \tag{8}$$

where:

N_s = New number of shares after stock dividend or stock split

N_{bs} = Number of shares held before stock split or stock dividend

SS = Percentage of stock dividend or stock split

At this point, it is necessary to mention that in Brazil there is no difference between stock splits and stock dividends. Therefore, in this study, they are treated as the same. Even in the United States, the difference involves only the accounting mechanism. There is no financial implication. The following expression represented the stock split or stock-dividend factor:

$$\left[1 + \frac{SS}{100} \right] = F_s \tag{9}$$

4. Dividends, stock splits, and subscriptions offered at the same time

Frequently, stock splits, dividends, and subscriptions were offered at the same time. Normally, the stock dividend (or stock split) and the subscription were offered as a percentage of the same basis. In this case, the adjustment was:

$$N_a = N_b F_d F_r + N_b F_d F_s - N_b F_d \tag{10}$$

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$$N_a = N_b F_d (F_r + F_s - 1) \tag{11}$$

where:

N_a = New number of shares after events
N_b = Number of shares before events
F_d, F_r, F_s = Adjustment factors already defined

However, there were cases in which a stock dividend or stock split was given over the resulting amount of equity after subscription. So, if all the events were on a different basis, the adjustment was:

$$N_a = N_b \cdot F_d \cdot F_r \cdot F_s \tag{12}$$

After the computation of these adjustments, it was possible to determine the index for each security. As in Equation 1,

$$N_o = \frac{1000}{P_o}$$

Therefore, the starting index was expressed as:

$$N_o P_o = 1000 = I_o \tag{13}$$

where:

N_o = Number of shares at the beginning of the first month for which the security return was computed
P_o = Price at the beginning of the first month
I_o = Starting index

The index at the beginning of each month was expressed as:

$$I_t = N_t P_t \tag{14}$$

where:

I_t = Index at the beginning of month t

N_t = Number of shares (after adjustments) at the beginning of month t

P_t = Price of share at the beginning of month t

t = (1,2....120) = number of months

Finally, the monthly returns were computed as:

$$R_{jt} = \frac{I_{jt} - I_{jt-1}}{I_{jt-1}} \qquad (15)$$

where:

R_{jt} = Return on security j during month t

I_{jt-1} = Index of security j at time t-1

I_{jt} = Index of security j at time t

Inflation

The returns computed according to Equation 15 were nominal rates of return instead of real rates of return. Since inflation in Brazil was very high in the past decade, it was important to know the real rates of return that occurred during the period.

It was necessary to select a good deflator. For several reasons, which are discussed in Chapter IV, two deflators were chosen. The first was the General Price-Level Index (GPLI) published monthly by the Getúlio Vargas Foundation. It is widely used and is the least-questionable deflator. The second deflator was the monthly variation in the value of the Obrigações Reajustáveis do Tesouro Nacional (ORTN) (Indexed National Treasury Bonds), which is an official index and is largely used as the basis for indexation of the Brazilian economy.

The method for fixing the values of the ORTN is presented in Appendix A. The method of computing the GPLI is presented in Appendix B.

Computation of Real Returns

Through use of two deflators, two sets of real returns for each stock were obtained. These real returns were computed as follows:

1. The inflated index was computed as:

$$II_t = I_t \frac{\rho 121 - \rho t}{\rho t} \tag{16}$$

where:

II_t = Inflated index of time t to January 1, 1980
I_t = Stock index computed according to Equations 13 and 15
$\rho 121$ = Value of the deflator on January 1, 1980
ρt = Value of the same deflator at time t

2. The real return was expressed as:

$$RR_{jt} = \frac{II_{jt} - II_{jt-1}}{II_{jt-1}} \tag{17}$$

where:

RR_{jt} = Real return of security j in period t

Sources of Information

The data were obtained from the following sources:

1. The São Paulo Stock Exchange

The São Paulo Stock Exchange has a relatively well-organized file with information about all securities traded. Since 1972, a

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great amount of information has been recorded on magnetic tapes. Unfortunately, not all of those files are complete; thus complementary material from other sources was used. In addition, several publications of the São Paulo Stock Exchange were consulted.[5]

2. IBEMEC Publications

The publications of the Instituto Brasileiro de Mercado de Capitais (Brazilian Institute on the Capital Market) were used to supplement the data.

3. S.N. Publications

Organização S.N. Consultores Financeiros (S.N. Financial Consultants) is a private statistical-information system that publishes analyses of companies in the market.

4. Others

In a few cases, it was necessary to consult other sources of information such as records of stockholders' meetings or stockholders' departments.

Limitations on the Data-Collection Procedure

Some variables that should be taken into consideration were neglected because of practical problems. These variables were as follows:

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[5]The most important publications systematically consulted were Anuário da Bolsa (Annual Bulletin of the Stock Exchange) and Boletim Diário de Informações (Daily Information Bulletin).

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1. Commissions

No commission for buying or selling any stock in the market was considered. This was because the value of the commission is a function of the amount traded.

2. Income tax

Income taxes were not considered because of the enormous complexity of the legislation in this area. In addition, it was impossible to determine a typical investor and to compute his typical income tax.

3. Tax incentives

The Brazilian government has designed a very complex system of tax incentives by which investors may save income taxes by investing in stocks. Again, it was impossible to determine the average investor; thus it was necessary to omit the benefits from the incentives.

Division of the Data Into Sectors

The companies were classified by sectors. Although any sector classification is, to some extent, arbitrary and subject to criticism, to facilitate the work the classification system used by the São Paulo Stock Exchange was used. The divisions and codes of the sectors are presented in Appendix C.

Number of Stocks and Representativity in the Market

Information about 395 stocks was collected from 203 companies. At this point, it is important to mention that normally each company

has at least two types of stocks being traded: common and preferred. In the United States, preferred stocks are closer to debt. In contrast, in Brazil, preferred stocks are similar to common stocks, with the following basic differences:

1. Preferred stocks do not carry voting rights;
2. Preferred stocks bring the minimum dividend stated;
3. Preferred stocks have priority of reimbursement in case of liquidation.

On the other hand, preferred stocks share equally with common stocks in all the profits of the companies. In this sense, it is logical to suppose that preferred stocks carry less risk than common stocks. It is also possible that the company might have more than one type of preferred stocks. In this case, the basic difference between them is generally the stated dividend. The tape codes used to identify the types of stock are presented in Appendix D.

The stocks included in the data file represented about 90 percent of the volume (measured in cruzeiros) traded on the São Paulo Stock Exchange. The total volume traded, the volume included in the tape, and the percentage of the total volume that is included in the tape for each of the past ten years are shown in Table 2.1. All of the companies included in the tape are listed in Appendix E.

Table 2.1.--Volume traded.

Year	Total Volume Cr$ x 1000	Volume on the Tape Cr$ x 1000	Percentage of the Total
1970	1,430,414	1,316,805	94
1971	9,110,730	8,316,338	91
1972	9,741,488	8,218,340	84
1973	9,086,236	7,815,188	86
1974	5,574,355	5,223,067	94
1975	9,248,010	8,187,748	89
1976	9,329,982	8,335,246	89
1977	12,744,707	11,757,107	92
1978	32,770,861	28,439,769	87
1979	32,863,168	29,323,889	89
Average for the entire period = 89.3%			

Information Provided by the Magnetic Tape

Two tapes were available. The first gave basic information, with no further computations. This information was as follows:

1. Code of the company
2. Sector classification of the company
3. Name of the company
4. Type of security
5. First date: for shares traded before January 1, 1970, this date was January 1, 1970; for shares initially traded after this date, the first day of the month following the first trading was used
6. Information date
7. Period number
8. Quantity of stocks held

9. Stock price

10. Total number of stocks of the company in the market

As a sample, the information for one company provided by the first tape as printed by the computer is presented in Table 2.2.

Table 2.2.--Sample of information provided on the first tape.

Name--ACESITA Type--02	Number--001		Sector--13072
Date	Period	Stock Price	Stocks Held	Total Number of Stocks x 1000
1/1/70	1	1.05	952.3810	194,495
1/2/70	2	0.98	952.3810	194,495
1/3/70	3	1.30	952.3810	194,495
1/4/70	4	1.17	952.3810	194,495
1/5/70	5	1.17	952.3810	194,495
1/6/70	6	0.95	952.3810	194,495
1/7/70	7	0.95	952.3810	194,495
1/8/70	8	0.99	952.3810	194,495
'	'	'	'	'
'	'	'	'	'
'	'	'	'	'
'	'	'	'	'
1/6/79	114	1.20	4562.9485	2644,990
1/7/79	115	1.03	5183.1551	2644,990
1/8/79	116	0.84	5183.1551	2644,990
1/9/79	117	1.03	5183.1551	2644,990
1/10/79	118	1.30	5183.1551	2644,990
1/11/79	119	1.40	5183.1551	2644,990
1/12/79	120	1.20	5183.1551	2644,990
1/1/80	121	1.10	5183.1551	2644,990

In addition to the information available on the first tape, the second tape provided the following: the nominal wealth, the nominal monthly return, the real wealth assuming the ORTN as the proper deflator, the real monthly return assuming the ORTN as the proper deflator, the real wealth assuming the GPLI as the proper deflator, and the real monthly return assuming the GPLI as the proper deflator. As a sample, the information for one company provided by the second tape as printed by the computer is presented in Table 2.3.

Final Comments

Four persons worked on a full-time basis during nine months in a special room at the São Paulo Stock Exchange to collect the data. In addition, the people from Getúlio Vargas Foundation Data Processing Department worked three months to process the data and to put them in the proper form. Now, the information is available to the public. The writer expects to update these tapes annually.

Table 2.3.--Sample of information provided in the second tape.

Name--ACESITA Number--001 Sector--13072
Type--02

Date	Period	Stock Price	Stocks Held	Nominal Wealth[a]	Nominal Return[b]	Total Number of Stocks x 1000	Real Wealth ORTN[c]	Real Return ORTN[d]	Real Wealth GPLI	Real Return GPLI[e]
1/1/70	1	1.05	952.3810	1000.0000	-0.0666	194,495	11519.0088	-0.0870	17601.8966	-0.0797
1/2/70	2	0.98	952.3810	933.3334	0.3265	194,495	10515.1968	0.3004	16198.1316	0.3022
1/3/70	3	1.30	952.3810	1238.0953	-0.0999	194,495	13673.8387	-0.1100	21093.0548	0.1041
1/4/70	4	1.17	952.3810	1114.2858	0.0000	194,495	12168.8387	-0.0090	18897.0655	-0.0134
'	'	'	'	'	'	'	'	'	'	'
'	'	'	'	'	'	'	'	'	'	'
'	'	'	'	'	'	'	'	'	'	'
1/10/79	118	1.30	5183.1551	6738.1061	0.0769	2644,990	7665.6906	0.0297	8106.6762	0.0240
1/11/79	119	1.40	5183.1551	7256.4171	-0.1482	2644,990	7893.2771	-0.1798	8272.0483	0.0240
1/12/79	120	1.20	5183.1551	6219.7861	-0.0832	2644,990	6473.5087	-0.1192	6605.7437	-0.1368
1/1/80	121	1.10	5183.1551	5701.4706	N/A	2644,990	5701.4706	N/A	5701.4706	N/A

[a]Nominal wealth was obtained by multiplying the stock price by the stock held.

[b]Nominal return was computed as indicated in Equation 15.

[c]Real wealth ORTN and real wealth GPLI were obtained according to Equation 16.

[d]Real return ORTN and real return GPLI were obtained according to Equation 17.

[e]The ORTN and GPLI values are presented in Appendix F.

CHAPTER III

REVIEW OF LITERATURE

Measuring Market Rates of Return

Two basic problems were presented when the market rates of return were measured. The first problem was to choose the proper weighting system. Fisher and Lorie chose to weigh each stock equally (the equally weighted index).[1] An alternative was to weigh according to the total value of each company in the market (the value-weighted index). Both indices had their advantages and shortcomings, although the value-weighted index was considered theoretically more sound.[2] In this study, indices were computed according to both assumptions.

The second problem was related to the reinvestment of dividends and proceeds of rights. As discussed in the previous chapter, the dividends were considered as reinvested in the same stock, and the proceeds of rights were treated as in Equation 5. Following Puggina's notation, I_S represented the value-weighted index and I'_S represented the equally weighted index.

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[1] Fisher and Lorie, "Rates of Return on Investments in Common Stocks: The Year by Year Records."

[2] See H. A. Latané, D. L. Tuttle, and W. E. Young, "How to Choose a Market Index," Financial Analyst Journal, Sept.-Oct. 1971, pp. 75-85, for a discussion of the development of market indices. Puggina (p. 58) showed the shortcomings of a value-weighted market index in the case of Brazil.

The Value-Weighted Index

In this index, investment in every listed security was proportional to the total value of outstanding securities. This index was computed as follows:

$$RM_t = \frac{\sum_{j=1}^{N} \frac{P_{jt+1} N_{jt+1}}{P_{jt} N_{jt}} \cdot P_{jt} N'_{jt}}{\sum_{j=1}^{N} P_{jt} N'_{jt}} \qquad (18)$$

or

$$RM_t = \frac{\sum_{j=1}^{M} P_{jt+1} \frac{N_{jt+1}}{N_{jt}} N'_{jt}}{\sum_{t=1}^{N} P_{jt} N'_{jt}} \qquad (19)$$

where:

N'_{jt} = Number of shares outstanding for security j at time t

and $$I_{st} = 100 \prod_{t=1}^{t} RM_t \qquad (20)$$

where:

I_{st} = The market portfolio index at time t

The Equally Weighted Index

In this index, equal investment was supposed to have been made in every listed security at the beginning of each month, and the portfolio was supposed to be sold at the end of a one-month period. At that time, a new portfolio was formed, and so on. Mathematically, this index was expressed as:

$$RM_t = \frac{1}{N} \sum_{j=1}^{N} \frac{P_{jt+1} N_{jt+1}}{P_{jt} N_{jt}} \tag{21}$$

where:

RM_t = Market return in period t

N = Number of securities in the market portfolio

P_{jt+1} = Price of security j at time t+1

The market index was expressed as:

$$I_{st} = 100 \prod_{t=1}^{t} RM_t \tag{22}$$

where:

I_{st} = The market-portfolio index at time t

Real-Market Returns

After these two market indices were computed, it was possible to compute the real monthly market returns as follows:

$$II_{st} = I_{st} \frac{\rho_{121} - \rho_t}{\rho} \tag{23}$$

and

$$RRM_t = \frac{II_{st+1}}{II_{st}} \tag{24}$$

where:

II_{st} = Inflated market index at time t

RRM_t = Real-market monthly return

ρ_t = Value of the deflator at time t

The Capital-Asset-Pricing Model

The capital-asset-pricing model is a general-equilibrium model of the behavior of the pricing of capital assets. The most important assumptions of the model are as follows:[3]

1. That an investor maximizes his utility function under a single-period context;

2. That there are perfect and competitive capital markets; that there are no taxes, commissions, or other transaction costs; that assets are perfectly divisible and the quantities of all assets are given; that all investors are price takers.

3. That there is a risk-free security; that all investors can borrow or lend unlimited amounts at the risk-free interest rate;

4. That all investors have homogeneous expectations about returns, variances, and covariances;

5. That all investors evaluate their portfolios based on two parameters: expected return and standard deviation of returns;

6. That investors are considered risk averters.[4]

The Single-Factor Model

According to the above assumptions, an investor's utility is a function of expected return and risk. This utility is represented as:

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[3]M. C. Jensen, "Capital Markets: Theory and Evidence," Bell Journal of Economics and Management Science 3 (October 1972): 358-59.

[4]M. E. Rubinstein, "A Mean-Variance Synthesis of Corporate Financial Theory," Journal of Finance 28 (March 1973): 168-81.

$$U = U(E(\tilde{R}), \sigma_{\tilde{R}}) \tag{25}$$

where:

U = Investor's utility function

$E(\tilde{R})$ = Expected return

$\sigma_{\tilde{R}}$ = Standard deviation of returns

In Figure 3.1, the efficient frontier, the investor's utility function, and the capital-market line are presented. It is clear that the investor will choose portfolio Y, which is the tangency point between the capital-market line and the highest possible indifference curve. Therefore, the slope of the capital-market line and the indifference curve U_1 at point Y must be the same.

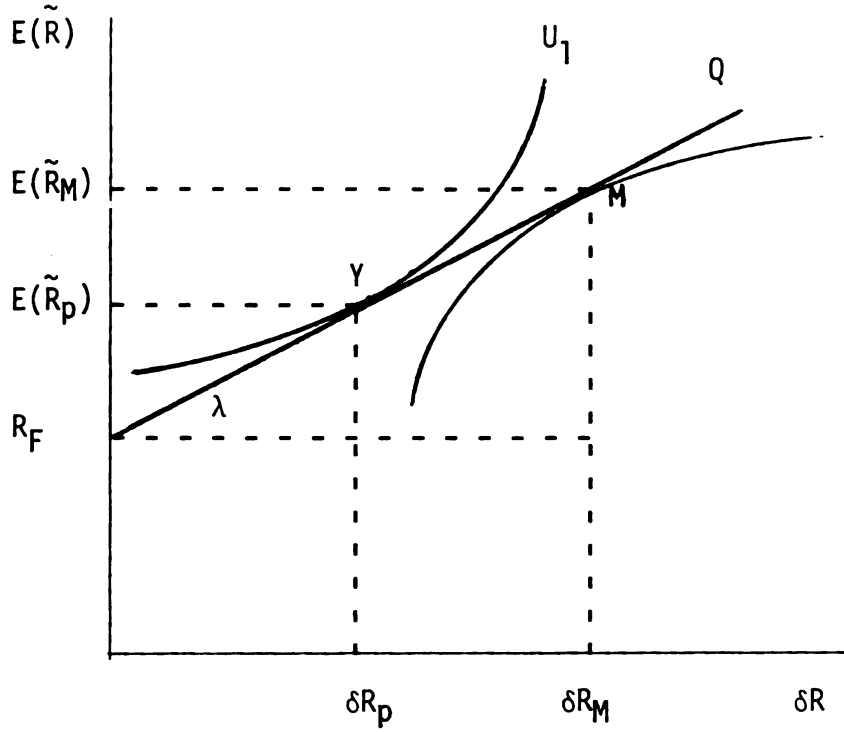

Figure 3.1.--The efficient frontier, the investor's utility function, and the capital-market line.

The slope of the indifference curve U_1 is obtained by the total differentiation of Equation 25, making it equal to zero since it is a constant-utility curve. This is expressed as:

$$\frac{\delta U}{\delta E(\tilde{R})} \, dE(\tilde{R}) + \frac{\delta U}{\delta \sigma \tilde{R}} \, d\sigma \tilde{R} = 0 \tag{26}$$

or

$$\frac{d\, E(\tilde{R})}{d\, \sigma \tilde{R}} = - \frac{\delta U / \delta \sigma \tilde{R}}{\delta U / \delta E(\tilde{R})} \tag{27}$$

The slope of the utility curve U_1 at the optimal point Y is given in Equation 27. On the other hand, the slope of the capital-market line is given by λ as illustrated in Figure 4.1. This is expressed as:

$$\lambda = \frac{E(\tilde{R}_p) - R_F}{\sigma \tilde{R}_p} = \frac{E(\tilde{R}_M) - R_F}{\sigma \tilde{R}_M} \tag{28}$$

By establishing the equality between Equation 28 and Equation 27, the following is obtained:

$$\lambda = - \frac{\delta U / \delta \sigma \tilde{R}}{\delta U / \delta E(\tilde{R})} \tag{29}$$

If x_j represents the proportion of the portfolio invested in the j^{th} asset and if $(1 - x_j)$ represents the proportion invested in the risk-free asset, the expected return of portfolio Y is expressed by:

$$E(\tilde{R}_p) = \sum_{j=1}^{N} x_j E(\tilde{R}_j) + (1 - \sum_{j=1}^{N} x_j) R_F \tag{30}$$

where:

$E(\tilde{R}_j)$ = Expected return of asset j

j = (1,2...n) = Assets in the market

The standard deviation is expressed by:

$$\sigma\tilde{R}_p = \left[\sum_{j=1}^{N} \sum_{k=1}^{N} x_j x_k \, \mathrm{cov}(\tilde{R}_j, \tilde{R}_k) \right]^{1/2} \tag{31}$$

where:

$\mathrm{cov}(\tilde{R}_j, \tilde{R}_k)$ = Covariance of returns of assets j and k

x_j = Proportion of asset j in portfolio p

x_k = Proportion of asset k in portfolio p

The objective is to derive an equation for the expected return of a j^{th} asset. To do this, the rate of change of the expected return of the investor's optimal portfolio is considered as he increases the amount invested in any individual asset j by decreasing the amount invested in the risk-free asset.[5]

Mathematically, it is necessary to have the derivative of the investor's utility function with respect to x_j, making it equal to zero. (At the optimal point, the rate of change of utility must be zero.) Thus,

$$\frac{\delta U}{\delta E(\tilde{R}_p)} \cdot \frac{\delta E(\tilde{R}_p)}{\delta x_j} + \frac{\delta U}{\delta \sigma \tilde{R}_p} \cdot \frac{\delta \sigma \tilde{R}_p}{\delta x_j} = 0 \tag{32}$$

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[5]Jensen, p. 361.

or, by rearranging the terms,

$$\frac{\frac{\delta U}{\delta \sigma \tilde{R}_p}}{\frac{\delta U}{\delta E(\tilde{R}_p)}} = - \frac{\frac{E(\tilde{R}_p)}{\delta x_j}}{\frac{\delta \sigma \tilde{R}_p}{\delta x_j}} \tag{33}$$

Equation 33 being equal to Equation 29, the following can be expressed:

$$\lambda \frac{\delta \sigma \tilde{R}_p}{\delta x_j} = \frac{\delta E(\tilde{R}_p)}{\delta x_j} \tag{34}$$

The derivative of Equation 30 in relation to x_j is expressed by:

$$\frac{\delta E(\tilde{R}_p)}{\delta x_j} = E(\tilde{R}_j) - R_F \tag{35}$$

The derivative of Equation 31 in relation to x_j is expressed by:[6]

$$\frac{\delta \sigma \tilde{R}_p}{\delta x_j} = \frac{\text{cov}(\tilde{R}_j, \tilde{R}_M)}{\sigma \tilde{R}_M} \tag{36}$$

Based on Equations 36, 35, and 34, the following can be expressed:

$$E(\tilde{R}_j) = R_F + \lambda \frac{\text{cov}(\tilde{R}_j, \tilde{R}_M)}{\sigma \tilde{R}_M} \tag{37}$$

This equation is the basic expression of the capital-asset-pricing model in its single-factor version. Thus the conclusion can be reached that the return of the j^{th} asset has two basic components:

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[6] Ibid., p. 362.

the return of the risk-free asset R_F and a premium for the investment risk. This premium is determined by the product of the risk of asset j as expressed by:

$$\frac{\text{cov}(\tilde{R}_j, \tilde{R}_M)}{\sigma\tilde{R}_M}$$

and the market-risk premium per unit of risk λ.

The Two-Factor Model

It has been suggested in several recent studies that returns on securities do not behave as predicted in the single-factor capital-asset-pricing model (see Equation 37). One possible explanation for these empirical results is that the assumption that there is a risk-free security is not valid. The deletion of this assumption results in the two-factor model.

If the investor chooses portfolio M, the fact that M is efficient means that the weights x_j (j=1,2...n) maximize the portfolio return. Mathematically, maximize

$$E(\tilde{R}_M) = \sum_{j=1}^{N} x_j \, E(\tilde{R}_j) \tag{38}$$

subjected to

$$\sigma\tilde{R}_p = \sigma\tilde{R}_M \tag{39}$$

and

$$\sum_{j=1}^{N} x_j = 1 \tag{40}$$

Lagrangian methods can be used to show that the weights x_j must be chosen in such a way that for any asset j in portfolio M[7]

$$E(\tilde{R}_j) - E(\tilde{R}_M) = S_M \left[\frac{\sum_{j=1}^{N} x_j \sigma ij}{\sigma \tilde{R}_M} \right] - \sigma \tilde{R}_M \tag{41}$$

where S_M is the rate of change of $E(\tilde{R}_p)$ with respect to a change in $\sigma \tilde{R}_p$ at the point on the efficient set corresponding to portfolio M.

Equation 41 may be rewritten as:

$$E(\tilde{R}_j) - E(\tilde{R}_M) = S_M \, (\beta_j \, \sigma R_M - \sigma \tilde{R}_M) \tag{42}$$

where:

$$\beta_j = \frac{\text{cov}(\tilde{R}_j, \tilde{R}_M)}{\sigma \tilde{R}_M{}^2} \tag{43}$$

or

$$E(\tilde{R}_j) = E(\tilde{R}_M) - S_M(\sigma \tilde{R}_M) + S_M \, \sigma \tilde{R}_M \beta_j \tag{44}$$

Parameter β_j can be interpreted as the risk of asset j in portfolio M. Assuming that $\beta_j = 0$, the interception of Equation 44 is obtained as follows:

$$E(\tilde{R}_z) = E(\tilde{R}_M) - S_M \sigma \tilde{R}_M \tag{45}$$

$E(\tilde{R}_z)$ is the expected return on a portfolio, the return from which is uncorrelated with $\tilde{R}_M$; that is, it is a zero-beta portfolio. From Equation 45, it follows that:

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[7] Fama and MacBeth, pp. 607-12.

$$S_M = \frac{E(\tilde{R}_Z) - E(\tilde{R}_M)}{\sigma\tilde{R}_M} \tag{46}$$

Equation 44 may be written as[8]

$$E(\tilde{R}_j) = E(\tilde{R}_Z) + (E(\tilde{R}_M) - E(\tilde{R}_Z))\ \beta_j \tag{47}$$

The expected return on security j is the expected return of the zero-beta security plus a risk premium given by beta multipled by the difference between $E(\tilde{R}_M)$ and $E(\tilde{R}_Z)$. Therefore, the return of security j is a function of two factors: the beta factor and the expected return of the zero-beta factor. Equation 47 is the expression of the capital-asset-pricing model in its two-factor formulation.

The Capital-Asset-Pricing Model and Inflation

In finance literature, there are several variations of the capital-asset-pricing model that take into account an inflationary environment. In this study, these models are called the capital-asset-pricing model under inflation (CAPMUI).

The models developed by Roll; Gonzales-Gaviria; Chen and Boness; Biger; Chen; Hagerman and Kim; Friend, Lands-Kroner, and Losg; and Gorden and Halpern are examples of the development of market theory in which inflation is considered.[9] The models are of two

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[8]F. Black, "Capital Market Equilibrium With Restricted Borrowing," Journal of Business 45 (July 1972): 444-54.

[9]R. Roll, "Assets, Money and Commodity Price Inflation Under Uncertainty," Journal of Money, Credit, and Banking, November 1973, pp. 903-23; Nestor Gonzales-Gaviria, "Inflation and Capital Asset Prices: Theory and Tests" (Ph.D. dissertation, Stanford University, 1973); A. H. Chen and A. J. Boness, "Effects of Uncertain Inflation

types: those that assume the existence of an index asset and those that assume the existence of nominally riskless assets. The models of Roll and Biger are of the first type and are particular cases of the zero-beta model of Black.[10]

Solnik concluded that if inflation does affect asset returns, the market portfolio is not nominally efficient.[11] Developing Solnik's work further, Manaster concluded that no portfolio can be efficient in both real and nominal terms.[12] Brazil has an indexed economy. Its indexed treasury bills are assets that are free from the risk of inflation. These bills offer an interest rate in addition

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on the Investment and Financing Decisions of a Firm," Journal of Finance, May 1975; Nahum Biger, "Real Returns, Portfolio Decisions and the Capital Asset Pricing Model" (Ph.D. dissertation, York University, 1974); Elaine Chen, "Capital Asset Prices Under Uncertain Inflation" (Berkeley: University of California, Berkeley, 1974) (Typewritten.); Robert L. Hagerman and Han E. Kim, "Capital Asset Pricing With Price Level Changes," Journal of Financial and Quantitative Analysis 11 (September 1976); Irwin Friend, Yoram Landskroner, and Etienne Losg, "The Demand for Risky Assets Under Uncertain Inflation," Journal of Finance 31 (December 1976): 1287-97; Myron J. Gordon and Paul J. Halpern, "Bond Share Yield Spreads Under Uncertain Inflation," American Economic Review 66 (September 1976): 559-65.

[10]A detailed comparison among these models can be found in Kamalakar Vinayak Pradhan, "Capital Asset Pricing Model Under Uncertain Inflation: Theory, Tests, and Application" (Ph.D. dissertation, University of Toronto, 1978). In his dissertation, Pradhan also presented two new forms of CAPMUI.

[11]Bruno H. Solnik, "Inflation and Optimal Portfolio Choices," Journal of Financial and Quantitative Analysis 13 (December 1978): 913-25.

[12]Steven Manaster, "Real and Nominal Efficient Sets," Journal of Finance 34 (March 1979): 93-102.

to an adjustment to compensate for price-level changes. This interest rate can be considered a real rate of interest.[13]

In the present study, it was assumed that investors measure real return by subtracting inflation from nominal returns and that investors are real mean-variance optimizers. Therefore, the traditional form of the capital-asset-pricing model in real terms is valid. Assuming no risk-free security, Black's zero-beta model,[14] stated in terms of real returns, is the proper model.

Empirical Tests

In this section, the most important tests of the validity of the capital-asset-pricing model are reviewed. In addition, the problems found in developing the tests and proposed solutions to these problems are discussed.

The Test Developed by G. W. Douglas

Douglas regressed mean annual rates of return on variances of annual rates of return for a large sample of common stocks for the period 1946-63. He concluded that these regressions "are consistent with the hypothesis that the market places a positive price on risk bearing because there is a significant relation between the means and the statistical risk proxy (variance)."[15]

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[13] If the price-level adjustment follows inflation, this conclusion is correct. As mentioned previously, this adjustment does not always follow inflation in Brazil.

[14] Black, pp. 444-54.

[15] G. W. Douglas, "Risk in the Equity Markets: An Empirical Appraisal of Market Efficiency," Yale Economic Essays 9 (Spring 1969): 3-45.

By substituting Equation 36 for Equation 37, the following is obtained:

$$E(\tilde{R}_j) - R_F = \lambda \frac{\delta \sigma \tilde{R}_p}{\delta x_j} \tag{48}$$

or

$$E(\tilde{R}_j) - R_F = \left[\frac{E(\tilde{R}_p) - R_F}{\sigma \tilde{R}_p} \cdot \frac{\delta \sigma \tilde{R}_p}{\sigma x_j} \right] \tag{49}$$

The risk premium $(E(\tilde{R}_j) - R_F)$ expected for any asset j is proportional to $\delta \sigma \tilde{R}_p / \sigma x_j$ that is the marginal contribution of asset j to the standard deviation of the investor's optimal portfolio. This marginal risk of asset j can be expressed in terms of its variance and covariances by changing Equation 36 as follows:[16]

$$\frac{\delta \sigma \tilde{R}_p}{\sigma x_j} = \frac{1}{\delta \tilde{R}_p} \left[x_j \, \delta \tilde{R}_j^2 + \sum_{\substack{j=1 \\ j \neq i}}^{N} x_j \, \mathrm{cov}(\tilde{R}_j, \tilde{R}_i) \right] \tag{50}$$

According to this expression, the relative premium demanded by the investor also depends on the covariance components of the marginal risk.

Douglas' conclusion that there is a positive relation between mean returns and variances on individual securities neither confirmed not contradicted implications or predictions of the capital-asset-pricing model. A very strong positive association might have existed

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[16] M. Miller and M. Scholes, "Rates of Return in Relation to Risk: A Re-Examination of Some Recent Findings," in Studies in the Theory of Capital Markets, ed. Michael Jensen (New York: Praeger, 1972), pp. 47-77.

between a typical stock's own variance and its covariance with many other stocks during this period. Therefore, the variance is merely proxying for the sum of the two components.

Douglas checked this possibility by regressing the mean quarterly rates of return of a large sample of common stocks both on their variance of return and on their covariances of return with the average return of all stocks in the sample for a given quarter. He found that the coefficient of the variance term was substantially greater than its standard error in five out of seven periods. The coefficient of the covariance term was greater than its standard error in only two of the seven periods, and in one of these periods the coefficient had the wrong sign. He concluded that, once given its own variance, the covariance of a stock with other stocks is generally not significantly related to the average returns.

This result seems to invalidate the capital-asset-pricing model. The marginal risk of asset j, as given in Equation 36, is a function of its covariance with the market return and not a function of its own variance. Diversification eliminates the effect of the asset's own variance on the variance of the portfolio. Only the covariance component remains. So, if the capital-asset-pricing model is to be valid, this strong asociation between mean returns and variances of returns should not exist. An apparent conflict does exist between the portfolio theory and this empirical test.

The Study of J. Lintner

Some of Lintner's unpublished results that did not seem to be consistent with the capital-asset-pricing model were summarized by Douglas.[17] By combining Equations 28, 37, and 43, the following is obtained:

$$E(\tilde{R}_j) - R_F = \left[E(\tilde{R}_M) - R_F\right] \beta_j \tag{51}$$

As a measure of beta, Lintner used the coefficient b_j, which was obtained by regressing annual rates of return R_{jt} for 301 common stocks over the 10-year period 1954-63 on the yearly average rate of return for all the stocks in the sample R_{Mt} according to the following generating function:

$$R_j = a_j + b_j (R_M - R_F) + e_j \tag{52}$$

where:

e_j = Error term

a_j, b_j = Regression parameters

In the second pass, Lintner regressed the mean annual return for each company $\bar{R}_j$ on the b_j obtained in the first-pass regression. To this second regression, he added, as an independent variable, the residual variance around the first-pass regression $s^2(e_i)$ according to the following generating function:

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[17] J. Lintner, "Security Prices and Risk: The Theory and a Comparative Analysis of A.T.T. and Leading Industrials" (paper presented at the Conference on the Economics of Regulated Public Utilities, Chicago, June 24, 1965), summarized in Douglas, pp. 3-45.

$$R_j = a_o + a_1 b_j + a_2 s^2(e_j) + e_j \qquad (53)$$

where:

e_j = Error term

a_o, a_1, a_2 = Regression parameters

To confirm the validity of the capital-asset-pricing model, the parameters of Equation 53 should meet the following specifications:

1. a_1 should be an estimate of excess returns $(R_M - R_F)$,
2. a_2 should not be significantly different from zero,
3. a_o should not be significantly different from zero.

Lintner's results for the second-pass regression were:

$$R_j = 0.108 + \underset{t=6.9}{0.063 b_j} + \underset{t=6.8}{0.237 s^2(e_j)} \qquad (54)$$

The coefficient of multiple correlation was equal to 0.541.

These results contradicted the validity of the capital-asset-pricing model not only because the value of the coefficient of b_j was below the value 0.165, which was the approximate mean return in excess of interest for the shares in the sample over the period, but also because there was a strong association with respect to the residual variance $s^2(e_j)$.

Lintner's results were similar to those of Douglas. If they are taken as valid, the conclusion can be reached that shareholders are being compensated, on the whole and on the average, for bearing risks that could have been diversified. According to the theory, this diversification could be achieved by a simple increase in the number of shares in the investor's portfolio.

Therefore, if the portfolio is equally divided among N shares, x_j can be replaced by 1/N. The equilibrium condition in Equation 49 can be rewritten as:

$$E(\tilde{R}_j) - R_F = \frac{E(\tilde{R}_p) - R_F}{\sigma\tilde{R}_p^2} \left[\frac{1}{N} \sigma\tilde{R}_j^2 + \frac{N-1}{N} \overline{cov}(\tilde{R}_j, \tilde{R}_i) \right] \quad (55)$$

where:

$\overline{cov}(\tilde{R}_j, \tilde{R}_i)$ = Average covariance of asset j with the other assets

As the number of securities N increases,

$$\frac{1}{N} \sigma\tilde{R}_j^2 \to 0$$

Thus, the contribution of any security's own variance to the marginal risk becomes negligible, and the marginal risk of the asset approaches its average covariance with the other assets. It would seem that the Douglas and Lintner studies invalidated the capital-asset-pricing model.

The Study of Miller and Scholes

Miller and Scholes replicated Lintner's results for a different set of data.[18] They used the New York Stock Exchange Security Price, Dividend and Capital Changes File compiled by the Center for Research in Security Prices (CRSP) of the University of Chicago. Their results for a sample of 631 common stocks for a 10-year period,

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[18] Miller and Scholes, "Rates of Return in Relation to Risk."

1954-63, were similar to those of Lintner. The second-pass regression gave the following result:

$$R_j = 0.127 + 0.042b_j + 0.310s^2(ei) \qquad (56)$$
$$t = 7.40 \quad t = 11.76$$

A comparison of this second-pass regression result with that of Lintner in Equation 54 shows the same pattern. The coefficient of the residual variance term in both cases is positive and very large. The value of this coefficient is higher in the study of Miller and Scholes than in Lintner's study. The b_j coefficient is positive and significant but smaller than in Lintner's sample.

Miller and Scholes concluded that Lintner's results could be used as the starting point of their study. They began to search for a bias in the test procedure that could be responsible for these disturbing results. They divided the possible sources of bias into two groups:

1. Bias due to the misspecification of the basic estimating equation and

2. Bias stemming from the variables used to approximate return and risk.

In the first group, three specific problems were analyzed.

1. Failure to include the riskless interest rate

Failure to include R_F and to allow its variation over time may lead to a missing-variable bias in the measure of the covariance risk term β_j and to a corresponding distortion in its coefficient in the second-pass regression.

Using the risk-premium form for both return variables, Miller and Scholes explicitly introduced the riskless rate. Their results for the second-pass regression were:

$$R_j = 0.098 + 0.043b_j + 0.310s^2(e_i) \qquad (57)$$
$$t = 7.38 \quad t = 11.7$$

The coefficients of b_j and $s^2(e_i)$ are virtually identical to those of Equation 56. Therefore, the inclusion or omission of a riskless interest is not the cause of bias in Lintner's results.

2. Possible nonlinearity in the risk-return relation

Miller and Scholes supposed that the relation between mean returns and β_j is concave and that it can be approximated by the equation

$$R_j = a_o + a_1 b_j - a_2 b_j^2 + e_j \qquad (58)$$

If the relation is curvilinear, the slope of the linear regression can be flattened. Omission of the square term would be a misspecification.

Adding the square term to the second-pass regression, Miller and Scholes obtained the following expression for $\overline{R}_j$:

$$\overline{R}_j = 0.114 + 0.031b_j + 0.015b_j^2 \qquad (59)$$

The direction of the curvature is the opposite of the necessary type to introduce a flattening of the linear regression. The inclusion of the quadratic term does not increase the coefficient of b_j nor reduce the constant term. No misspecification was found.

3. Possible distortion due to heteroscedasticity

Heteroscedasticity by itself does not imply any bias in the coefficient of the second-pass regression. However, it is possible that the excessive weight given to observations at the right of the scale might distort the relation between systematic risk and return.

The regression scatter plot suggests that the variance of the disturbance term is not constant. To test this possibility, the second-pass regression was computed using natural logarithms of the variables. The result is as follows:

$$\ln\bar{R}_j = - 1.20 + 0.158b_j + 0.457\ln s^2(e_i) \qquad (60)$$

The coefficient of b_j remained below 1, and the component of the residual variance was still too large.

Miller and Scholes concluded that these three types of misspecifications of the test equation are not responsible for the results obtained by Lintner.

In the second group of possible sources of bias, four problems were analyzed.

1. Errors of measurement in β_j and the attenuation bias

The variable b_j represents sample statistics obtained from the first-pass regression. They are only estimates of the true betas. There is no reason to believe that these estimates are biased but that they are subject to sampling fluctuations. The lack of precision in estimating beta can be converted into an estimate of the amount of attenuation in the second-pass regression.

Miller and Scholes showed that, as the number of firms increases, the value of the estimate of the beta coefficient converges to:

$$\text{plim } \hat{a}_1 = 0.64\ a_1 \tag{61}$$

where:

$\hat{a}_1$ = Estimate of the coefficient of b_j

a_1 = The true coefficient of b_j

This means that the observed value of coefficient of b_j in the second-pass regression could be reduced to less than two-thirds of its true value. Therefore there was an attenuation of the coefficient of b_j from 0.165, which was the mean return in excess in the sample for the period, to 0.105. Miller and Scholes concluded that this bias could have been responsible for part of the attenuation that occurred in the b_j coefficient but not for all of it.

2. Residual risk as a proxy for covariance risk

The errors of measurement in b_j could also have distorted the coefficient of the residual variance terms. This bias occurs when there is a correlation between a company's residual variance and the true and unobservable beta. The bias is upward when the correlation is positive. Miller and Scholes regressed the values of b_j with $s^2(e_i)$ and obtained the following result:

$$b_j = 0.857 + 1.87s^2(e_i) \tag{62}$$

There was a positive correlation ($\rho = 0.131$).

This result confirms the existence of this bias. Miller and Scholes also showed that this bias is not large enough to justify the results obtained by Lintner.

3. Biases due to improper choice of index

The market index used in the first-pass regression can never be more than an approximation of the portfolio of the representative investor. Additional and more systematic errors of measurement can arise.

The authors elaborated two other indexes and used each one to recompute the first-pass regression. The new coefficients of systematic risk turned out to be almost perfectly correlated and proportional to the original b_j. The new and old measures of residual risk were almost identical. The coefficients of the new risk variables in the second-pass regression were virtually unchanged. Therefore, improper choice of index is not responsible for the results of Douglas or Lintner.

4. The lack of independence between sample moments: the skewness effect

Miller and Scholes showed that if the distribution of sample data is skewed to the right, an apparent ex post association between mean returns and residual variances can be observed, even though no such association exists ex ante in an investor's mind and, in fact, even though all the firms in the particular sample have exactly the same expected return and the same expected residual variance. The skewness effect tends to inflate the coefficient of $s^2(e_i)$ in the

second-pass regression and may also contribute to the downward trend of the coefficient of b_j. Examination of the returns of individual companies indicated that the data were skewed to the right. The conditions for this kind of bias in fact existed in the sample.

To show whether these skewness effects were large enough, either by themselves or in combination with measurement-error biases, thus accounting for Douglas' and Lintner's results, Miller and Scholes ran simulations with an artificially constructed sample. The conclusion was that the skewness effect itself could have been responsible for values of coefficient of $s^2(e_i)$ as high as those observed in Douglas' and Lintner's studies.

The conclusion of Miller and Scholes was that the findings of Douglas and of Lintner could not be accepted as definitive. As will be seen, the study of Miller and Scholes is fundamentally important for the design of research to test the validity of the capital-asset-pricing model. All of the sources of bias discussed above should be avoided.

The Study of Black, Jensen, and Scholes

To describe the work of Black, Jensen, and Scholes, it is necessary to review Equation 51:[19]

$$E(\tilde{R}_j) - R_F = \left[E(\tilde{R}_M) - R_F \right] \beta_j$$

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[19] Black, Jensen, and Scholes, "The Capital Asset Pricing Model: Some Empirical Tests."

To simplify, $[E(\tilde{R}_j) - R_F]$ can be represented as $E(\tilde{R}_j)$ and $[E(\tilde{R}_M) - R_F]$ can be represented as $E(\tilde{R}_M)$. Therefore, Equation 51 can be expressed in terms of excess returns as:

$$E(\tilde{R}_j) = E(\tilde{R}_M)\ \beta_j \tag{63}$$

This is the formulation of the capital-asset-pricing model in terms of excess returns. If α_j is defined by

$$\alpha_j = E(\tilde{R}_j) - E(\tilde{R}_M)\ \beta_j \tag{64}$$

If Equation 63 is valid, then α_j for every asset is zero.

One way to test the validity of the capital-asset-pricing model is to use the following generating function, derived from Equation 63:

$$\tilde{R}_{jt} = \alpha_j + b_j\ \tilde{R}_{Mt} + \tilde{e}_{jt} \tag{65}$$

Again, if the capital-asset-pricing model expressed by Equation 63 is valid, then the intercept α_j in Equation 65 is zero. Thus, a direct test of the model can be obtained by estimating Equation 65 for a security and testing to see if α_j is significantly different from zero.

Black, Jensen, and Scholes considered the above-described test as "simple but inefficient since it makes use of information on only a single security whereas data is available on a large number of securities."[20] Their objective was to design a test that

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[20] Ibid., p. 84.

would allow the aggregation of data on a large number of securities in an efficient manner.

To solve the problem caused by the nonindependence of the residuals, the authors ran the tests on grouped data. They formed portfolios and estimated Equation 65 defining $\tilde{R}_{jt}$ to be the average return on all securities in portfolio j for time t. The average risk of the securities in the portfolio was b_j, and α_j was the average intercept. This grouping procedure reduced substantially the errors in the estimate of b_j for the portfolio and consequently avoided the attenuation bias problem described by Miller and Scholes.

Black, Jensen, and Scholes were also interested in grouping the securities to obtain the maximum possible dispersion of the risk coefficients b_j. The use of ranked values of b_j obtained for the individual securities to construct portfolios would have introduced a selection bias into the procedure. This would occur because those securities entering the first high-beta portfolio would tend to have positive measurement errors in their risk coefficients b_j. This would have introduced a positive bias in the estimated risk coefficient for the portfolio. This positive bias would also have introduced a negative bias in the estimate of the intercept. The opposite would have occurred for the lowest-beta portfolio. To avoid this selection problem, the authors introduced an instrumental variable that was simply an independent estimate of beta of the security obtained from past data used in the ranking procedure. Then, with the data from other periods, the betas for the portfolio were

estimated. This procedure gave unbiased estimates of beta and α for the portfolios.

The data for the tests were taken from the Monthly Price Relative File of the Center for Research in Security Prices of the University of Chicago. The monthly returns on the market portfolio R_{Mt} were defined as the returns that would have been earned on a portfolio consisting of an equal investment in every security listed on the New York Stock Exchange at the beginning of each month. The risk-free rate was defined as the 30-day rate of U.S. treasury bills for the period 1947-66. For the period 1926-47, the dealer-commerce-paper rate was used.

To avoid a selection bias, Black, Jensen, and Scholes used five years of monthly data prior to the time being studied to obtain the estimate of risk b_j for each security. The ranked values of b_j were used to assign the security to a portfolio. The data from a subsequent period were used to estimate the portfolio-risk coefficient.

The group-assignment procedure just described is satisfactory as long as the coefficients b_j are stationary over time. A procedure to allow for the betas to be nonstationary over time was used and consisted of estimating the coefficient b_j using monthly returns over a five-year period. Based on the ranked value of b_j, the securities were grouped in 10 portfolios. The 10 percent of securities with the largest b_j were assigned to the first portfolio, and so on. Then, using data from the next 12 months, the returns of each of the 10 portfolios were computed. At the end of this period, the

entire process was repeated. Thus each portfolio may be considered a mutual fund that contains stocks that change over time.

With this procedure, 35 years of monthly returns on each of the 10 portfolios were obtained. Using these data in Equation 65, the least-square estimates of parameters b_j and α_j for each of the 10 portfolios were calculated.

The results of this time-series test showed that the intercepts were consistently negative for the high-risk portfolios ($b>1$) and consistently positive for the low-risk portfolios ($b<1$). Thus, the high-risk securities earned less than the amount predicted by the traditional form of the capital-asset-pricing model. The low-risk securities earned more than the amount predicted by the model.

In the cross-sectional test, 35 years of monthly returns were used for each of the 10 portfolios to compute the average return for each portfolio. This average and the estimates of the risk b computed in the time-series regression were used in estimating the cross-sectional relation given by

$$\overline{R}_j = \alpha o + a_1 b_j + e_j \qquad (66)$$

The 35-year interval was divided into four equal subperiods. The same procedure was repeated for the entire period.

The result of this test indicated that the relation between return and risk is linear but that the slope is nonstationary. In one of the subperiods, the slope a_1 had the wrong sign. The intercepts αo were different for each of the subperiods, but their t values were large, and all were significantly different from their

theoretical values. This evidence suggested that the model expressed by Equation 63 was misspecified.

The analysis of the empirical results of both time-series and cross-sectional tests indicates that these tests are consistent with a model that expresses the return on a security as a linear function of the risk beta and a second factor R_z.

Thus Equation 47 may be rewritten as

$$E(\tilde{R}_j) = E(\tilde{R}_z)\ (1 - \beta_j) - E(\tilde{R}_M)\ \beta_j \tag{67}$$

The generating function can be expressed by

$$R_{jt} = R_{zt}\ (1-b_j) + R_{Mt}b_j + e_{jt} \tag{68}$$

and the intercept in this regression can be expressed by

$$\alpha = R_z\ (1 - b_j) \tag{69}$$

If R_z is positive, a high-beta security tends to have a negative α, and a low-beta security tends to have a positive α. If R_z is negative, a high-beta security tends to have a positive α, and a low-beta security tends to have a negative α.

In the cross-sectional regression given by Equation 66, the two-factor model implies that the true values of parameters αo and a_1 are not equal to zero and $\bar{R}_M$. Instead they are expressed by

$$\alpha o = \tilde{R}_z \text{ and } a_1 = \tilde{R}_M - \tilde{R}_z$$

Based on Equation 67, it is apparent that the traditional form of the capital-asset-pricing model is consistent with the two-factor model, for $E(R_z) = o$.

In conclusion, the empirical results are consistent with the capital-asset-pricing model under the two-factor formulation.

The Study of Fama and MacBeth

According to Fama and MacBeth, there are three testable implications for Equation 47:[21]

1. The relationship between the expected return on a security and its risk in any efficient portfolio is linear.

2. Beta is a complete measure of risk of security j in the efficient portfolio.

3. Higher risk is associated with higher expected return: that is $E(\tilde{R}_M) - E(\tilde{R}_z) > o$.

To test Equation 47, Fama and MacBeth suggested the following stochastic model

$$\tilde{R}_{jt} = \tilde{\gamma}_{ot} + \tilde{\gamma}_{1t}\, b_j + \tilde{\gamma}_{2t}\, b_j^2 + \tilde{\gamma}_{3t}\sigma(e_i) + \tilde{e}_{jt} \qquad (70)$$

where:

$\tilde{R}_{jt}$ = One period return on security j

In Equation 70, γ_{ot} and γ_{1t} may vary stochastically from period to period. As mentioned in the third testable implication, the expected value of the risk premium γ_{1t}, which is the slope $[E(\tilde{R}_M) - E(\tilde{R}_z)]$, is positive. Thus

$$E(\tilde{\gamma}_{1t}) = E(\tilde{R}_{Mt}) - E(\tilde{R}_{zt}) > o$$

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[21] Fama and MacBeth, "Risk, Return, and Equilibrium: Empirical Tests."

The variable b_j^2 is included in Equation 70 to test linearity. Therefore, the condition for the first testable implication is that $E(\tilde{\gamma}_{2t}) = 0$. The expression for the second testable implication is that $E(\tilde{\gamma}_{3t}) = 0$ because beta should be a complete measure for risk. The disturbance term $\tilde{e}_{jt}$ is assumed to have zero mean and to be independent of all other variables.

The data used were obtained from the Center for Research in Security Prices of the University of Chicago. The methodology was very similar to that of Black, Jensen, and Scholes. They also used earlier data to rank securities to be entered in the portfolios, thus avoiding the regression phenomenon. On the other hand, the grouping of data in portfolios reduces substantially the bias introduced due to errors in the measurement of beta. The authors formed 20 portfolios based on the ranked value of b_j of securities computed from previous data.

To compute the estimate of b for the portfolios, Fama and MacBeth used an expression developed by Blume:[22]

$$b_p = \sum_{j=1}^{N} x_j b_j \tag{71}$$

where:

x_j = the weight of security j in portfolio p

They used seven years of data to form portfolios. For the subsequent five years, they computed initial values of the independent variables

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[22] M. E. Blume, "Portfolio Theory: A Step Toward Its Practical Applications," Journal of Business 43 (April 1970): 152-73.

and the risk-return regression given by Equation 70, fitted month-by-month for the subsequent four-year period. The results of the regressions supported all the three testable implications of Equation 47.

The Behavior of Other Stock Markets

Pogue and Solnik presented results of tests of the market model for seven European countries and compared these results with a sample of 65 American securities.[23] The data base consisted of 229 stocks from these seven countries. On the whole, the results did not show substantial differences between the United States and the four major European markets (Great Britain, France, Germany, and Italy). Some evidence indicated that the three smaller markets (Belgium, the Netherlands, and Switzerland) were less efficient.

Sharma and Kennedy tested the applicability of the random-walk hypothesis in a less-developed country, India, and compared this behavior to that of stock markets in advanced countries, the United States and England.[24] The methodology included analysis of runs and a test for independence. The sample covered 132 monthly observations in the index for each market from 1963 to 1973. The conclusion was that stocks on the Bombay Stock Exchange obeyed a random walk and

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[23]Gerald A. Pogue and Bruno H. Solnik, "The Market Model Applied to European Common Stocks: Some Empirical Results," Journal of Financial and Quantitative Analysis 9 (December 1974): 917-44.

[24]J. L. Sharma and Robert E. Kennedy, "A Comparative Analysis of Stock Price Behavior on the Bombay, London and New York Stock Exchanges," Journal of Financial and Quantitative Analysis 12 (September 1977): 391-413.

were equivalent in this sense to the behavior of stock prices in the market of advanced industrialized countries.

The primary objective of Lau, Quay, and Ramsey was to determine, first, whether the capital-asset-pricing model was applicable to the Tokyo Stock Exchange and, second, to estimate the degree of dependence between the Tokyo Stock Exchange and the New York Stock Exchange.[25] The results indicated that this model was applicable to the Tokyo Stock Exchange for the five-year period from October 1964 to September 1969 and that the two markets had a relatively low correlation coefficient.[26] The methodology used to test the model was very similar to that used by Black, Jensen, and Scholes.

Altman, Jacquillat, and Levasseur applied the market model to the French stock market and compared the results with equivalent studies of markets in the United States.[27] They analyzed a sample of 316 common stocks traded on the Paris Bourse for the period 1964-71. They concluded that the risk parameter beta was as stationary and stable in the French market as in the U.S. market and that the market model explained approximately the same amount of variability in

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[25]C. Sheila Lau, Stuart R. Quay, and Carl M. Ramsey, "The Tokyo Stock Exchange and the Capital Asset Pricing Model," Journal of Finance 29 (May 1974): 507-14.

[26]However, after Richard Roll's article, "A Critique of the Asset Pricing Theory's Tests," Journal of Financial Economics 3 (March 1977): 129-76, these conclusions cannot be considered as definitive. Roll's article is discussed in more detail below.

[27]Edward I. Altman, B. Jacquillat, and M. Levasseur, "Comparative Analysis of Risk Measures: France and the United States," Journal of Finance 29 (May 1975): 1495-1511.

individual firms' rates of return in France as in the United States.

Officer searched for seasonality in the Australian stock market.[28] Based on the performance of the forecasting model, he concluded that the Australian share market was seasonal but the presence of seasonality in share prices was not sufficient for rejecting the efficient-market hypothesis.

Although other studies could be cited, it seems that there is no reason to believe that the behavior of the Brazilian stock market is different, in terms of efficiency, from stock markets of other countries. In particular, it is reasonable to expect that the results from the tests that are described in this chapter will be similar for data from both Brazil and the United States.

The Critique of Richard Roll

Roll showed that the only economic conclusion of the capital-asset-pricing model is that the market portfolio should be mean-variance efficient.[29] The so-called tests of the model, based on a market-portfolio proxy, whether mean-variance efficient or not, have no relevance as tests of the capital-asset-pricing model.

Neither of the models mentioned previously nor the capital-asset-pricing model in its original form can be tested for validity.

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[28]R. R. Officer, "Seasonality in Australian Capital Markets, Market Efficiency and Empirical Issues," Journal of Financial Economics 2 (March 1975): 29-51.

[29]Richard Roll, "A Critique of the Asset Pricing Theory's Tests," Journal of Financial Economics 3 (May 1977): 129-76.

The purpose of the empirical evidence that is presented, which duplicates tests developed in the American market, is to compare and contrast the findings, not with regard to their validity as tests of this model, but as new evidence bearing on the issue.

Returns From Risky Assets and Inflation

The classic models of Fisher and Williams presented the effects of inflation on unlevered firms.[30] The assumption of these models was that the real value of unlevered equity is unaffected by inflationary or deflationary changes in general price levels. The same models, adjusted for a company's net creditor-debtor position, implied significant additional gains from unanticipated inflation when the company was in a net debtor position. Empirical evidence seems to show that this classic position is biased. Most of the studies of the relationship between inflation and returns from risky assets showed a negative relationship. Some of the findings of these studies are mentioned here.

Empirical Evidence

Michael Keran concluded that an increase in expected corporate earnings leads to a higher level of stock prices and that expectations of increasing inflation tend to lower the level of stock prices.[31]

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[30]Irving Fisher, Appreciation and Interest (New York: Macmillan, 1896, reprint ed., New York: Augustus M. Kelley, 1965), The Theory of Interest (New York: Macmillan, 1930); and John Burr Williams, Theory of Investment Value (Cambridge: Harvard University Press, 1938).

[31]Michael W. Keran, "Expectations, Money and the Stock Market," Review: Federal Reserve Bank of St. Louis, January 1971.

Expectations of inflation increase both corporate earnings and the interest rate at which earnings are discounted. Changes in inflation expectations exert much greater influence on the rate of discount than on corporate earnings.

John Lintner found that "a 5 percent deflation would reduce stock prices by 16.5 percent and 5 percent inflation reduces them by 3.35 percent."[32] Charles Nelson concluded that the evidence appeared to suggest that ex ante as well as ex post returns on stocks are correlated negatively with current and past changes in the consumer-price index.[33]

Jaffe and Mandelker analyzed the relationship between a stock index and the rate of change in the consumer-price index.[34] The regression estimated was:

$$R_{mt} = .0168 - 3.014\ \rho_t + \tilde{e}_t$$
$$t = 2.50$$

where:

R_{mt} = Return on the stock-price index at time t

ρ_t = Rate of change in the consumer-price index

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[32]John Lintner, "Inflation and Common Stock Prices in a Cyclical Context," National Bureau of Economic Research, 53rd Annual Report, 1973.

[33]Charles Nelson, "Inflation and Rates of Return on Common Stocks," Journal of Finance 31 (May 1976): 471-87.

[34]Jeffrey F. Jaffe and Gershon Mandelker, "The 'Fisher Effect' for Risky Assets: An Empirical Investigation," Journal of Finance 31 (May 1976): 447-58.

The regression of the real return (rm) on the one-period lagged consumer-price index was estimated as:

$$r_{mt} = .015 - 3.338\ I_{t-1} + \varepsilon_t$$
$$t = (-2.75)$$

Using the Fama measure of anticipated inflation, the authors estimated the regression of the stock market returns on unanticipated inflation as:

$$R_{mt} = .003016 - 2.518\ (\rho_t - \rho'_t) + \varepsilon_t$$
$$t = (-1.642)$$

where:

ρ'_t = One month treasury-bill rate

Jaffe and Mandelker concluded that nominal returns are negatively correlated with unanticipated inflation. However, Cagan and Lintner found that inflation was positively related to stock prices.[35]

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[35]Phillip Cagan, "Stock Values and Inflation," National Bureau of Economic Research, September 1973; and Lintner, "Inflation and Common Stock Prices in a Cyclical Context."

CHAPTER IV

ANALYSIS OF RATES OF RETURN

In this chapter, the performance of the market as a whole in the past decade is measured. Equation 14 showed how to compute the stock index. With this index, it was possible to compute market indices based on different methods. Equations 20 and 22 showed how to compute the value-weighted index and the equally weighted index. Equation 24 showed how to compute the real market return. As discussed in this chapter, the deflated market index is computed by using two different deflators. The first is the variation in value of the indexed national treasury bonds, and the second is the General Price-Level Index.

Why Use Two Deflators?

As was shown in Chapter I, the Brazilian economy is indexed based on a government index called the indexed national treasury bonds (ORTN). Recently this index was used as a tool to reduce inflation. Therefore, the variation in this official index has been smaller than the real inflation. For the entire decade, the variation of the official index was 35 percent smaller than the variation of real inflation measured by the General Price-Level Index (GPLI).

On the other hand, government and private bonds and long-term loans were indexed according to a variation of the ORTN. The

official index represents an alternative opportunity of investment. The official index followed inflation closely until the middle of the decade; then it started to lag behind real inflation.

Because the variation of the ORTN values represents an alternative type of investment and is the basis for indexation of the economy, a comparison is presented between the performance of the market and the performance of indexed bonds. In this study, indexed government bonds were viewed as risk-free securities. However, as discussed above, in the second half of the past decade this investment had inflation risk and could not be considered as risk free.[1]

Market-Performance Analysis

The Value-Weighted Index I_S for the Total Market

In nominal terms, the market index I_S increased from 103 to 1490 or 1390 percent during the decade. On the other hand, as deflated according to the GPLI, the market index decreased from 101 in the first period to 84 in the last, representing a real loss of 16 percent. Deflated according to the ORTN, the market index showed a gain for the decade, increasing from 100 to 129 or a 29 percent increase.

At this point it is interesting to analyze the 1971 market boom. The market index, deflated according to the GPLI, increased from 335 in July 1971 or a 235 percent increase in real terms in only 18 months. Since then, the market decreased, although with a few periods

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[1]The term "risk free" is used here as in the textbooks of finance. In reality, there is no pure risk-free security.

of small recoveries. At the end of the decade, the total market, in real terms, was only 25 percent of its value in July 1971. This means that an investor who bought the entire market (a portfolio of all the stocks in the same proportions as in the market) in July 1971 had, at the end of the decade, only 25 percent of his original purchasing power. To the extent that explanation of the market is possible, the implications of the boom market of 1971 are presented in Appendix G.

The behavior of the market as measured by the value-weighted index for the period of this study is presented in Figure 4.1 and Table 4.1.

The Equally Weighted Index I's for the Total Market

The behavior of the equally weighted index I'_S was substantially superior compared with the behavior of the value-weighted index. In nominal terms, the equally weighted index increased from 100 to 12405 for the decade. When deflated according to the GPLI, the index increased from 99 in the first period to 704 in the last, showing a real gain for the decade of 1.65 percent a month. When deflated according to the ORTN value variations, the index increased from 98 to 1076, showing a real gain for the period of about 2.02 percent a month.

This difference between the two indices was confirmed by Puggina.[2] Although he was working with another set of data, his

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[2] Puggina, p. 111.

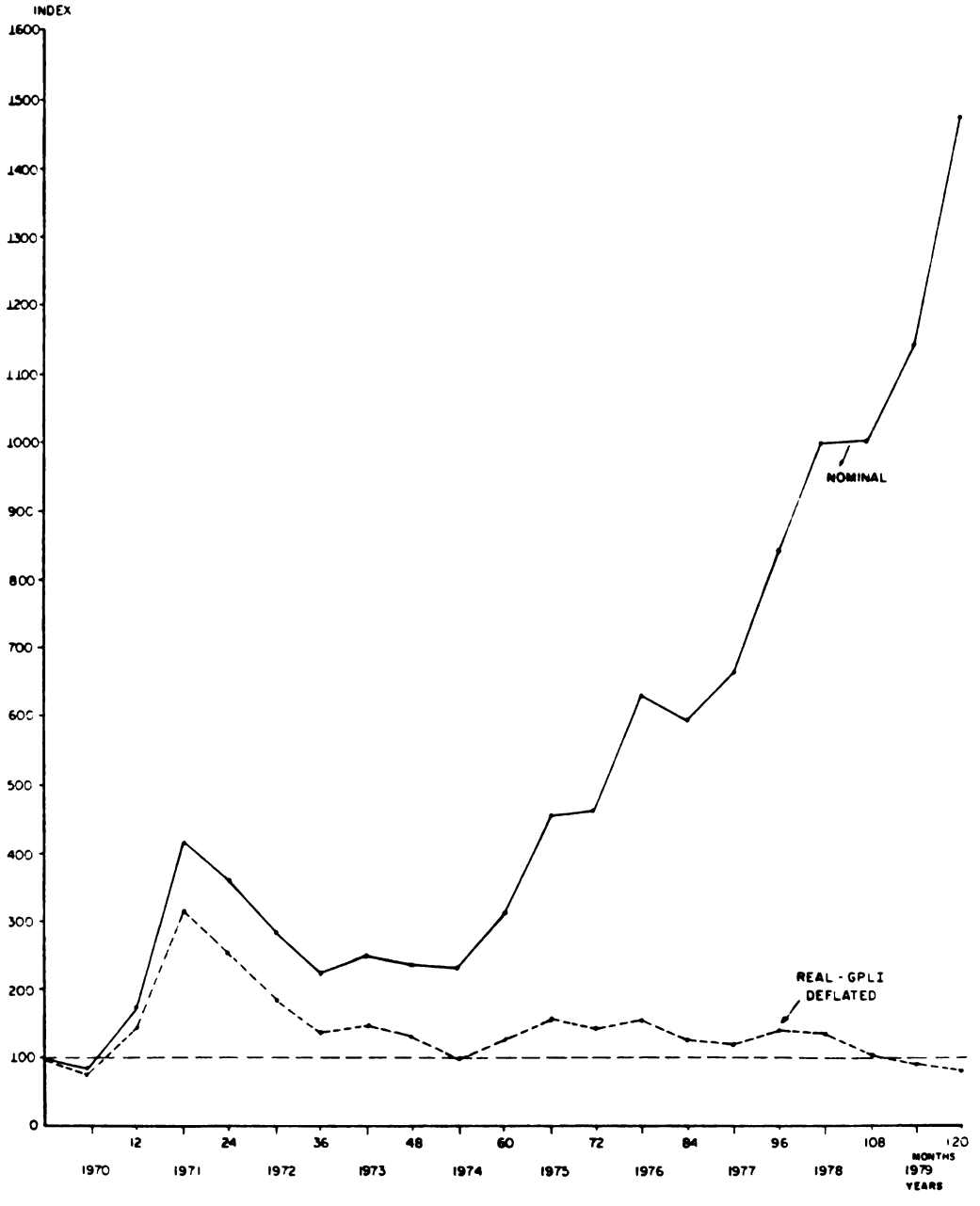

Figure 4.1.--Value-weighted index I_S for the total market.

Table 4.1.--The value-weighted index I_S for the total market.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Nominal						
1970	103	106	102	94	86	88	106	113	134	125	135	166
1971	212	224	266	311	430	412	451	396	385	326	297	361
1972	337	361	334	316	311	290	266	288	253	224	230	220
1973	212	199	222	307	267	251	275	276	307	251	245	235
1974	242	261	263	235	229	231	254	246	225	237	292	318
1975	312	324	341	352	369	462	503	457	492	467	467	469
1976	540	549	495	507	573	633	601	626	576	502	561	594
1977	631	631	672	677	668	662	716	776	822	826	860	846
1978	926	1020	993	997	1026	1002	1085	1099	1085	1053	1026	1004
1979	1032	1008	1027	1145	1184	1133	1157	1220	1408	1580	1416	1490
						Deflated (ORTN)						
1970	100	102	97	88	80	80	96	102	119	109	115	139
1971	175	182	214	247	337	316	340	292	278	231	207	248
1972	229	242	221	206	200	183	166	178	155	136	139	131
1973	125	116	128	176	151	140	152	152	167	135	131	123
1974	126	133	133	117	111	109	114	106	93	96	117	126
1975	122	124	128	130	133	164	175	157	165	154	173	149
1976	168	167	147	147	161	173	160	162	145	121	132	137
1977	143	140	146	143	136	131	138	146	153	151	155	150
1978	161	173	164	160	160	152	159	157	151	143	136	130
1979	130	124	124	133	132	123	122	125	139	149	128	129

Table 4.1.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Deflated (GPLI)						
1970	101	103	99	89	80	80	95	99	116	107	115	139
1971	175	180	211	242	327	309	335	290	279	234	211	252
1972	231	244	223	209	204	188	170	181	158	139	141	133
1973	127	117	129	177	152	141	153	153	167	135	130	121
1974	122	125	120	104	99	99	107	102	92	95	115	123
1975	118	120	124	126	129	158	168	149	157	145	143	139
1976	153	150	131	129	142	151	138	139	125	107	117	119
1977	123	118	121	117	113	110	118	125	129	127	129	124
1978	131	140	131	128	127	121	127	126	121	114	109	103
1979	102	94	93	101	101	92	89	87	96	102	85	84

real I'_S index increased 111 percent between March 1970 and December 1972, whereas the index used in this study increased 107 percent for the same period. On the other hand, Puggina's real I_S index increased 52 percent, whereas the index in this study increased 49 percent for the same period.

In Figure 4.2 and Table 4.2, the behavior of the market as measured by the equally weighted index is shown. The I_S and I'_S indices are compared in real terms in Figure 4.3.

It is possible to come to one important conclusion based on the analyses presented in these figures and table. If the same weight was given to all companies, the market index was substantially superior to the market index weighted according to the value of the companies. This means that smaller companies did better than larger ones. The reason for this can be found in the fact that a small number of low-performance large companies represented a large percentage of the total volume traded. In Appendix H the names of these companies and their percentage of the total volume traded are presented.

The BOVESPA Index

The BOVESPA index is the official index of the São Paulo Stock Exchange. This index assumes the reinvestment of dividends and sale of rights in the same stock. The basic characteristics of this index are as follows:

1. A group of stocks most actively traded in a certain period is selected to form the BOVESPA Portfolio.

2. The weighting system is based on the volume of trading.

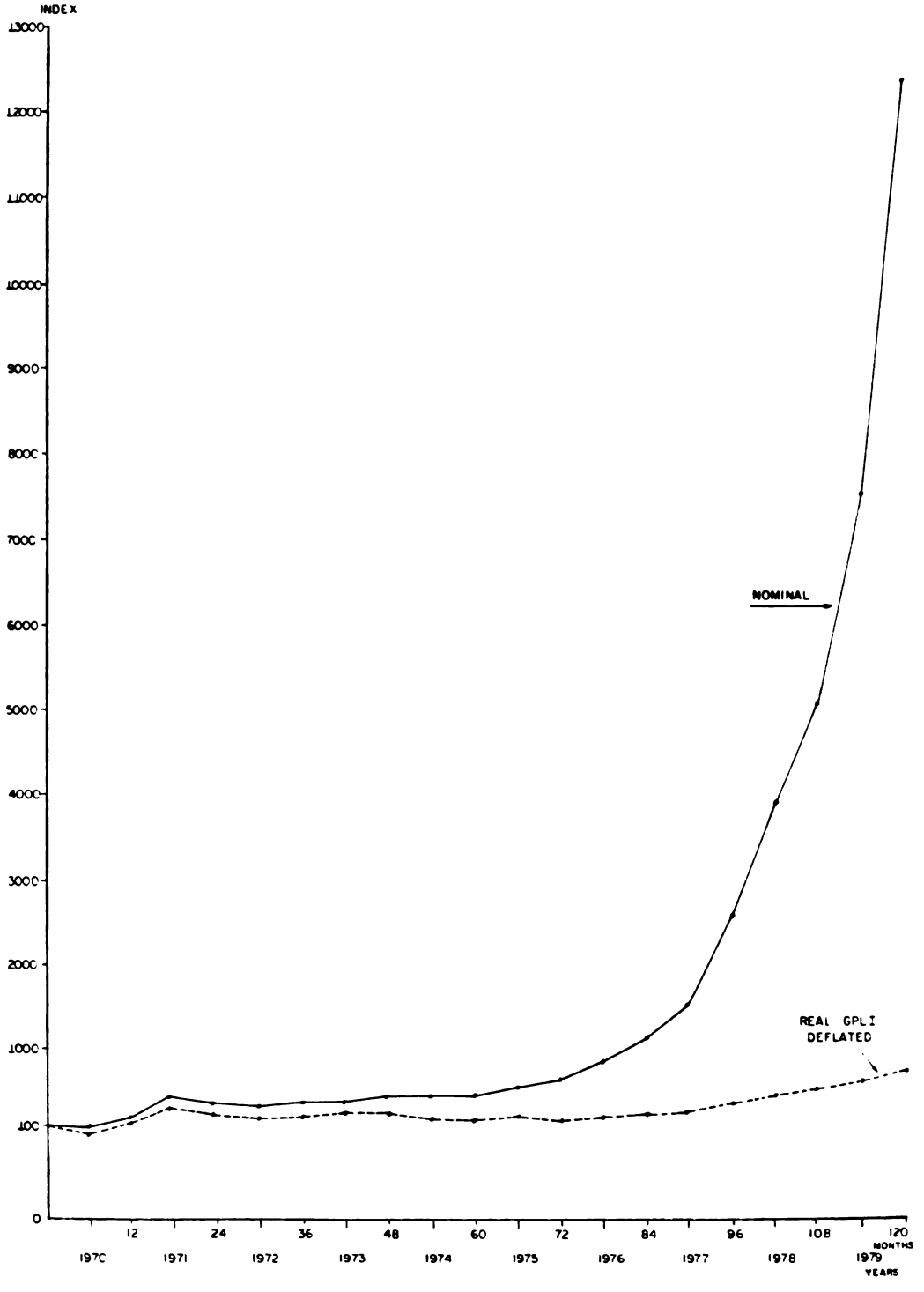

Figure 4.2.--Equally weighted index I'_S of the total market: nominal and real.

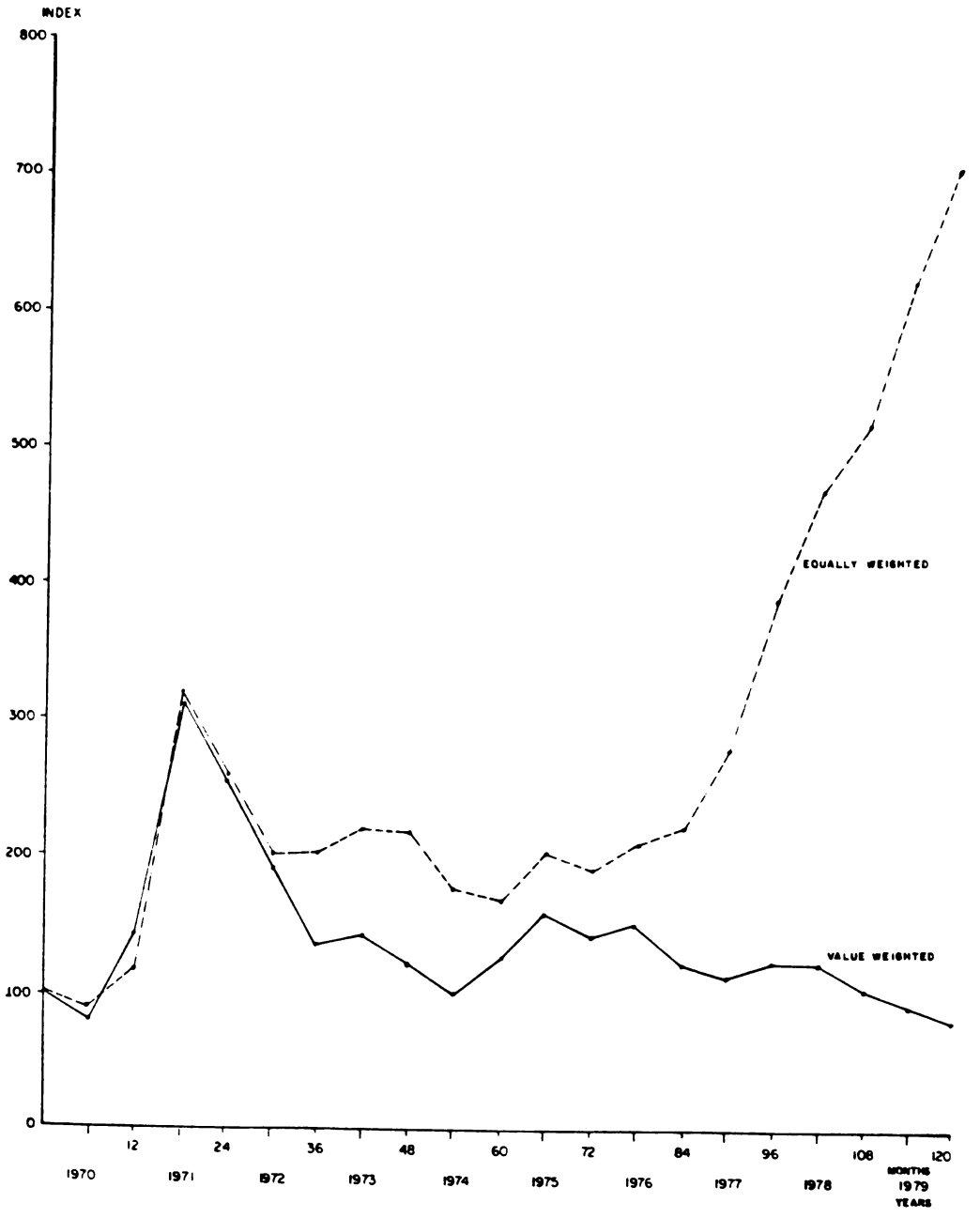

Figure 4.3.--Value-weighted and equally weighted indices of the total market, GPLI deflated.

Table 4.2.--The equally weighted index I'_s of the total market.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Nominal						
1970	100	105	103	98	97	99	108	112	119	118	125	142
1971	173	192	224	302	449	425	408	376	374	362	365	368
1972	468	336	315	320	321	308	306	327	338	326	332	339
1973	335	332	369	404	376	386	410	448	449	439	428	425
1974	430	446	453	420	406	410	428	418	394	399	419	428
1975	429	425	429	469	539	587	589	588	608	623	625	647
1976	694	736	742	778	837	883	961	1016	978	971	1043	1106
1977	1170	1260	1383	1519	1605	1665	1786	2002	2119	2267	2431	2687
1978	2965	3434	3517	3715	3884	3930	4214	4415	4628	4775	4888	5033
1979	5233	5374	6019	6951	7798	7640	7963	8807	10248	11390	11550	12405
						Deflated (ORTN)						
1970	98	100	98	92	91	91	98	101	106	103	107	119
1971	142	156	180	240	352	326	308	277	270	257	254	253
1972	237	226	209	209	207	195	191	202	208	198	201	202
1973	198	194	213	231	212	216	227	246	244	237	229	223
1974	223	228	229	209	198	193	193	180	164	162	168	169
1975	167	163	162	173	195	208	205	202	204	205	232	205
1976	216	224	221	226	236	242	256	264	246	235	246	255
1977	265	280	300	321	328	329	344	378	395	417	440	477
1978	516	584	583	598	607	596	620	638	646	651	650	652
1979	663	665	727	809	874	829	841	904	1012	1075	1043	1076

Table 4.2.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Deflated (GPLI)						
1970	99	101	99	93	91	90	96	98	102	101	106	119
1971	142	154	178	235	342	319	303	275	271	260	259	257
1972	238	227	210	211	210	199	195	206	211	202	204	205
1973	200	195	214	232	214	218	229	247	244	236	227	219
1974	216	215	207	185	176	175	181	173	162	161	165	165
1975	162	158	157	168	189	201	196	192	194	194	191	191
1976	197	202	196	199	208	212	221	226	213	207	218	222
1977	228	236	249	264	273	278	294	324	334	348	366	394
1978	420	471	467	478	482	474	495	511	516	518	522	519
1979	520	505	545	615	667	626	617	633	700	737	696	704

3. If the trading volume of one stock increases, it is included in the index; if the trading volume decreases, the stock is excluded.

4. The index is reviewed periodically, normally every three months.

Puggina felt that this index is biased. He stated: "The index is biased twice, in the sampling process and in the weighting system."[3]

In Figure 4.4, the evolution of the BOVESPA index and the I_S index is presented, both in nominal terms. In Table 4.3, the monthly values of this index are presented having 100 as a base for January 1, 1971. The I_S index in nominal terms for the total market is also presented.

Assuming that the value-weighted index I_S is the best market representation, it can be seen in Table 4.3 that, during the bull market of 1971, the BOVESPA index overstated the market. For all the other periods, the BOVESPA index understated the same market. In any case, the difference between the value-weighted index and the BOVESPA index was not extremely large. The reason for this behavior can be found in the fact that larger companies were more actively traded than small ones. Thus the weighting systems of the two indices were similar. The BOVESPA index can be considered a reasonable market representation.

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[3]Puggina, p. 29.

Fig

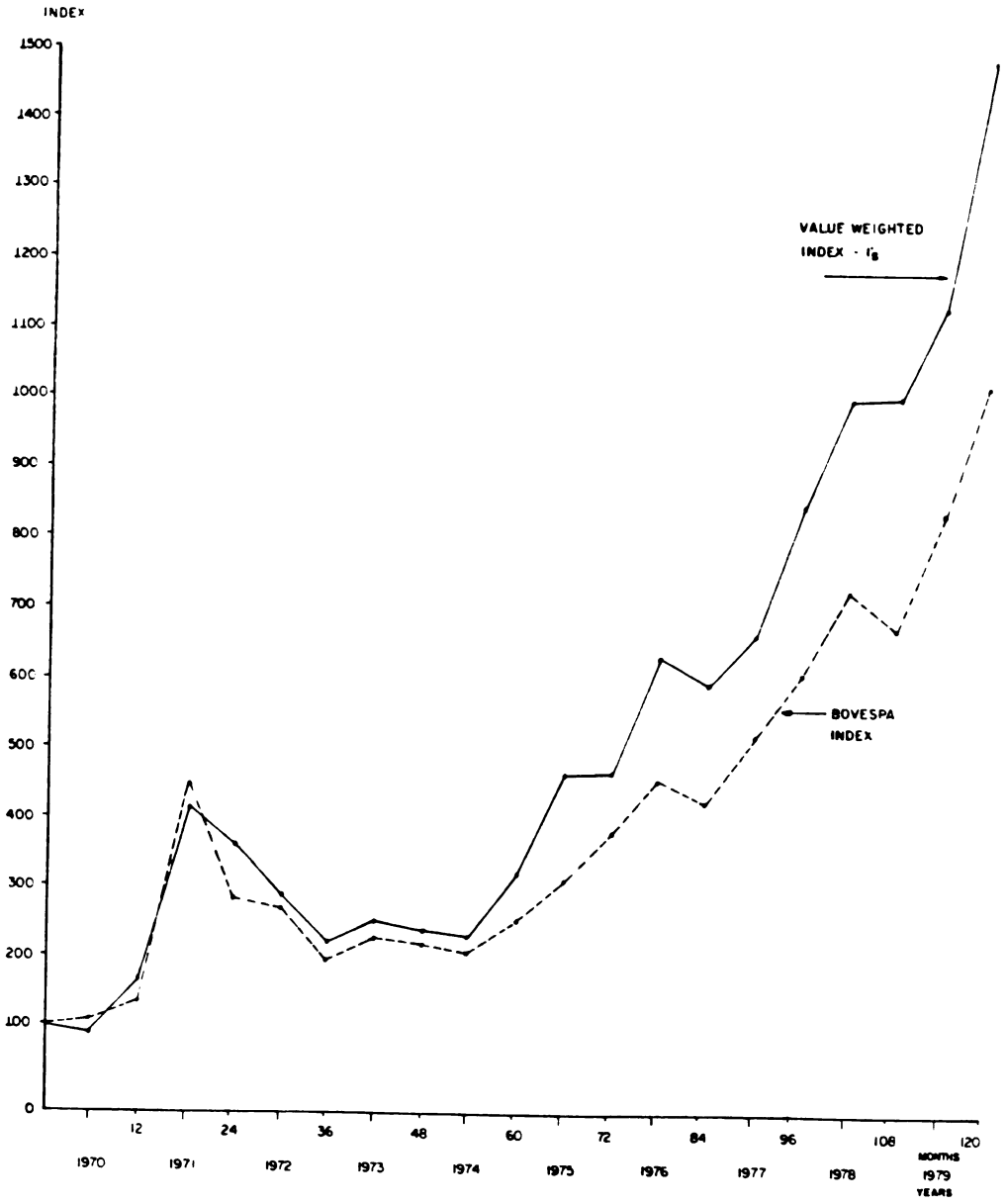

Figure 4.4.--The BOVESPA and the value-weighted indices for the total market.

Table 4.3.--The BOVESPA index and the value-weighted indices.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						BOVESPA Nominal						
1970	550	565	602	601	587	595	563	658	644	739	692	766
1971	855	1073	1093	1270	1508	2416	2140	2376	1980	1900	1738	1529
1972	1822	1560	1642	1480	1397	1449	1246	1078	1297	1176	997	1062
1973	1010	995	941	1035	1378	1233	1207	1266	1322	1334	1232	1171
1974	1062	1154	1272	1419	1137	1109	1078	1248	1223	1070	1021	1361
1975	1427	1460	1459	1453	1466	1666	2199	2412	2086	2289	2113	2040
1976	1963	2352	2429	2161	2162	2470	2805	2613	2726	2503	2129	2301
1977	2410	2668	2621	2840	2821	2791	2767	2824	3148	3456	3436	3276
1978	3397	3771	4103	4035	3761	3914	3887	4089	4003	4013	3744	3587
1979	3549	3614	3480	3592	4148	4489	4167	4164	4505	5455	6328	5445
						BOVESPA Nominal--Restated						
1970	103	105	112	112	109	111	105	123	120	138	129	143
1971	160	201	204	237	282	452	400	444	370	355	325	286
1972	341	292	307	277	261	271	233	201	242	220	186	198
1973	189	186	176	193	258	230	226	237	247	249	230	219
1974	198	216	238	265	213	207	201	233	229	200	191	254
1975	267	273	273	272	374	312	411	451	390	428	395	381
1976	367	440	454	404	404	462	525	489	510	468	398	430
1977	451	499	490	531	528	522	518	528	589	647	643	613
1978	636	706	768	755	704	732	727	765	749	751	701	671
1979	664	676	651	672	776	840	780	779	843	1021	1185	1019

Table 4.3.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Value-Weighted Index--Nominal						
1970	103	106	102	94	86	88	106	113	134	125	135	166
1971	212	224	226	311	430	412	451	396	385	326	297	361
1972	337	361	334	316	311	290	266	288	253	224	230	220
1973	212	199	222	307	267	251	275	276	307	351	245	235
1974	242	261	263	235	229	229	254	246	225	237	292	318
1975	312	324	341	352	369	462	503	457	492	467	467	469
1976	540	549	495	507	573	633	601	626	576	502	561	594
1977	631	631	672	677	668	662	716	776	822	826	860	846
1978	926	1020	993	997	1026	1002	1085	1099	1085	1053	1026	1004
1979	1032	1008	1027	1145	1184	1133	1157	1220	1408	1580	1416	1490

The Value-Weighted Indices for Common and Preferred Stocks

The value-weighted index was also computed with two different sets of data. In the first, only common stocks were included, and, in the second, only preferred stocks were used.

In Figure 4.5, a comparison is presented of the two indices on a real basis, deflated according to GPLI deflators. In Table 4.4, the value of this index in nominal and real terms is given.

It is evident from the data presented in Figure 4.5 and Table 4.4 that the common-stock index was almost always ahead of the preferred-stock index in nominal and real terms. The bull market of 1971 was the only point at which the preferred-stock index was higher than the common-stock index.

Since preferred stocks are less risky than common stocks, it would be expected that the return on preferred stocks would be less than the return on common stocks. Except for the bull market of 1971, this was true. This was the first evidence of irrationality of the market during 1971. During this period, the index for common stock in real terms reached a peak of 342 in June; the same index for preferred stocks reached a peak of 375 in May. After this period, common stocks showed a better resistance in the bearish market than preferred stocks. At the end of the decade, the index for common stocks was 106, showing a real gain for the 10-year period of 6 percent. On the other hand, the preferred-stock index closed the decade at 52, representing a real loss of 48 percent.

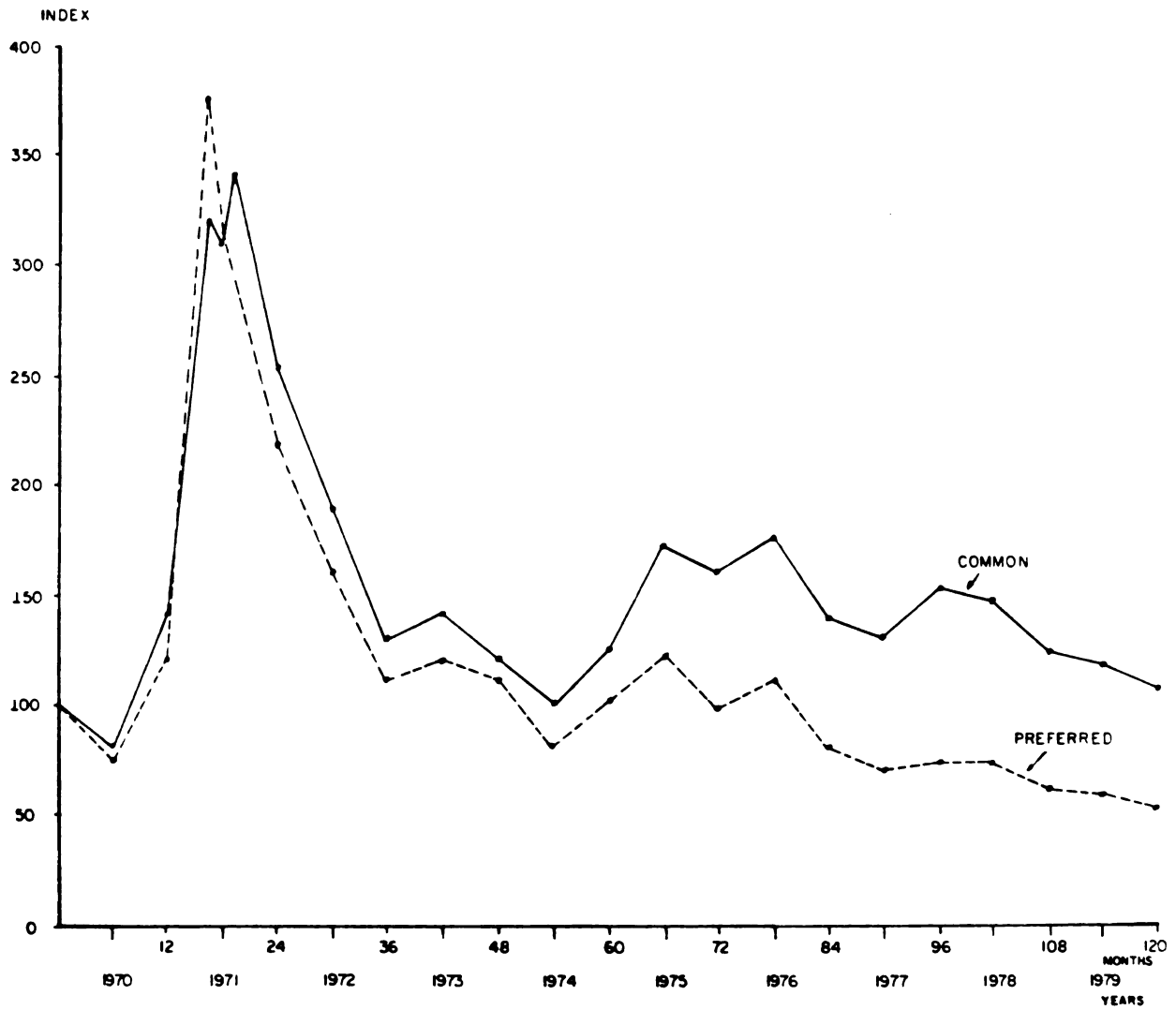

Figure 4.5.--Value-weighted indices for common and preferred stocks: real terms.

Table 4.4.--The value-weighted indices for common and preferred stocks.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Common Stock--Nominal							
1970	103	106	102	94	86	88	107	114	137	128	137	168
1971	218	227	267	307	420	409	460	399	392	327	297	364
1972	340	369	343	322	318	293	268	294	255	222	231	222
1973	216	204	221	310	255	253	275	279	276	265	241	226
1974	230	246	264	236	230	235	260	256	241	245	302	325
1975	320	335	346	361	400	502	540	498	544	530	519	536
1976	613	621	563	582	655	725	695	715	654	583	662	706
1977	741	747	801	806	795	796	822	912	970	986	978	1034
1978	1130	1238	1200	1229	1268	1230	1342	1365	1332	1334	1286	1256
1979	1284	1255	1278	1449	1449	1420	1472	1541	1754	1979	1826	1871
					Common Stock--Real							
1970	101	103	98	90	80	80	95	99	118	109	116	140
1971	179	183	212	239	320	307	342	292	284	235	211	254
1972	233	249	229	213	209	189	170	185	159	137	142	134
1973	129	120	128	178	145	143	153	154	150	142	128	117
1974	116	118	120	104	100	101	110	106	99	99	119	125
1975	121	124	126	129	140	172	180	162	173	165	158	159
1976	174	170	149	149	163	174	160	159	142	124	138	142
1977	144	140	144	140	135	132	135	147	153	151	147	151
1978	160	170	159	158	157	148	158	156	148	144	137	129
1979	127	118	115	128	128	116	114	110	119	128	110	106

Table 4.4.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Preferred Stock--Nominal						
1970	100	105	102	85	85	85	98	107	107	103	116	140
1971	160	190	244	329	492	418	363	354	315	301	286	320
1972	301	293	260	254	244	247	230	228	214	200	197	187
1973	175	162	191	260	250	212	235	233	317	192	216	216
1974	227	249	225	201	194	192	208	105	169	189	234	260
1975	252	258	281	287	280	350	388	344	364	332	344	330
1976	385	393	352	354	403	445	417	442	410	346	377	397
1977	428	424	447	450	444	434	502	527	555	547	609	542
1978	595	661	647	630	646	638	683	687	691	639	631	621
1979	643	626	639	696	720	699	699	744	876	976	838	916
						Preferred Stock--Real						
1970	98	102	99	80	79	78	87	94	92	88	99	118
1971	132	153	193	256	375	314	269	259	229	216	203	223
1972	206	198	173	168	160	159	146	144	133	124	121	113
1973	105	95	111	149	142	119	131	129	172	103	115	112
1974	114	120	103	88	84	82	88	81	69	76	92	100
1975	95	96	102	103	98	120	129	112	116	103	105	97
1976	109	107	93	90	100	106	96	98	89	74	78	80
1977	83	79	80	78	75	72	82	85	87	84	91	79
1978	84	90	86	81	80	77	80	78	77	69	67	64
1979	63	58	57	61	61	57	54	53	59	63	50	52

Sector Analysis

In Appendix C, the division of the companies on the exchange into sectors is shown. The behavior of the major sectors and subsectors is analyzed in this section according to the following order:

Sector	Subsector
10000--Industry	11000--Construction
	12000--Mining
	13000--Manufacturing
20000--Trade	21000--Domestic
	22000--Oil Dealers
30000--Services	31000--Financial Institutions
	32000--Public Utilities
90000--Miscellaneous	

Thus, seven subsectors and four sectors are analyzed:

1. Industry Subsectors: Construction, Mining, and Manufacturing

In Figure 4.6, the behavior of the three subsectors in real terms is compared. In Table 4.5, the value-weighted indices in real and nominal terms for the 10-year period for the three subsectors of the industry sector are shown.

During the bull market of 1971, the mining subsector reached the highest index level in real terms, 930 points in September 1971. After that, the index for mining declined, closing the decade at 32, showing a loss of 68 percent in real terms for the entire period.

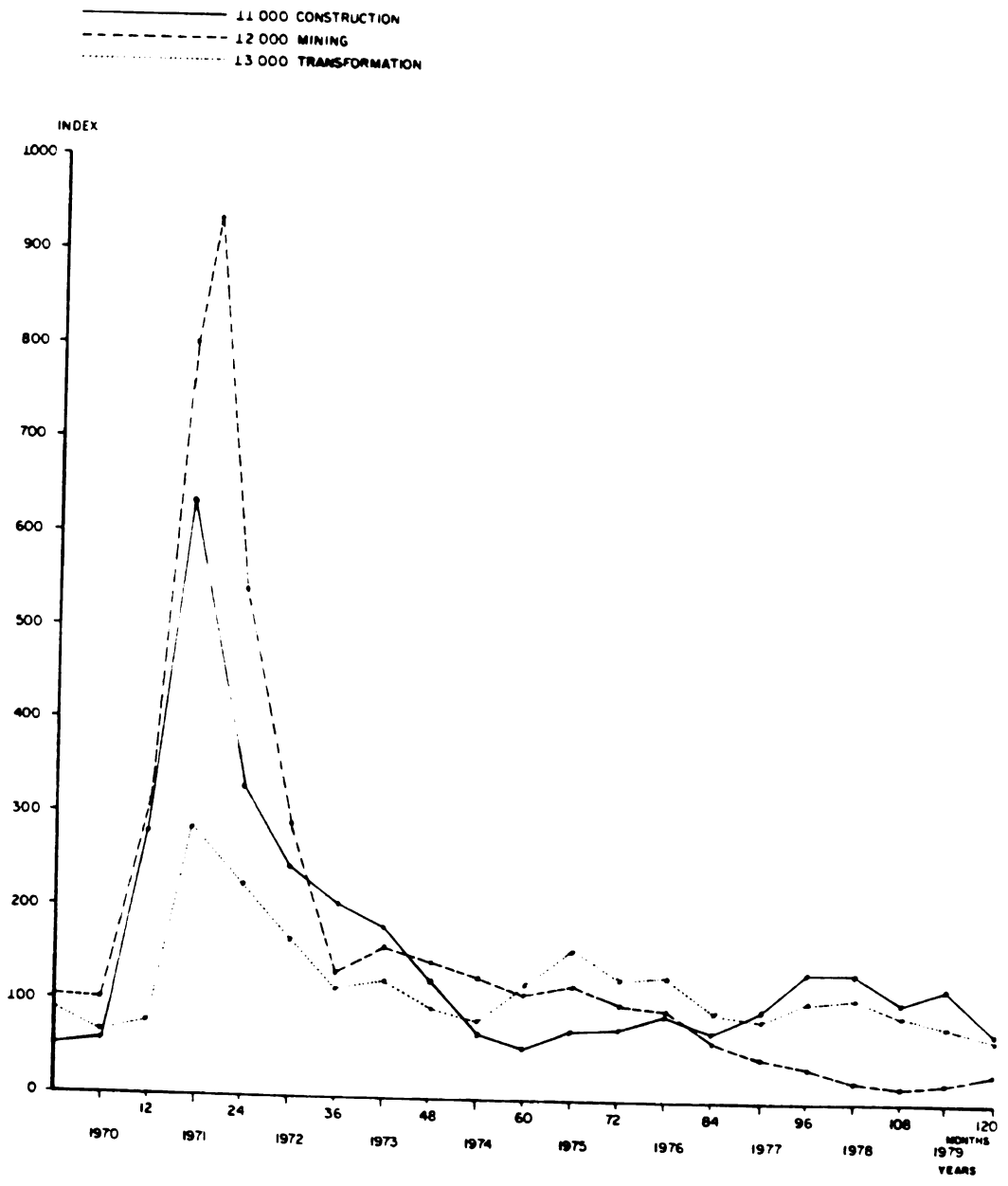

Figure 4.6.--Value-weighted indices for industry subsectors: GPLI deflated.

Table 4.5.--The value-weighted indices by sectors: 10000 industry.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						11000 Construction--Nominal						
1970	51	58	62	62	63	67	77	115	149	164	199	335
1971	269	516	638	748	835	704	578	567	549	507	498	473
1972	488	486	446	418	401	377	357	361	334	320	325	332
1973	303	282	299	311	285	314	307	319	324	301	274	235
1974	230	228	216	188	174	163	164	144	133	133	130	147
1975	160	161	163	178	213	216	200	194	196	199	189	235
1976	255	309	330	334	345	363	373	377	332	309	346	369
1977	409	424	484	539	562	587	635	678	720	735	885	944
1978	1129	1215	1196	1281	1286	1120	1213	1117	1179	1146	1062	1022
1979	969	1004	1004	1356	1482	1443	1098	1179	1270	1459	1851	1306
						11000 Construction--Real						
1970	50	56	59	59	59	61	69	100	128	141	169	280
1971	221	416	506	582	636	529	429	415	398	364	354	330
1972	334	328	298	276	263	244	228	227	208	198	200	201
1973	181	166	174	179	162	177	171	176	176	162	145	121
1974	116	110	98	83	75	70	69	60	54	53	51	56
1975	60	60	59	63	74	74	66	63	62	62	57	69
1976	72	84	87	85	85	87	86	84	72	66	72	74
1977	79	79	87	93	95	98	104	109	113	113	133	138
1978	160	165	159	164	159	135	142	128	131	124	113	105
1979	96	90	120	126	126	118	85	84	86	94	111	74

Table 4.5.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						12000 Mining--Nominal						
1970	106	107	108	107	101	111	93	207	272	292	296	376
1971	427	556	578	702	1049	936	1006	1108	1282	1054	954	784
1972	608	451	399	392	362	449	389	324	273	271	256	219
1973	178	204	300	350	314	278	339	293	291	268	244	281
1974	297	343	293	277	266	299	301	248	215	232	189	291
1975	283	318	353	356	357	359	360	325	283	406	387	335
1976	358	354	319	321	336	367	354	355	319	311	323	322
1977	323	298	345	314	264	234	223	237	315	285	237	233
1978	240	260	240	217	196	178	191	198	176	161	164	179
1979	214	260	264	295	295	296	307	399	572	551	492	564
						12000 Mining--Real						
1970	105	104	104	101	94	101	83	181	234	250	252	314
1971	352	448	458	561	799	703	747	811	930	756	678	547
1972	417	305	266	259	237	291	248	204	170	168	157	132
1973	106	120	174	201	179	156	189	162	158	144	129	145
1974	149	165	134	122	115	128	127	103	88	94	75	112
1975	107	118	129	127	125	123	120	106	90	126	118	99
1976	102	97	84	82	83	88	81	79	69	66	67	65
1977	63	56	62	54	45	39	36	38	49	43	35	34
1978	34	35	31	27	24	21	22	22	19	17	17	18
1979	21	23	23	25	25	24	23	28	39	35	29	32

Table 4.5.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					13000 Manufacturing--Nominal							
1970	91	100	95	86	73	74	78	83	85	80	84	98
1971	127	165	212	281	368	375	395	334	316	266	254	315
1972	300	339	302	294	283	257	238	271	234	207	211	201
1973	198	185	202	284	236	222	229	240	234	230	205	192
1974	198	214	225	193	188	192	220	209	195	195	312	319
1975	294	314	335	359	373	467	519	442	473	444	437	428
1976	518	524	435	452	494	555	513	517	475	402	451	461
1977	514	507	538	534	533	528	605	660	687	689	683	734
1978	870	971	902	879	946	949	1065	1056	1016	961	928	902
1979	929	885	985	1040	1040	986	995	1082	1287	1389	1185	1296
					13000 Manufacturing--Real							
1970	90	96	92	82	68	67	69	73	73	68	71	82
1971	105	133	168	219	280	281	294	245	229	191	180	220
1972	205	229	202	195	186	166	151	171	146	128	129	122
1973	118	109	117	163	134	125	128	132	127	124	109	99
1974	100	103	103	85	81	82	93	87	80	79	123	123
1975	111	116	123	128	131	160	173	144	150	138	133	127
1976	147	143	115	115	123	133	118	115	103	86	94	93
1977	100	95	97	92	91	88	99	107	108	106	102	107
1978	123	133	119	113	117	114	125	121	113	104	99	93
1979	92	82	80	87	89	80	77	77	87	89	71	73

The construction subsector index also increased dramatically during the bull market of 1971, reaching 636 in May. After that, the index decreased, reaching its lowest level in December 1974. From 1977, the index recovered, showing values superior to 100. It closed the decade at 74, with a 26 percent real loss for the 10-year period.

The manufacturing subsector showed the smallest variations. During 1971, the index reached 294 in June. It closed the decade at 73, showing a loss of 27 percent for the entire period.

2. Trade Subsectors: Domestic Equipment and Oil Dealers

The behavior of the subsectors in real terms is shown in Figure 4.7. The value-weighted indices in real and nominal terms for the trade subsectors are presented in Table 4.6. During the bull market of 1971, the increase in the deflated value-weighted indices was the smallest of all the subsectors. The index of oil dealers reached its highest point in June at 209. The value of the index for domestic equipment was even lower, reaching its peak in June at 162.

The index for the oil dealers reacted only after 1977, closing the decade at 219. The index for domestic equipment closed the decade at 59, showing a loss of 41 percent for the entire decade.

3. Services Subsectors: Financial Institutions and Public Utilities

The value-weighted indices in real terms for the service subsectors are shown in Figure 4.8. The value-weighted indices for the two subsectors in real and nominal terms are given in Table 4.7.

During the bull market of 1971, the value-weighted index deflated, reaching 415 in July for financial institutions and 329 in

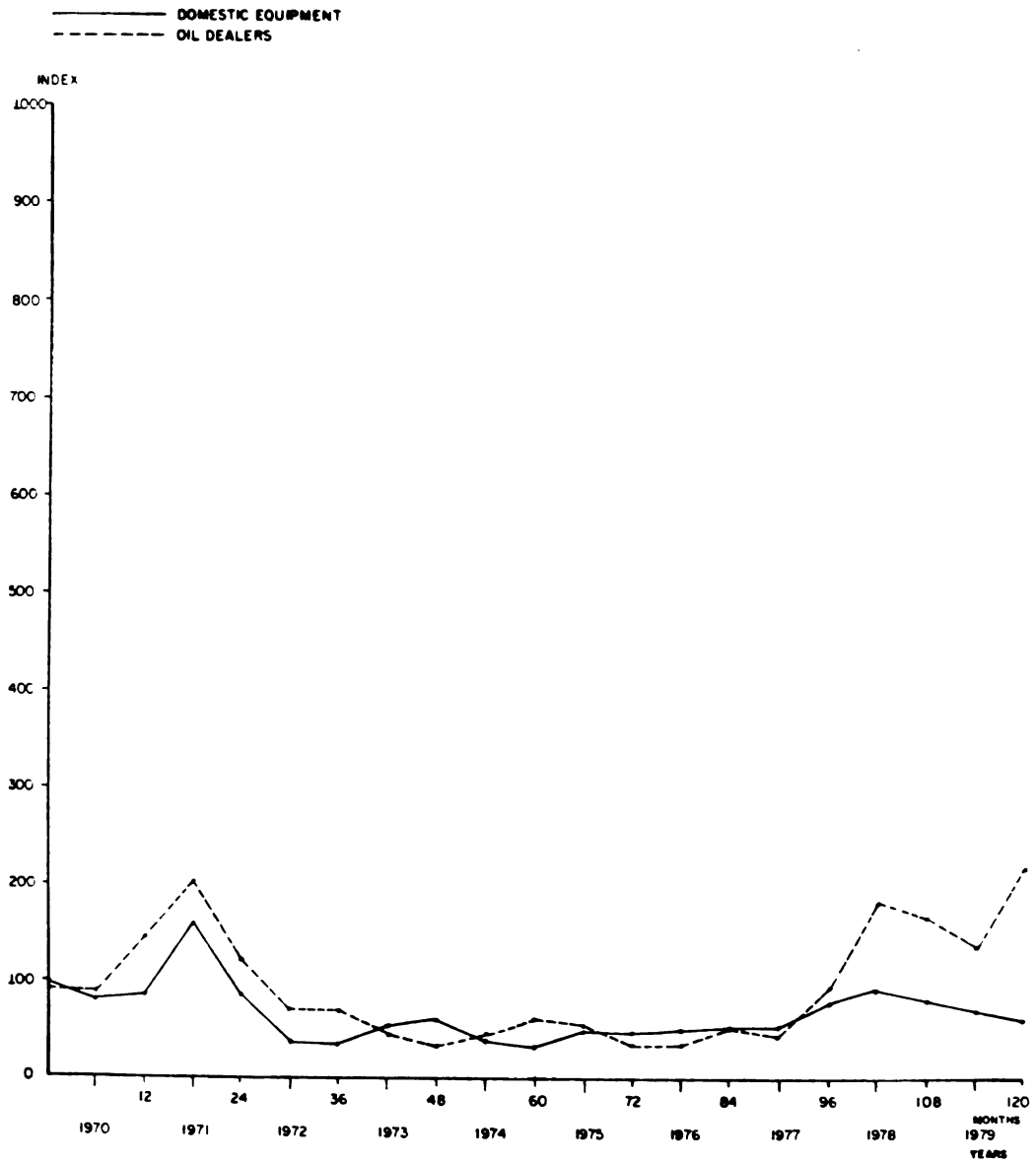

Figure 4.7.--Value-weighted indices for trade subsectors: GPLI deflated.

Table 4.6.--The value-weighted indices by sectors: 20000 trade.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
21000 Domestic Equipment--Nominal												
1970	98	100	93	95	95	91	91	88	92	83	90	101
1971	116	123	144	185	239	216	242	136	123	114	117	121
1972	100	95	87	94	90	68	72	73	69	67	72	74
1973	73	77	99	102	99	99	111	120	114	112	110	112
1974	119	127	121	101	100	98	105	92	84	89	90	89
1975	83	84	82	98	120	137	135	129	131	128	129	151
1976	168	187	167	187	202	210	209	214	183	219	239	260
1977	259	270	308	315	286	299	310	358	346	428	509	530
1978	536	659	670	834	733	746	821	852	828	800	817	793
1979	921	904	823	863	855	857	936	918	983	1049	1123	1055
21000 Domestic Equipment--Real												
1970	96	97	89	90	89	83	82	77	79	71	76	85
1971	95	99	114	144	182	162	180	99	89	82	83	85
1972	69	64	58	62	59	44	46	46	43	41	44	44
1973	43	45	57	59	56	55	62	66	62	60	58	58
1974	70	61	55	45	43	42	44	38	34	36	35	34
1975	31	31	30	35	42	47	45	42	41	39	39	45
1976	48	51	44	47	50	50	48	47	39	46	50	52
1977	50	50	55	54	48	50	51	58	54	65	76	77
1978	76	90	89	107	91	90	96	97	92	86	87	81
1979	91	84	74	76	73	70	72	66	67	67	67	59

Table 4.6.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					22000 Oil Dealers--Nominal							
1970	96	106	109	94	95	94	103	102	104	76	84	86
1971	98	123	171	166	273	278	243	206	189	168	162	180
1972	153	155	134	138	140	112	103	116	121	121	113	121
1973	111	101	99	114	76	76	77	79	82	77	77	68
1974	72	89	104	100	104	114	121	118	98	131	168	171
1975	152	150	145	129	141	159	139	129	135	131	131	129
1976	145	146	142	130	133	142	143	140	144	146	180	262
1977	276	338	297	271	254	258	325	340	470	539	607	643
1978	704	837	851	888	1361	1529	1641	1397	1523	1601	1681	1630
1979	1748	1658	1669	1572	1704	1751	1751	2399	2860	3456	3863	3866
					22000 Oil Dealers--Real							
1970	95	102	105	89	88	86	92	89	89	65	71	72
1971	81	99	136	129	208	209	180	151	137	120	115	126
1972	104	105	89	91	92	72	65	73	75	75	69	73
1973	66	59	58	65	43	42	43	43	44	41	40	35
1974	36	43	47	44	45	49	51	49	40	53	66	66
1975	57	56	53	46	49	54	46	42	43	41	40	38
1976	41	40	37	33	33	34	32	31	31	31	37	52
1977	54	63	53	47	43	43	53	55	74	82	91	94
1978	99	115	113	114	169	184	193	160	169	173	179	168
1979	173	155	151	139	145	143	135	172	195	223	233	219

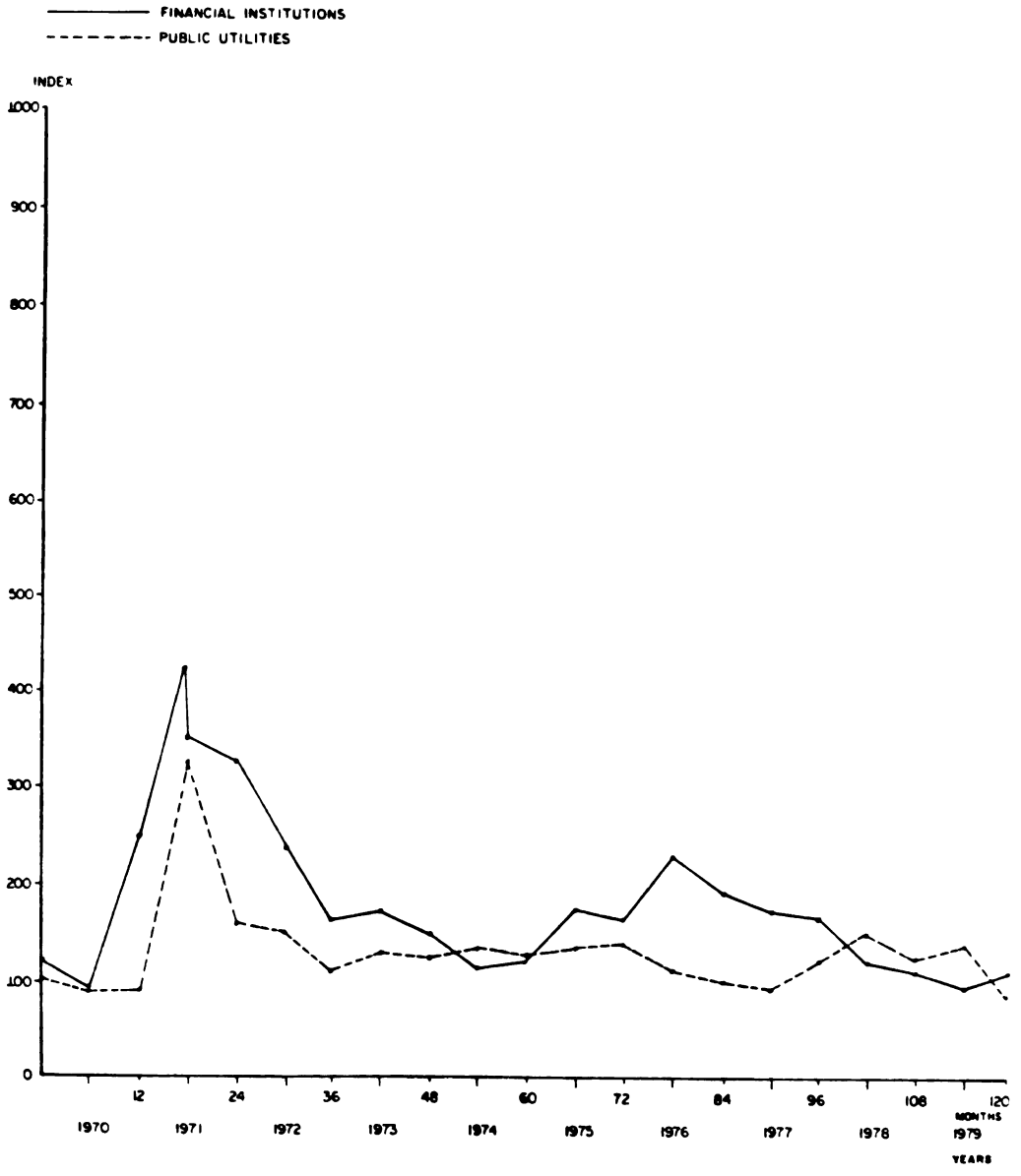

Figure 4.8.--Value-weighted indices for service subsectors: GPLI deflated.

Table 4.7.--The value-weighted indices by sectors: 30000 services.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					31000 Financial Institutions--Nominal							
1970	120	114	112	100	100	105	154	165	227	210	232	297
1971	386	346	380	371	570	464	558	531	553	461	396	485
1972	444	448	432	379	395	362	328	355	306	252	277	270
1973	247	212	239	386	334	304	362	346	466	270	298	293
1974	299	320	307	254	250	241	268	269	239	282	265	315
1975	340	344	344	334	353	508	552	531	611	559	571	560
1976	634	647	634	655	816	930	885	966	891	749	848	947
1977	969	992	1041	1080	1067	1041	1072	1149	1229	1218	1314	1125
1978	1122	1187	1247	1158	1126	1033	1060	1057	1118	1137	1101	1132
1979	1104	1128	1110	1248	1284	1193	1263	1304	1574	1954	1977	1920
					31000 Financial Institutions--Real							
1970	118	110	108	95	93	96	137	144	196	180	197	249
1971	318	279	301	289	434	349	415	389	400	331	281	339
1972	304	303	288	250	258	234	209	224	191	155	170	163
1973	147	124	138	222	190	171	202	191	253	145	158	151
1974	151	154	140	112	108	103	113	112	98	114	104	121
1975	128	128	126	119	124	174	184	173	195	174	174	165
1976	180	177	167	167	203	223	204	215	194	160	177	191
1977	189	186	187	188	182	174	176	186	194	187	197	165
1978	159	163	165	149	136	124	124	121	124	123	117	116
1979	109	106	100	110	109	97	97	93	107	126	107	109

Table 4.7.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					32000 Public Utilities--Nominal							
1970	106	120	113	115	106	103	108	111	107	104	104	111
1971	123	139	172	245	260	438	415	327	238	231	213	226
1972	220	231	222	251	232	229	213	208	209	194	192	184
1973	199	204	216	231	234	235	245	255	268	266	268	256
1974	256	272	294	321	310	218	323	328	306	297	309	333
1975	335	328	356	367	386	394	413	415	419	408	419	485
1976	504	512	502	478	480	459	476	482	449	450	486	491
1977	510	498	551	535	520	549	575	627	670	690	756	822
1978	876	1005	961	1183	1211	1219	1284	1425	1373	1328	1319	1210
1979	1322	1350	1479	1670	1670	1677	1662	1649	1612	1714	1637	1512
					32000 Public Utilities--Real							
1970	104	116	109	109	98	94	96	97	97	98	89	93
1971	102	112	136	191	198	329	308	239	173	166	151	158
1972	151	156	148	166	152	148	135	131	130	120	118	111
1973	119	120	126	132	133	132	136	141	146	143	142	127
1974	129	131	134	142	134	136	137	136	125	120	122	128
1975	126	122	130	131	135	135	138	135	134	127	128	143
1976	143	140	132	122	119	110	109	107	97	96	101	99
1977	99	93	99	93	88	91	94	101	105	106	113	120
1978	124	138	127	152	150	147	151	163	153	144	141	124
1979	131	126	134	147	142	137	128	118	110	111	98	85

June for public utilities. After that, both indices declined; but, in general, the index for financial institutions was always ahead of the index for public-utilities companies. At the end of the period, the indices were 109 for financial institutions and 85 for public utilities, both in real terms.

4. Sector Analysis: Industry, Trade, Services, and Miscellaneous

In Figure 4.9, the behavior of the four sectors is shown. The value-weighted indices for the four sectors are given in Table 4.8. During the bull market of 1971, the service sector reached its highest level in May at 387. The service sector outperformed all the other sectors until the middle of 1977, when the stocks included under miscellaneous obtained better results. It is important to note that only six companies were included in the miscellaneous sector. As shown in Figure 4.9, after June 1977, the miscellaneous sector was substantially superior to all the other sectors. Only two sectors closed the decade lower than 100: industry and trade. The trade sector had the poorest performance for the entire decade. Only during the 1971 boom was the deflated index for trade higher than 100.

From the analysis of the sectors and subsectors, it is apparent that the bull market of 1971 was of tremendous importance for the Brazilian stock market. After that, the market did not recover. Thus it would seem that the stock market was not a good hedge against inflation during that decade.

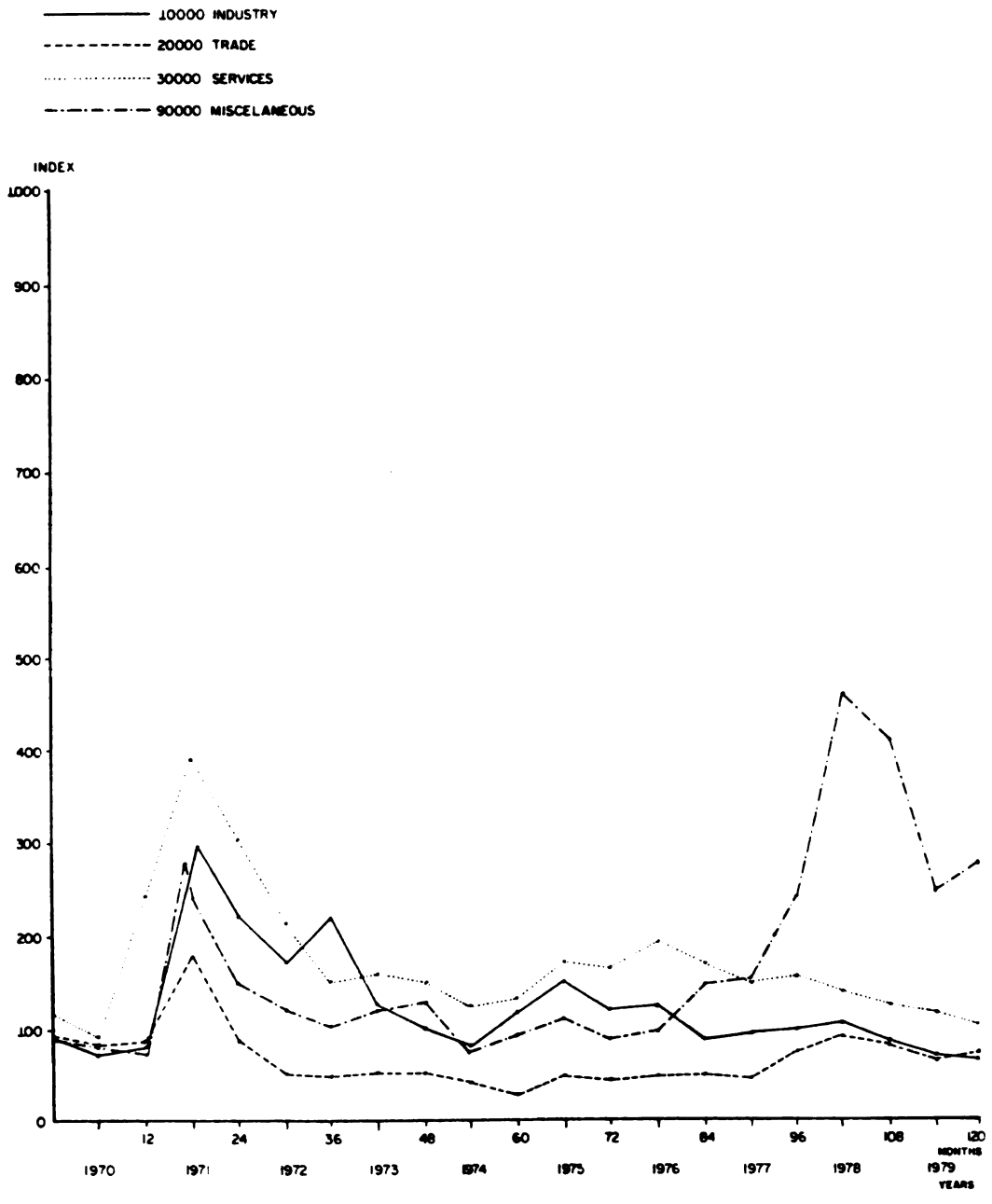

Figure 4.9.--Value-weighted indices by sectors: GPLI deflated.

Table 4.8.--The value-weighted indices by sectors: industry, trade, services, and miscellaneous.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						10000 Industry--Nominal						
1970	91	99	95	86	73	74	78	84	85	81	85	100
1971	129	168	215	285	373	379	398	338	320	270	258	317
1972	302	339	303	295	284	267	245	270	232	209	211	200
1973	193	184	206	282	236	222	233	239	234	228	204	195
1974	201	219	224	194	189	195	219	205	190	191	291	305
1975	283	303	325	345	359	441	488	417	441	424	417	406
1976	487	493	412	427	465	522	484	488	447	382	427	436
1977	483	475	507	502	497	491	559	609	639	639	631	677
1978	800	892	830	808	866	866	970	961	925	875	845	822
1979	848	798	813	906	958	910	915	999	1193	1285	1104	1201
						10000 Industry--Real						
1970	90	96	91	82	68	67	69	73	74	69	72	83
1971	106	135	171	222	284	284	296	248	232	194	183	221
1972	207	229	202	195	186	173	156	170	145	129	129	221
1973	115	108	119	162	134	125	130	132	127	123	108	101
1974	101	105	102	86	82	83	93	85	78	77	115	118
1975	107	112	119	123	126	151	162	136	140	132	127	120
1976	138	135	109	109	116	125	111	108	97	81	89	87
1977	94	89	91	87	84	82	92	98	100	98	95	99
1978	113	122	110	104	107	104	114	110	103	95	90	84
1979	84	75	73	80	81	74	70	71	81	83	66	68

Table 4.8.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					20000 Trade--Nominal							
1970	98	102	95	94	95	91	93	90	94	83	90	100
1971	115	126	152	186	250	230	243	156	143	131	133	133
1972	111	110	99	107	109	87	87	91	88	85	85	86
1973	84	84	101	108	97	97	107	114	109	107	107	107
1974	112	121	119	102	99	99	106	96	87	94	101	100
1975	93	94	90	102	122	137	133	126	129	126	128	145
1976	161	176	159	173	185	193	192	197	173	202	221	247
1977	244	260	286	288	265	277	292	335	342	414	488	509
1978	521	637	645	780	746	773	847	849	843	827	849	824
1979	942	920	857	883	893	900	965	1013	1118	1238	1334	1268
					20000 Trade--Real							
1970	96	98	92	89	88	83	83	79	81	71	77	84
1971	94	101	120	145	190	173	181	114	103	94	95	93
1972	76	74	66	71	71	56	56	57	55	52	52	52
1973	50	49	59	62	55	54	59	63	59	58	57	55
1974	56	58	54	45	43	42	45	40	35	38	40	38
1975	35	35	33	36	42	47	44	41	41	39	39	43
1976	45	48	42	44	46	46	44	44	37	43	46	49
1977	47	48	51	50	45	46	48	54	54	63	73	74
1978	74	87	85	100	92	93	99	97	94	89	90	85
1979	93	86	77	78	76	73	74	72	76	80	80	72

Table 4.8.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					30000 Services--Nominal							
1970	117	115	112	103	101	105	144	154	203	189	207	261
1971	335	305	339	345	509	456	529	489	491	416	360	434
1972	399	405	390	353	356	333	307	320	292	251	265	257
1973	247	225	248	355	320	300	344	337	424	289	309	297
1974	305	326	325	300	293	289	310	313	283	310	302	346
1975	365	365	376	373	394	506	544	530	586	546	558	577
1976	636	649	635	639	750	818	794	852	787	692	773	843
1977	865	877	931	952	936	930	962	1035	1107	1107	1198	1087
1978	1104	1196	1222	1240	1227	1165	1207	1256	1280	1277	1249	1232
1979	1250	1277	1311	1477	1501	1442	1484	1507	1675	1969	1820	1869
					30000 Services--Real							
1970	115	111	108	98	94	96	129	135	175	162	176	218
1971	276	246	269	269	387	342	393	358	356	298	255	303
1972	273	274	261	233	233	215	194	202	182	155	163	155
1973	148	133	144	204	182	169	192	186	231	155	164	153
1974	154	157	149	132	127	124	131	130	116	125	119	134
1975	138	163	137	133	138	173	181	173	187	170	170	171
1976	181	178	168	163	186	196	183	190	171	147	161	170
1977	169	164	167	165	159	155	158	167	174	170	180	159
1978	156	164	162	159	152	140	142	144	142	138	133	127
1979	124	120	118	130	128	118	115	108	114	127	109	106

Table 4.8.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					90000 Miscellaneous--Nominal							
1970	92	123	112	100	100	91	104	93	90	92	92	90
1971	111	115	138	237	360	320	255	242	227	208	202	217
1972	204	199	190	202	264	205	193	237	186	173	176	179
1973	179	170	204	229	223	228	200	258	279	287	261	256
1974	247	240	230	216	198	195	217	204	165	171	216	236
1975	232	215	192	224	285	329	306	313	318	311	297	300
1976	294	320	299	356	429	406	533	600	597	590	619	704
1977	818	785	852	881	885	907	1200	1394	1528	1723	1991	2362
1978	2287	2453	2106	3437	3544	3537	3918	4199	4097	4096	4094	4069
1979	4089	3517	3706	3502	3212	3049	3605	3999	5080	5807	4812	4926
					90000 Miscellaneous--Real							
1970	91	119	108	95	93	83	93	81	78	79	78	76
1971	91	93	109	184	274	240	190	177	164	149	144	152
1972	140	134	127	133	173	132	123	149	116	107	108	108
1973	107	100	118	131	127	128	111	142	151	154	139	132
1974	124	115	105	95	86	83	92	85	67	69	85	91
1975	88	80	70	80	100	112	102	102	101	97	90	89
1976	83	87	79	91	106	97	123	133	130	126	129	141
1977	159	147	153	153	151	151	198	226	241	265	300	346
1978	324	337	279	442	440	427	461	481	457	444	437	419
1979	406	330	335	309	274	250	279	287	347	376	290	279

5. Market Rates of Return

From the deflated value-weighted index, tables expressing average rates of return were constructed. Table 4.9 was constructed assuming 210 investment strategies. The semi-annual average rates of return for each strategy are shown. The table can be used as follows: If an investor bought a market portfolio on the first day of January 1970 and held his portfolio until June 1970, his loss would have been 20 percent for the six-month period. On the other hand, if he held his portfolio for six months more, his gain would have been 17.90 percent per semester. Finally, if he held his portfolio until the end of the decade, his average loss would have been 9.86 percent per semester. All the other semi-annual investment strategies are included in this table.

Of the 210 investment strategies, there were 138 negative rates of return in real terms or 65.71 percent of the cases. The best investment strategy was to buy in June 1970 and to sell one year later, giving a 96.53 percent real gain per semester. After June 1971, of 157 investment strategies, 123 showed real negative rates of return.

If viewed in this way, the stock market cannot be considered a hedge against inflation for the period of this study. On the other hand, large losses were found for those who invested at the 1971 peak. For an investor who bought in the market in June 1971, the loss until the end of the decade was 7.38 percent every six months in real terms.

Again, the bull market of 1971 had a negative effect on the Brazilian stock market. Investors lost confidence and changed

Table 4.9.--Value-weighted index for the total market: GPLI deflated--semi-annual average rates of return.

	1/1/70	June 1970	Dec. 1970	June 1971	Dec. 1971	June 1972	Dec. 1972	June 1973	Dec. 1973	June 1974	Dec. 1974	June 1975	Dec. 1975	June 1976	Dec. 1976	June 1977	Dec. 1977	June 1978	Dec. 1978	June 1979	Dec. 1979
June 1970	-20.00																				
Dec. 1970	17.90	73.75																			
June 1971	45.65	96.53	122.30																		
Dec. 1971	25.99	46.59	34.65	-18.45																	
June 1972	13.46	23.81	10.59	-22.00	-25.40																
Dec. 1972	4.87	10.70	-1.10	-24.50	-27.35	-29.26															
June 1973	5.03	9.91	0.29	-17.81	-17.60	-13.40	6.02														
Dec. 1973	2.41	6.09	-2.28	-17.10	-16.76	-13.66	-4.62	-14.18													
June 1974	-0.11	2.70	-4.73	-17.28	-17.04	-14.81	-9.37	-6.21	-18.18												
Dec. 1974	-2.09	4.90	-1.52	-12.33	-11.27	-8.14	-1.94	-4.45	0.82	24.24											
June 1975	4.25	7.04	1.43	-8.04	-6.45	-2.86	3.50	2.89	9.30	26.33	28.46										
Dec. 1975	2.78	5.15	0.00	-8.49	-7.17	-4.22	0.74	-0.29	3.53	11.98	6.31	-12.03									
June 1976	3.22	5.44	0.76	-6.91	-5.53	-2.70	1.83	1.15	4.53	11.13	7.08	-2.24	8.63								
Dec. 1976	1.25	3.10	-1.29	-8.31	-7.23	-4.95	-1.38	-2.39	-0.28	3.75	-0.82	-9.02	-7.47	-21.19							
June 1977	0.64	2.30	-1.78	-8.04	-7.26	-5.22	-2.09	-3.06	-1.35	1.77	-2.21	-8.66	-7.50	-14.65	-7.56						
Dec. 1977	1.35	2.96	0.81	-6.78	-5.74	-3.71	-0.70	-1.42	0.31	3.27	0.14	-4.73	-2.81	-6.36	2.08	12.73					
June 1978	1.12	2.62	-0.92	-6.48	-5.49	-3.61	-0.86	-1.52	0.00	2.54	-0.23	-4.35	-2.74	-5.39	0.56	4.88	-2.42				
Dec. 1978	0.16	1.50	-1.86	-7.06	-6.19	-4.52	-2.11	-2.81	-1.60	0.44	-2.19	-5.93	-4.87	-7.37	-3.55	-2.17	-8.86	-14.88			
June 1979	-0.43	0.78	-2.40	-7.29	-6.50	-4.98	-2.80	-3.50	-2.46	-0.73	-3.18	-6.54	-5.73	-7.93	-5.02	-4.37	-9.47	-12.80	-10.69		
Dec. 1979	-0.86	0.26	-2.76	-7.38	-6.64	-5.23	-3.23	-3.91	-3.00	-1.48	-3.74	-6.78	-6.10	-8.04	-5.64	-5.25	-9.28	-11.45	-9.69	-8.70	

investments to papers that offered fixed income, thus avoiding risky investments. It will take time for confidence in the stock market to be restored.

Conclusions

The conclusions from this chapter are simple and may be stated as follows: From the comparison between the value-weighted index and the equally weighted index, it is apparent that small companies did better than larger ones. This conclusion is supported by the fact that a few large companies represented a very high percentage of the volume traded at the São Paulo Stock Exchange.

The BOVESPA Index, despite its construction bias, seems to be a reasonable representation of the market. When compared with the value-weighted index, which is considered theoretically more sound, the difference was small. Common stocks did better than preferred as was expected, except during the bull market of 1971. This means that during the boom market, less risk was associated with more return. This is evidence of irrationality during this period.

The bull market of 1971 had a tremendous effect on the Brazilian stock market. The market has never recovered. Finally, the analysis of rates of return for 210 investment strategies during the 10-year period showed that investment in the stock market was not a good hedge against inflation.

CHAPTER V

CAPITAL-ASSET-PRICING MODEL: EMPIRICAL TESTS

In financial literature, the stock market in the United States has been extensively examined. However, due primarily to the absence of machine-readable data bases, there are not many studies about stock markets in other countries. In this chapter, validity tests of the capital-asset-pricing model (CAPM), developed in the United States, are reproduced. These tests are discussed as they were developed by Black, Jensen, and Scholes and by Fama and MacBeth.

The Risk-Free Rate of Interest in Real Terms

To reproduce the test developed by Black, Jensen, and Scholes, as it is performed in real terms, it was necessary to know the monthly real return of the risk-free security. It was assumed that the indexed national treasury bonds (ORTN) were the risk-free security. Unfortunately, as shown in Appendix A, the ORTN indexation did not follow strictly the variation in the purchasing power of the currency. Thus it was necessary to compare the nominal return from these bonds with the GPLI to obtain the real risk-free return. The following procedure was used.

1. The ORTN pay 6 percent interest annually on a nominal value that is adjusted monthly. Thus, a monthly interest rate of 0.4868 percent was assumed.

2. An index was created as of January 1, 1972, having 1000 as a base. At this time, the ORTN price was Cr$61.52. Therefore, the value of the index at the end of January 1972 was expressed as:

$$1000 \times \frac{62.26}{61.52} \times 1{,}004868 = 1016.9552$$

where:

Cr$62.26 = the ORTN value in February 1972

The index at the end of February 1972 was expressed as:

$$1016.9552 \times \frac{63.09}{62.26} \times 1.004868 = 1035.5290$$

where:

Cr$63.09 = The ORTN value in March 1972

This procedure was followed, and 96 monthly index values were obtained for the period January 1, 1972, to January 1, 1980.

3. The index obtained as described above was then inflated according to the variation in the GPLI. Thus the inflated index for January 1972 was expressed as:

$$1016.9552 \times \frac{3714}{302} = 12506.5285$$

where:

1016.9552 = The index in January 1972

3714 = GPLI in January 1980

302 = GPLI in January 1972

The inflated index for February 1972 was expressed as:

$$1035.5290 + \frac{3714}{308} = 12486.8659$$

where:

1035.5290 = The index for February 1972

4. Finally, the real return was obtained by a comparison between two consecutive real-index values. Thus, for January 1972, the ORTN real return was expressed as:

$$\frac{12486.8659 - 12506.5285}{12506.5285} = -0.001572$$

The ORTN real monthly returns are shown in Table 5.1.

The CAPM Test Based on the Procedure of Black, Jensen, and Scholes

The capital-asset-pricing model in real terms was expressed as in Equation 63.

$$E(\tilde{R}_j) = E(\tilde{R}_M)\ \beta_j$$

where:

$E(\tilde{R}_j)$ = Expected real-excess return of security j

$E(\tilde{R}_M)$ = Expected real-excess return of the market

β_j = Beta measure of systematic risk

The following generating function was used to perform the test:

$$\tilde{R}_{jt} = \alpha_j + b_j\tilde{R}_{Mt} + \tilde{e}_{jt} \qquad (72)$$

The coefficients b_j were estimated by Equation 72 for a two-year period, from January 1970 to December 1971, for all securities listed on the São Paulo Stock Exchange at the beginning of January

Table 5.1.--Risk-free rate of interest--real return.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1972	-0.001572	0.003306	0.005364	0.012200	0.013370	0.006775	-0.002002	-0.000023	0.005482	0.002609	0.010410	-0.002653
1973	0.003892	0.002753	0.002401	0.006536	0.005039	0.005750	0.002554	0.004016	-0.003938	0.003114	0.011660	-0.011910
1974	-0.006860	-0.026630	-0.029640	-0.008182	0.019055	0.036275	0.040096	0.024011	0.012582	0.001919	-0.005133	-0.002304
1975	-0.004119	0.007497	0.007158	0.007094	0.001131	0.000450	-0.006927	0.001489	0.004947	-0.128360	0.152200	-0.007485
1976	-0.012860	-0.008722	-0.005964	-0.000346	0.007641	-0.006975	-0.007757	0.003905	0.016392	0.016610	0.003682	-0.013858
1977	-0.007567	-0.012538	-0.006758	0.001289	0.018233	0.010467	0.012640	0.000953	-0.007867	-0.006139	0.003350	-0.000324
1978	-0.005723	-0.002105	0.000352	0.003267	-0.000829	0.007151	0.005714	0.005322	0.000434	0.003016	0.015630	-0.008619
1979	-0.009080	-0.026467	0.004910	0.019210	0.003772	-0.011110	-0.022785	-0.029603	-0.001465	-0.004903	-0.025619	-0.015248

1972 for which 24 monthly returns were available. These securities were ranked on the basis of estimates b_j and were assigned to 10 portfolios. The 10 percent of securities with the largest b_j were assigned to the first portfolio, and so on. The return in each of the next 12 months (January 1972-December 1972) for each of the 10 portfolios was calculated. This entire process was repeated for securities listed at the beginning of January 1973 to estimate new coefficients b_j to be used for ranking and assignment to the 10 portfolios. This process was repeated for each time period from January 1970 through December 1979. This procedure yielded 96 monthly returns on 10 portfolios. The data used in the tests were collected as described in Chapter II. All returns were in real terms computed as described before.

The Time-Series Test of the Model

Using Equation 72 and the 96 monthly returns, it was possible to calculate the least-square estimates of the parameters α_j and b_j for each of the 10 portfolios. In Table 5.2 the following are presented: the b_j and α_j estimates, the student t values of α_j and b_j, the coefficient of correlation between $\tilde{R}_j$ and $\tilde{R}_M$, the standard deviation of residuals, the average monthly excess returns, and the standard deviation of the monthly excess returns. Note that the intercepts α were consistently positive but that the significance tests expressed by t values were greater than 2 in only five cases.

The estimate-risk coefficients ranged from 0.6710 to 0.1941 with t(b) always greater than 2 except in Portfolio 10, in which t(b)

Table 5.2.--Time-series tests--statistics.

Item	Portfolio Number									
	1	2	3	4	5	6	7	8	9	10
b	0.6710	0.2102	0.4997	0.4755	0.4531	0.2468	0.3095	0.3244	0.2593	0.1941
α	0.0365	0.0120	0.0109	0.0037	0.0128	0.0103	0.0091	0.0128	0.0079	0.0196
t(b)	5.6865	3.2152	8.0036	6.8850	6.7582	3.5824	4.2739	4.8013	3.7874	1.9032
$t(\alpha)$	3.5939	1.4825	2.0276	0.6218	2.2201	1.7373	1.4589	2.2005	1.3369	2.2241
$\rho(R,R_M)$	0.5059	0.3147	0.6366	0.5789	0.5718	0.3466	0.4033	0.4437	0.3638	0.1926
$\sigma(e_i)$	0.0990	0.0789	0.0524	0.0580	0.0562	0.0578	0.0608	0.0567	0.0576	0.0859
$\overline{R}$	0.0306	0.0119	0.0066	-0.0004	0.0088	0.0081	0.0063	0.0100	0.0060	0.0186
σ	0.1142	0.0827	0.0676	0.0707	0.0682	0.0613	0.0061	.0629	0.0615	0.0871

was 1.9032. Most surprising was the fact that no portfolio had a risk coefficient greater than one. In analyzing the reasons for this behavior, it would seem that the real return on the risk-free security and the computation of the real-market return were the causes of this fact because of the following:

1. The indexation of the ORTN did not follow the variation of the currency-purchasing power, especially after 1975. (The negative real returns for the risk-free security are shown in Table 5.1.) In the space representing security-excess return and market excess return, the points corresponding to the second half of the decade were depressed resulting in a reduction in the beta estimate.

2. The real-market return was computed according to the value-weighted index. The portfolios were formed on an equally weighted basis. As discussed in Chapter IV, the equally weighted index and the value-weighted index presented substantially different results. The equally weighted index was always ahead of the value-weighted index. This fact tended to increase the real returns of the portfolios and to reduce the market return, introducing a bias downward in the beta estimates.

The correlation coefficients between the portfolio returns and the market returns were substantially lower than the coefficients obtained by Black, Jensen, and Scholes for the American market. The standard error of residuals was very small. The intercept α appeared to be nonstationary.

Cross-Sectional Tests of the Model

The cross-sectional procedure provided an opportunity to analyze the linearity between risk and return without any specification being made about the intercept. The two-factor formulation of the capital-asset-pricing model was expressed as follows:

$$E(\tilde{R}_j) = E(\tilde{R}_z)\ (1-B_j) + E(\tilde{R}_M)B_j \qquad (73)$$

where:

$E(\tilde{R}_z)$ = Expected real return in the zero-beta portfolio

The following generating function was used in the cross-sectional test:

$$\tilde{R}_j = \alpha_j + b_j\gamma_j + \tilde{e}_{jt} \qquad (74)$$

The traditional form of the capital-asset-pricing model implied that $\alpha_j = 0$ and $\gamma_j = \tilde{R}_M$. The two-factor model required only that the linearity of Equation 73 be valid and that the intercept α_j could be nonzero.

The cross-sectional parameters of Equation 74 were estimated through use of the portfolio mean-excess returns over the period and of the risk coefficients obtained from the time-series procedure described in the previous section.

The results obtained from the cross-sectional test are presented in Figure 5.1 and Table 5.3. The visual representation shown in Figure 5.1 does not imply that there was a linear relationship between risk and return. This implication is confirmed by the data in Table 5.3. The coefficients α_j and γ_j had very low t values. The

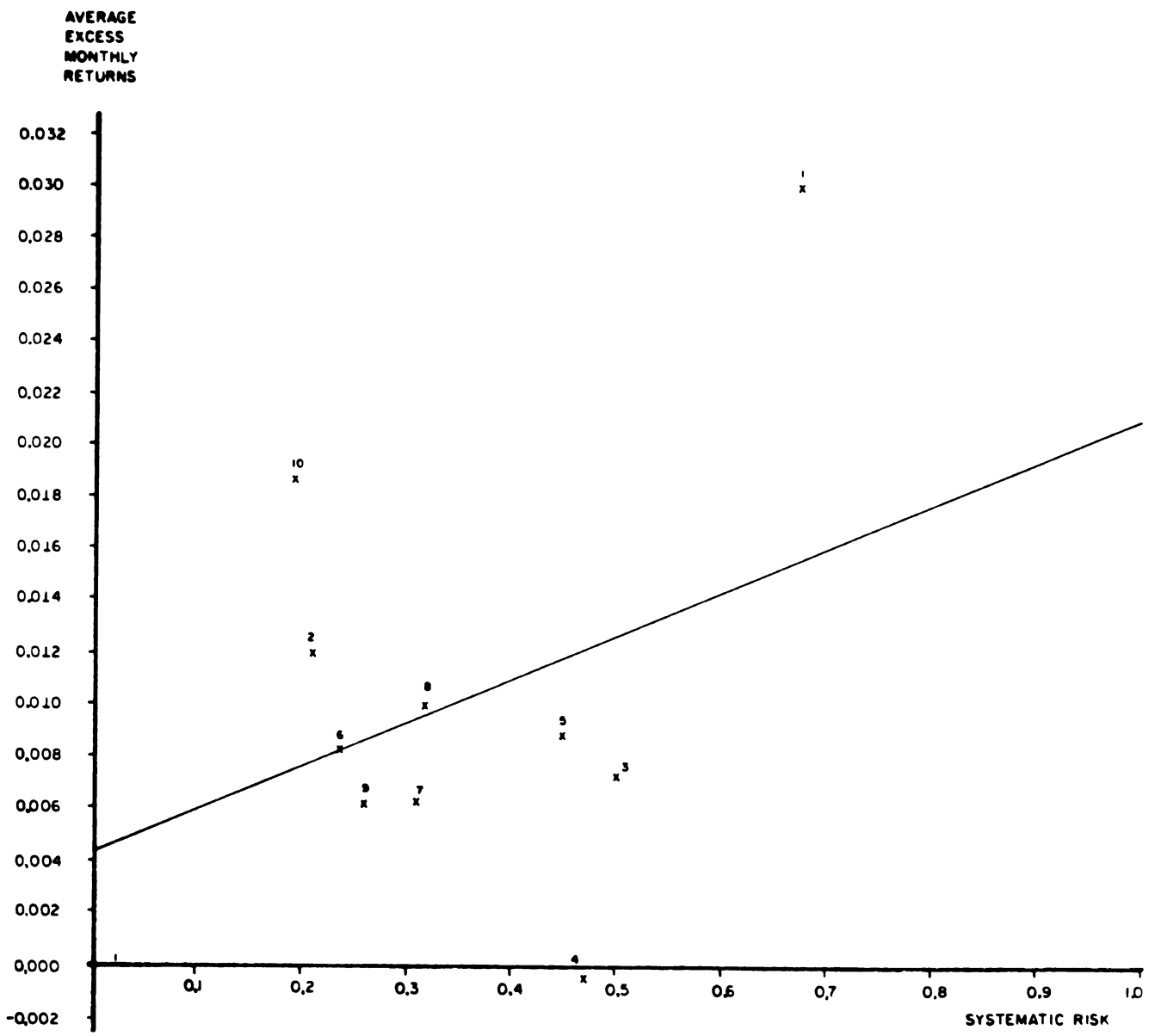

Figure 5.1.--Relationship between risk and return: cross-sectional test.

correlation coefficient and the F statistics were also very low. Because of the bias introduced in this test, it was not possible to conclude that the relationship between risk and return was not linear. The Fama and MacBeth procedure, discussed below, seemed to be more appropriate.

Table 5.3.--Relationship between risk and return: cross-sectional test.

$$R_j = \alpha_j + \gamma_j b + e_j$$

Item	Value
α_j	0.0044
γ_j	0.0171
$t(\alpha_j)$	0.6109
$t(\gamma_j)$	0.9263
R	0.3112
R^2	0.0968
$\sigma(e_j)$	0.0085
F	0.8581

The CAPM Test: Based on the Procedure of Fama and MacBeth

According to Fama and MacBeth, Equation 47 had three testable implications. First, the relationship between the expected return on a security and its risk in any efficient portfolio was linear. Second, β was a complete measure of risk, and third, in a market of risk-averse

investors, higher risk should have been associated with higher expected return: that is, $E(\tilde{R}_m) - E(\tilde{R}_z) > 0$.

The Methodology of This Procedure

From data for the first two-year period (1970-71), 20 portfolios were formed on the basis of ranked b_i for individual securities. The 5 percent of the securities with the largest b_i were assigned to the first portfolio, and so on. From data for the following two-year period (1972-73), b_i was recomputed, and these b_i were averaged across securities within portfolios to obtain 20 initial portfolio b_{pt} for the risk-return test. Thus, equal weights were applied to individual securities. The subscript t was added in b_{pt} to indicate that, for each month t of the following year (1974), the b_{pt} were recomputed as single averages of individual securities, thus allowing for delisting of securities. The month-by-month returns on the 20 portfolios, with equal weighting of securities, were also computed for 1974. For each month t of 1974, the least-square method was used to compute:

$$R_{pt} = \gamma_{1t} + \gamma_{2t} b_{p,t-1} + \gamma_{3t} b^2_{p,t-1} + \gamma_{4t}\tilde{\sigma}(e_i)_{p,t-1} + e_j \tag{75}$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t} b_{p,t-1} + \gamma_{3t} b^2_{p,t-1} + e_j \tag{76}$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t} b_{p,t-1} + \gamma_{4t}\sigma(e_i)_{;,t-1} + e_j \tag{77}$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t} b_{p,t-1} + e_j \tag{78}$$

The variable b_i^2 was included to test linearity. The first testable implication mentioned above was that $E(\tilde{\gamma}_{3t}) = 0$. The term

involving $\sigma(e_i)$, represented some measure of risk of security i that was not related to β_i. The second testable implication was that $E(\tilde{\gamma}_{4t}) = 0$. The disturbance term e_j was assumed to be independent of all other variables.

The explanatory variable $b_{p,t-1}$ was the average b_i for securities in each portfolio; $b^2_{p,t-1}$ was the average of the squared values of these b_i; and $\sigma(e_i)_{,t-1}$ was the average of $\sigma(e_i)$ for securities in Portfolio p. The $\sigma(e_i)$ were sample standard deviations of market-model residuals for individual securities. The results from these equations were the time series of month-by-month values of γ_{1t}, γ_{2t}, γ_{3t}, and γ_{4t}. Results for other periods were obtained in the same manner for yearly intervals. Thus, there were six different portfolio-formation periods. These portfolio-formation periods, the initial-estimation periods, and the testing periods are shown in Table 5.4. All tests were predictive in the sense that the explanatory variables were computed from a period prior to the month of the returns. After this time, to facilitate the tests, the subscripts p and t were dropped.

The Results of the Fama-MacBeth Procedure

The relationships between return and risk are shown in Table 5.5. The relationships between return, risk, and average squared risk are shown in Table 5.6. The relationships between return, risk, and average standard deviation are shown in Table 5.7. Finally, the relationships between return, risk, average squared risk, and average standard deviation are shown in Table 5.8. The

Table 5.4.--Portfolio formation, estimation, and testing periods.

	1	2	3	4	5	6
Portfolio-formation period	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Initial-estimation period	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Testing period	1974	1975	1976	1977	1978	1979

Table 5.5.--The month-by-month record of the relationship between return and risk.

$$R_j = \gamma_1 + \gamma_2 b + e_j$$

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_1						
1974	...	0.0096	-0.0568	-0.0835	-0.0223	0.0419	0.0418	-0.0359	-0.0553	0.0226	0.0468	-0.0369
1975	-0.0766	-0.0766	-0.0621	-0.0046	0.0431	0.1649	0.0254	-0.1091	0.0236	0.0359	0.0135	0.0016
1976	-0.0009	0.0019	-0.0418	-0.0324	0.0236	0.0065	0.0736	0.0269	-0.0158	0.0099	0.0330	0.0009
1977	0.0000	0.0094	0.0694	0.0497	0.0528	0.0050	0.0341	0.0943	0.0427	0.0215	0.0669	0.0572
1978	0.0725	0.1028	0.0184	-0.0158	0.0055	-0.0030	0.0141	0.0608	0.0130	-0.0203	0.0135	-0.0155
1979	-0.0028	-0.0336	0.0610	0.1815	0.1106	-0.0532	-0.0651	0.0697	0.0606	0.0208	0.0461	-0.0419
						γ_2						
1974	...	-0.0343	0.0634	-0.0658	-0.0433	0.0025	0.0024	0.0459	-0.0472	-0.0147	0.0678	0.0678
1975	0.1115	0.1128	-0.0284	0.0710	-0.0637	0.1854	0.2776	-0.1581	-0.0173	-0.0282	-0.0555	0.0821
1976	0.0933	0.0528	0.0575	0.1375	0.0383	0.0174	-0.0955	-0.0232	-0.1134	-0.0808	0.0498	0.0706
1977	0.0241	-0.0153	0.0099	-0.0365	-0.0535	0.0279	0.0735	0.0662	-0.0331	0.0972	-0.0357	0.0127
1978	-0.0272	0.0008	-0.0453	0.0323	0.0058	-0.0684	0.1492	-0.3036	-0.0128	0.0208	-0.0353	0.0855
1979	0.0064	-0.0009	0.0235	-0.1028	-0.0522	-0.0149	0.0883	-0.0737	0.0708	0.0527	-0.1919	0.0846
						R^2						
1974	...	0.0190	0.1176	0.0865	0.0472	0.0115	0.0115	0.0625	0.0504	0.0025	0.0105	0.1195
1975	0.2592	0.1475	0.0218	0.0843	0.0301	0.0638	0.2085	0.3200	0.0044	0.0050	0.0695	0.0674
1976	0.1057	0.0306	0.0658	0.2807	0.0334	0.0124	0.1652	0.0050	0.1260	0.1224	0.0175	0.0593
1977	0.0184	0.0058	0.0007	0.0356	0.0801	0.0288	0.1063	0.1117	0.0384	0.2232	0.0416	0.0000
1978	0.0113	0.0000	0.0189	0.0099	0.0005	0.1053	0.3191	0.2790	0.0019	0.0083	0.0190	0.0464
1979	0.0005	0.0001	0.0107	0.1488	0.0907	0.0185	0.2576	0.1800	0.0499	0.0696	0.1740	0.1486

Table 5.6.--The month-by-month record of the relationship between return, risk, and average squared risk.

$$R_j = \gamma_1 + \gamma_2 b + \gamma_3 b^2 + e_j$$

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_1						
1974	...	0.0032	-0.0666	-0.0805	-0.0209	0.0092	0.0449	-0.0401	-0.0532	0.0253	0.0251	-0.0464
1975	-0.0801	-0.0731	-0.0119	0.0651	0.1379	0.0258	-0.0914	0.0162	0.0474	0.0148	0.0094	-0.0344
1976	0.0133	-0.0038	-0.0090	-0.0175	0.0154	-0.0044	0.0860	0.0269	-0.0082	0.0309	0.0106	0.0119
1977	-0.0012	0.0157	0.0783	0.0508	0.0562	0.0047	0.0378	0.0950	0.0414	0.0202	0.0688	0.0400
1978	0.0828	0.0954	0.0335	-0.0259	-0.0265	-0.0148	0.0214	0.0412	-0.0023	-0.0302	0.0244	-0.0031
1979	-0.0011	-0.0436	0.1088	0.2312	0.1470	-0.0626	-0.0758	0.0841	0.0540	-0.0190	0.1570	-0.0627
						γ_2						
1974	...	-0.0525	0.0474	-0.0548	-0.0380	0.0183	0.0036	0.0392	-0.0439	-0.0105	-0.0408	0.0525
1975	0.1055	0.2106	0.0365	0.0400	-0.0279	0.1828	0.1384	-0.0902	-0.1259	-0.0408	-0.1306	0.2094
1976	-0.0330	0.0923	-0.1468	0.0460	0.0877	0.0834	-0.1686	-0.0231	-0.1610	-0.2132	0.1794	0.0080
1977	0.0310	0.0461	0.1004	-0.0278	-0.0240	0.0253	0.1008	0.0711	-0.0429	0.0889	-0.0225	-0.0868
1978	0.0311	-0.0080	-0.0254	0.0195	-0.0319	-0.0793	0.2355	-0.3229	-0.0287	0.0111	-0.0247	0.0944
1979	0.0089	0.0003	0.0205	-0.1055	-0.0545	-0.0158	0.0872	-0.0724	0.0693	0.0467	-0.1772	0.0820

Table 5.6.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_3						
1974	...	0.0324	0.0370	-0.0173	-0.0083	-0.0265	0.0000	0.0160	-0.0079	-0.0102	0.0831	0.0367
1975	0.0139	-0.0896	-0.0595	-0.0340	0.0461	0.0024	0.1193	-0.0624	0.1009	0.0117	0.0680	-0.1152
1976	0.1131	-0.0154	0.0664	0.0294	-0.0159	-0.0212	0.0234	-0.0000	0.0166	0.0461	-0.0413	0.0199
1977	-0.0022	-0.0519	-0.0761	-0.0076	-0.0257	0.0024	-0.0263	-0.0046	0.0093	0.0086	-0.0132	0.1070
1978	-0.0632	0.0211	-0.0439	0.0285	0.0986	0.0310	-0.0231	0.0515	0.0408	0.0262	-0.0287	-0.0310
1979	-0.0043	0.0080	-0.0383	-0.0399	-0.0290	0.0085	0.0095	-0.0128	0.0066	0.0362	-0.0999	0.0187
						R^2						
1974	...	0.2762	0.2492	0.1046	0.0524	0.0673	0.0286	0.0888	0.0553	0.0069	0.1559	0.2400
1975	0.2726	0.1820	0.0574	0.2014	0.1299	0.0639	0.2237	0.3401	0.0656	0.0054	0.1103	0.1195
1976	0.1649	0.0551	0.6654	0.3687	0.0738	0.1420	0.2344	0.0050	0.1505	0.4842	0.1027	0.0931
1977	0.0196	0.1790	0.1106	0.0395	0.1276	0.0294	0.1368	0.1129	0.0453	0.2270	0.0535	0.1352
1978	0.1264	0.0085	0.0822	0.0374	0.1361	0.1947	0.1815	0.3050	0.0650	0.0529	0.0616	0.0671
1979	0.0012	0.0104	0.0615	0.1898	0.1416	0.0381	0.2678	0.2000	0.0516	0.1777	0.3484	0.1757

Table 5.7.--The month-by-month record of the relationship between return, risk, and average standard deviation.

$$R_j = \gamma_1 + \gamma_2 b + \gamma_4 \sigma(e_i) + e_j$$

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_1						
1974	...	-0.0404	-0.0775	-0.0771	-0.0188	0.0208	0.0907	-0.0409	-0.0209	0.0374	-0.0273	-0.0844
1975	-0.0801	0.1160	0.0389	0.1176	0.1800	-0.2400	0.0512	-0.0791	0.1638	0.1434	-0.0117	-0.0377
1976	-0.1125	0.0028	-0.1717	-0.0086	-0.0008	0.0642	-0.0102	0.0051	0.0030	0.0020	0.0704	-0.0121
1977	0.0273	0.0767	-0.0788	-0.0288	0.0756	-0.0173	0.1010	-0.0313	-0.0525	-0.0181	0.0414	0.0712
1978	0.0525	0.1289	-0.0623	-0.0043	-0.0621	-0.0104	0.0186	0.1974	-0.0498	0.0372	0.0541	-0.0946
1979	-0.1207	-0.0611	-0.0090	0.2572	0.0580	-0.0695	-0.1092	0.0824	-0.1481	-0.0021	0.1595	-0.1063
						γ_2						
1974	...	0.0010	0.0777	-0.0700	-0.0457	-0.0090	-0.0073	0.0496	-0.0725	-0.0256	0.0483	0.1028
1975	0.1140	0.1594	-0.0169	0.0789	-0.0620	0.1278	0.3123	-0.1827	0.0100	0.0003	-0.0586	0.0782
1976	-0.1125	0.0028	-0.1717	-0.0086	-0.0008	0.0642	-0.0102	0.0051	0.0030	0.0020	0.0704	-0.0121
1977	0.0273	0.0767	-0.0788	-0.0288	0.0756	-0.0173	0.1010	-0.0131	-0.0490	0.0911	-0.0393	0.0117
1978	-0.0294	0.0099	-0.0716	0.0018	-0.0229	-0.0712	0.1427	-0.2486	-0.0389	0.0452	-0.0417	0.0616
1979	-0.0301	0.0062	0.0419	-0.1219	-0.0391	-0.0136	0.0942	-0.0757	0.0956	0.0557	-0.2042	0.0924

Table 5.7.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_4						
1974	...	0.1956	0.0811	-0.0254	-0.0141	-0.0646	-0.2002	0.0190	-0.1322	-0.0569	0.2865	0.1837
1975	0.0133	-0.4119	-0.3459	-0.5480	-0.1115	2.0565	-1.2431	0.8022	-0.9859	-1.0042	0.1021	0.1263
1976	0.8491	-0.0863	1.0424	-0.1905	0.1891	-0.4451	0.6516	0.1700	-0.1519	0.0631	0.8775	0.1138
1977	-0.2338	-0.4221	0.9344	0.5016	-0.1452	0.1432	-0.4257	0.8026	0.6077	0.2518	0.1615	-0.0772
1978	0.1258	-0.1631	0.4807	0.0362	0.4225	0.0456	-0.0081	-0.8448	0.3912	-0.3583	0.4226	0.4736
1979	0.7057	0.1313	0.3349	-0.3641	0.2532	0.0879	0.2302	-0.0652	1.1054	0.1211	-0.6109	0.3449
						R^2						
1974	...	0.1186	0.1487	0.0883	0.0478	0.0170	0.1000	0.0639	0.1022	0.0076	0.0716	0.2357
1975	0.2597	0.3005	0.0435	0.1089	0.0305	0.1356	0.2486	0.3931	0.1351	0.0558	0.0717	0.0689
1976	0.1942	0.0902	0.2599	0.2856	0.0412	0.0898	0.2367	0.0082	0.1288	0.1234	0.0674	0.0609
1977	0.0351	0.0703	0.0915	0.1393	0.0894	0.0407	0.1614	0.3614	0.2336	0.2452	0.0541	0.0033
1978	0.0148	0.0030	0.0714	0.0004	0.0543	0.1065	0.3121	0.3192	0.0316	0.0514	0.0521	0.0813
1979	0.1389	0.0174	0.0378	0.1728	0.1187	0.0277	0.2836	0.1822	0.2310	0.0752	0.2034	0.1930

Table 5.8.--The month-by-month record of the relationship between return, risk, average squared risk, and average standard deviation.

$$R_j = \gamma_1 + \gamma_2 b + \gamma_3 b^2 + \gamma_4 \sigma(e_i) + e_j$$

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_1						
1974	...	-0.0392	-0.0385	-0.1051	-0.0308	-0.0109	0.0712	-0.0126	0.0062	0.0344	0.0547	-0.0672
1975	-0.0525	0.1040	0.0161	0.0858	0.2451	-0.3668	0.2354	-0.1555	0.2702	0.2104	0.0204	-0.1016
1976	-0.0821	-0.0125	-0.0343	0.0836	-0.0465	0.0294	0.0220	-0.0035	0.0607	0.1350	-0.1942	0.0227
1977	0.0305	0.0411	-0.1751	-0.0477	0.0579	-0.0188	0.0925	-0.0497	-0.0580	-0.0172	0.0307	0.0704
1978	0.0240	0.1392	-0.0664	-0.0548	-0.0460	0.0062	0.0074	0.2421	-0.0324	0.0564	-0.0039	-0.1128
1979	-0.1309	-0.0668	0.0223	0.2786	0.0811	-0.0723	-0.1101	0.0847	-0.1452	-0.0054	0.1626	-0.1072
						γ_2						
1974	...	-0.0009	0.0138	-0.0252	-0.0261	0.0426	0.0051	0.0072	-0.1131	-0.0210	-0.0755	0.0768
1975	0.0737	0.1860	0.0322	0.0439	-0.0085	0.3664	-0.0214	-0.0357	-0.2004	-0.1125	-0.1335	0.2269
1976	-0.0034	0.2647	-0.1486	0.0534	0.0813	0.0869	-0.1771	-0.0264	-0.1529	-0.2009	0.1285	0.0114
1977	0.0388	0.0434	0.1249	-0.0202	-0.0242	0.0264	0.0983	0.0761	-0.0397	0.0895	-0.0205	-0.0937
1978	0.0338	0.0057	-0.0542	0.0101	-0.0379	-0.0723	0.1471	-0.2509	-0.0398	0.0446	-0.0357	0.0650
1979	-0.0283	0.0055	0.0455	-0.1188	-0.0362	-0.0149	-0.0930	-0.0725	0.1046	0.0443	-0.1781	0.0894
						γ_3						
1974	...	0.0016	0.0548	-0.0352	-0.0155	-0.0413	-0.0235	0.0354	0.0339	-0.0038	0.1043	0.0219
1975	0.0335	-0.0264	-0.0491	-0.0325	0.0545	-0.2307	0.3116	-0.1483	0.2137	0.1156	0.0728	-0.1446
1976	0.0725	-0.0430	0.0630	0.0428	-0.0229	-0.0174	0.0164	-0.0042	0.0264	0.0609	-0.0655	0.0211
1977	0.0016	-0.0468	-0.1264	-0.0284	-0.0253	-0.0023	-0.0153	-0.0331	-0.0100	0.0017	-0.0206	0.1119
1978	-0.0734	0.0283	-0.0546	0.0235	0.0890	0.0356	-0.0023	0.0926	0.0353	0.0418	-0.0338	-0.0537
1979	-0.0305	0.0086	-0.0475	-0.0344	-0.0370	0.0075	0.0051	-0.0128	-0.0321	0.0383	-0.0990	0.0111

Table 5.8.--Continued.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						γ_4						
1974	...	0.1895	-0.1157	0.1110	0.0446	0.0913	-0.0245	-0.1252	-0.2704	-0.0414	-0.1358	0.0950
1975	-0.1248	-1.3422	-0.2130	-0.1592	-0.8257	2.7959	-2.3114	1.2609	-1.6266	-1.4272	-0.0805	0.4890
1976	0.6873	-0.1739	0.1896	-0.7582	0.4503	-0.2464	0.4677	0.2249	-0.5187	-0.7825	1.6265	-0.0886
1977	-0.2529	-0.1633	1.6345	0.6479	-0.0108	0.1549	-0.3575	0.9494	0.6552	0.2446	0.2487	-0.1720
1978	0.3813	-0.2865	0.6169	0.1897	0.1412	-0.1410	0.0466	-1.3391	0.2002	-0.5759	0.1885	0.7106
1979	0.8398	0.1069	0.4684	-0.2609	0.3651	0.0581	0.2050	-0.0029	1.2773	-0.0833	-0.0355	0.2831
						R^2						
1974	...	0.1186	0.2750	0.1169	0.0549	0.0806	0.0346	0.1113	0.1353	0.0078	0.1618	0.2514
1975	0.2869	0.3032	0.0645	0.2032	0.1513	0.1611	0.3228	0.4825	0.3353	0.0805	0.1115	0.1385
1976	0.2153	0.2190	0.6703	0.4284	0.1101	0.1615	0.2651	0.0093	0.1747	0.5890	0.2449	0.0939
1977	0.0357	0.1870	0.3404	0.1838	0.1276	0.0411	0.1704	0.4159	0.2405	0.2454	0.0794	0.1466
1978	0.1557	0.0168	0.1649	0.0436	0.1408	0.2041	0.3196	0.3895	0.0716	0.1487	0.0698	0.1344
1979	0.1703	0.0278	0.1117	0.2013	0.1960	0.0419	0.2862	0.2001	0.2605	0.1800	0.3486	0.2012

month-by-month values of R^2, which were the coefficients of determination, are also given in these tables.

The major tests are summarized in Table 5.9. The following statistics are given in the table: $\bar{\gamma}_j$, the average of the month-by-month least-squares values of γ_j; $\sigma(\gamma_j)$, the sample standard deviation of the monthly γ_{jt}; $\bar{\rho}^2$ and $\sigma(\rho^2)$, the mean and standard deviation of month-by-month coefficients of determination. Also shown is the first-order autocorrelation of the various γ_j labeled $\hat{\rho}(\gamma_j)$. Finally, the t values are presented.

The results presented in panels C and D were consistent with the hypothesis $E(\tilde{\gamma}_4) = 0$. The t values for the mean values of γ_4 were small. Therefore, the hypothesis that beta is a complete measure of risk cannot be rejected. The results presented in panels B and D did not reject the proposition that the relationship between return and systematic risk was linear. In panel B, the t value for γ_3 is 0.61762 and in panel D, 0.26101. Thus, the results were consistent with the hypothesis $E(\tilde{\gamma}_3) = 0$. The autocorrelations of γ_3 and γ_4 were always low, so there was no information in the time series about past values. This result was consistent with a market that is efficient. The average coefficient of determination $\bar{\rho}^2$ was small in all panels. The small values $t(\bar{\gamma}_2)$ reflected the variability of γ_2.

Fama and MacBeth found large values for $t(\gamma_2)$ only for the entire period of their study, 34 years. Thus, in the present study, which included data for only 10 years, no statistically significant relationship between risk and return was found. On the other hand,

Table 5.9.--Tests of the two-parameter model.

Panel	$\bar{\gamma}_1$	$\bar{\gamma}_2$	$\bar{\gamma}_3$	$\bar{\gamma}_4$	$\sigma(\gamma_1)$	$\sigma(\gamma_2)$	$\sigma(\gamma_3)$	$\sigma(\gamma_4)$	$\hat{\rho}(\gamma_1)$	$\hat{\rho}(\gamma_2)$	$\hat{\rho}(\gamma_3)$	$\hat{\rho}(\gamma_4)$	$t(\bar{\gamma}_1)$	$t(\bar{\gamma}_2)$	$t(\bar{\gamma}_3)$	$t(\bar{\gamma}_4)$	ρ^2	$\sigma(\rho^2)$
								$R_j = \gamma_1 + \gamma_2 b + e_j$										
A	0.01542	0.00799	...	...	0.05240	0.08568	...	...	0.35175	-0.09425	...	...	2.47960	0.78577	...	...	0.07751	0.08473
								$R_j = \gamma_1 + \gamma_2 b + \gamma_3 b^2 + e_j$										
B	0.01688	0.00279	0.00350	...	0.05980	0.09975	0.04775	...	0.30098	-0.15487	-0.19520	...	2.37849	0.23568	0.61762	...	0.13853	0.11793
								$R_j = \gamma_1 + \gamma_2 b + \gamma_4 \sigma(e_i) + e_j$										
C	0.00364	0.00587	...	0.08736	0.08951	0.08858	...	0.54831	-0.03565	-0.12848	...	-0.18400	0.34266	0.55838	...	1.34250	0.12324	0.09709
								$R_j = \gamma_1 + \gamma_2 b + \gamma_3 b^2 + \gamma_4 \sigma(e_i) + e_j$										
D	0.00649	0.00112	0.00233	0.05998	0.11232	0.10660	0.07522	0.74132	-0.21246	-0.08543	-0.38621	-0.29848	0.48687	0.08853	0.26101	0.68176	0.18972	0.13065

as shown in all panels, γ_2 was consistently positive. This is what was expected in a market of risk-averse investors.

CHAPTER VI

THE RELATIONSHIP BETWEEN INFLATION AND STOCK PRICES

In this research, the relationship between stock returns and inflation was studied by linear regression, having as a dependent variable the monthly real return in the value-weighted index and as independent variables the anticipated and the unanticipated inflation. The anticipated inflation was measured by the inflation two months previous to the time in question.

$$AI_t = \frac{\rho_{t-2} - \rho_{t-3}}{\rho_{t-3}} \tag{79}$$

where:

ρ_t = Inflation index at time t

The unanticipated inflation was measured by the real rate of inflation less the anticipated rate of inflation.

$$UI_t = (RI_t - AI_t) \tag{80}$$

This model was expressed as:

$$R_{mt} = \alpha + bAI_t + cUI_t + \varepsilon_t \tag{81}$$

Anticipated Inflation

As mentioned before, the anticipated inflation was calculated in a nontraditional way. It was not possible to use the

one-month return on the nonindexed treasury bill as a measure of inflation as Fama[1] did because of the enormous discrepancy between this rate and real inflation. For example, in June, July, and August 1980, inflation was over 6 percent a month in Brazil, and 30-day treasury bills were sold at a discount of approximately 3 percent with no indication that there would be any spectacular decrease in inflation. The only reason for this behavior was the lack of other investment opportunities or of government intervention to lower interest rates.

A lag of two months was necessary for computing anticipated inflation because the inflation indices for each month are published at the end of the following month. Therefore, inflation indices may be acted upon only after a lag of two months.

Results

The month-by-month variations in the GPLI are presented in Table 6.1. The relationships among monthly real return in the value-weighted index, anticipated inflation, and unanticipated inflation are shown in Table 6.2. The relationship between monthly real return and total inflation is also shown in Table 6.2.

As can be seen, no statistically significant relationship was found between return and inflation. The t values of the coefficients b and c were always very small. The hypothesis cannot be rejected that there was no relationship between inflation and real return from

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[1]Eugene F. Fama, "Short Term Interest Rates as Predictors of Inflation," American Economic Review 65 (June 1975): 269-82.

Table 6.1.--Variations in the GPLI.

Period	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1970	0.0142	0.0187	0.0046	0.0137	0.0225	0.0176	0.0216	0.0212	0.0166	0.0041	0.0081	0.0161
1971	0.0040	0.0234	0.0153	0.0188	0.0221	0.0144	0.0107	0.0141	0.0104	0.0103	0.0102	0.0168
1972	0.0199	0.0130	0.0128	0.0095	0.0094	0.0124	0.0153	0.0121	0.0089	0.0089	0.0059	0.0175
1973	0.0115	0.0142	0.0140	0.0110	0.0109	0.0458	0.0107	0.0106	0.0157	0.0103	0.0127	0.0277
1974	0.0270	0.0453	0.0525	0.0347	0.0189	0.0123	0.0122	0.0181	0.0138	0.0156	0.0230	0.0225
1975	0.0220	0.0161	0.0176	0.0208	0.0221	0.0216	0.0276	0.0273	0.0216	0.0227	0.0207	0.0319
1976	0.0407	0.0378	0.0364	0.0351	0.0267	0.0378	0.0409	0.0339	0.0243	0.0186	0.0233	0.0366
1977	0.0325	0.0407	0.0409	0.0359	0.0198	0.0210	0.0127	0.0180	0.0269	0.0262	0.0211	0.0264
1978	0.0341	0.0329	0.0338	0.0321	0.0360	0.0283	0.0269	0.0256	0.0268	0.0275	0.0154	0.0365
1979	0.0376	0.0580	0.0374	0.0236	0.0344	0.0438	0.0579	0.0771	0.0525	0.0554	0.0733	0.0620

risky assets. Brazil has an indexed economy, and in an indexed economy the effect of inflation is minimized. All long-term loans are indexed as are most of the long-term receivables.

Table 6.2.--Relationship between inflation and stock prices.

$$R_{Mt} = \alpha + bAI_t + CUI_t + e_i$$

Period	α	b	c	t(b)	t(c)
70-73	-0.0162	1.9527	1.3035	0.4543	0.4553
74-79	0.0389	-1.3487	-0.8197	-1.7873	-1.1390
70-79	0.0262	-0.9581	-0.5017	-1.2657	-0.6052

$$R_{Mt} = \alpha + bI + e_i$$

Period	α	b	t(b)
70-73	-0.0061	1.2470	0.4538
74-79	0.0305	-1.0574	-1.7157
70-79	0.0219	-0.7642	-1.1935

Unanticipated inflation could influence the results of a company only to the extent that the company is a net debtor or creditor on a short-term basis. The expectation of inflation in the short run is generally accurate, and so this influence seems to be minimal. This analysis is valid to the extent that inflation affects in the same way cost and value of sales. In the aggregate, it seems to be reasonable to suppose that sales prices and cost will increase in the same way as inflation. This being so, it would be reasonable to anticipate no

significant relationship between inflation and real returns in an indexed economy.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

The structure of the Brazilian capital market was presented in Chapter I. As discussed, the 1964 political revolution altered the economy. Prior to 1964, the economy had grown very quickly. However, despite this fact, lack of adequate structure in the capital market had provoked severe distortions. The usury law had forbidden interest on savings over 12 percent per annum. With high levels of inflation, the real interest paid to savers was negative, providing a severe disincentive to investing funds in fixed-income paper. The inflationary climate, together with a government inclined to the left, created an unbearable political situation. In 1964 the revolution brought into being a new government that proposed to reorganize the country, reinstate economic growth, and reduce inflation.

The most important changes in the capital market occurred under the first government after the 1964 revolution. Law 4357 of June 16, 1964, created the indexed national treasury bonds. Law 4595 of December 31, 1964, the Bank Reform Law, introduced a complete reformulation of the national financial system. This law defined the role of the national financial system, specifying its components as follows: Conselho Monetário Nacional (CMN) (National Monetary Council), Banco Central da Republica do Brasil (BACEN) (Brasil Central

Bank), Banco do Brasil (Bank of Brazil), Banco Nacional de Desenvolvimento Economico (BNDE) (National Economic Development Bank). Other private and public financial institutions were also established. Law 4728 of July 16, 1965, assigned to the National Monetary Council the function of regulating the capital market and, to the Central Bank, its control. This law created new agents, organized the capital-market distribution system, and determined the institutions that could act in this market. Law 4380 of August 1964 created and regulated the Sistema Financeiro da Habitação (Housing Finance System). In 1976, the Comissão de Valores Mobiliarios (CVM) (Stock Exchange Commission) undertook most of the regulatory functions of the stock market.

In the first years after 1964, inflation was reduced at the cost of a serious slowdown in economic growth. In 1967, the second government of the revolution tried to stimulate the economy, having inflation reduction as only a secondary target. During the period 1967-73, the gross national product grew at an average annual rate of 10.5 percent. Inflationary rates were gradually contained, decreasing from 28.2 percent in 1967 to 15.4 percent in 1973. However, the strong external pressures to increase prices caused a return to the growth in inflation. By 1975, inflation was already 28.7 percent, reaching 110 percent in 1980. After 1973, economic growth continued but at a slower rate.

The Brazilian experience after 1964 showed that high inflation rates may be associated with an orderly development of the capital market. The main reason for this seemed to be the indexation

of the Brazilian economy. The origin of indexation was Law 4357 of 1964, which created the indexed national treasury bonds and applied the indexation principle to overdue fiscal debts and companies' balance sheets. Law 4380 of 1964 extended the concept of indexation to loans provided by the national housing system. Afterwards, this principle was extended to several other sectors, including savings, loans, debts, rents, insurance, interest, wages, the real estate sector, and the exchange rate.

In the Brazilian economy now, the state controls a high proportion of financial savings, taking in the funds through compulsory savings or through assets yielding interest and subject to monetary adjustment.

Law 157 of 1967 instituted the fiscal mutual funds that allow individual taxpayers to deduct from 12 to 24 percent of their tax bills (depending on their gross incomes) and to invest this money in the purchase of fiscal-fund quotas. The fiscal funds, by reason of the volume and constancy of the resources that they operate, are among the most important investors in the market. However, the concentration of a large volume of stocks with relatively few institutions can reduce the efficiency of the market.

Chapter I also showed the objectives of this research, which were as follows:

1. To build a machine-readable data base of price information for securities traded at the São Paulo Stock Exchange in the past decade;

2. To analyze the rates of return for common and preferred stocks traded at the São Paulo Stock Exchange for the period covered by the study;

3. To reproduce the tests developed by Black, Jensen, and Scholes and by Fama and MacBeth with new data from the São Paulo Stock Exchange and to compare the findings;

4. To determine the relationship between inflation and returns from risky assets in an indexed economy.

The methodology for collecting the data was presented in Chapter II. The period covered by this study was from January 1970 to December 1979. Therefore, there were data collected on each stock and monthly returns for listed securities since January 1970. The total universe of securities traded on the São Paulo Stock Exchange was searched. To compute the monthly security returns, it was assumed that the ideal investor received dividends and reinvested them in the same securities, buying shares quoted ex dividend. It was also assumed that, in the case of subscription rights, the ideal investor subscribed all shares corresponding to his rights and immediately sold the exact number of stocks quoted ex subscription rights necessary to recover the amount spent. Adjustments were also made in the case of stock dividends, stock splits, and all possible combinations of these events. Through the use of two deflators, two sets of real returns for each stock were obtained. Commissions and income taxes were not considered.

Information about 395 stocks was collected from 203 companies. The stocks included in the data file represented about 90 percent of the volume traded on the São Paulo Stock Exchange.

Two magnetic tapes are now available. The first gives basic information with no further computations. The second tape offers as a final product the monthly returns of the securities in real and nominal terms.

A review of the literature was presented in Chapter III. The choice of the proper weighting system and the methods of computing the value-weighted index and the equally weighted index in nominal and real terms were discussed in this chapter. Then, a brief review of the theory of the capital-asset-pricing model in its single-factor and two-factor formulations was presented. The tests realized by Douglas; Lintner; Miller and Scholes; Black, Jensen, and Scholes; and Fama and MacBeth to test the validity of the capital-asset-pricing model were discussed in some detail. Finally, studies about the relationship between inflation and return from risky assets were mentioned.

The performance of the market was presented in Chapter IV. The value-weighted index and the equally weighted index in real and nominal terms were presented for the entire period of this study. The behavior of the BOVESPA index (the official index of the São Paulo Stock Exchange) was compared with the behavior of the value-weighted index. The performance of preferred and common stocks was shown through the computation of the value-weighted index in real and nominal terms. Finally, the behavior of several sectors and subsectors was presented.

In Chapter V, the tests realized by Black, Jensen, and Scholes and by Fama and MacBeth were reproduced with the new set of data. For the procedures of Black, Jensen, and Scholes, the coefficients b_j were estimated for a two-year period, from January 1970 to December 1971, for all securities listed on the São Paulo Stock Exchange at the beginning of January 1972. These securities were ranked on the basis of estimates b_j and were assigned to 10 portfolios. The 10 percent of the securities with the largest b_j were assigned to the first portfolio and so on. The returns in each of the next 12 months for each of the 10 portfolios were calculated (from January 1972 to December 1972). This entire process was repeated for securities listed at the beginning of January 1973 to estimate new coefficients b_j to be used for ranking and assignment of securities to the 10 portfolios. This process was repeated from January 1970 through December 1979. This procedure gave 96 monthly returns on 10 portfolios.

For the Fama and MacBeth procedure, using the first two years of data (1970-81), 20 portfolios were formed on the basis of ranked b_i for individual securities. The 5 percent of securities with the largest b_i were assigned to the first portfolio and so on. Data from the following two-year period (1972-73) were then used to recompute b_i, and these b_i were averaged across securities within portfolios to obtain 20 initial portfolio b_{pt} for the risk-return test. Thus, equal weights were applied to individual securities. The month-by-month returns on the two portfolios, with equal weighting of securities, were also computed for 1974. For each month t of 1974, the least-square method was used to compute:

$$R_{pt} = \gamma_{1t} + \gamma_{2t}\, b_{p,t-1} + \gamma_{3t} b^2_{p,t-1} + \gamma_{4t} \tilde{\sigma}(e_i)_{p,t-1} + e_j$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t}\, b_{p,t-1} + \gamma_{3t} b^2_{p,t-1} + e_j$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t}\, b_{p,t-1} + \gamma_{4t} \sigma(e_i)_{p,t-1} + e_j$$

$$R_{pt} = \gamma_{1t} + \gamma_{2t}\, b_{p,t-1} + e_j$$

The explanatory variable $b_{p,t-1}$ represented the average b_i for securities in each portfolio; $b^2_{p,t-1}$ was the average of the squared values of these b_i; $\sigma(e_i)_{,t-1}$ was the average of $\sigma(e_i)$ for securities in portfolio p. The $\sigma(e_i)$ were sample standard deviations of market-model residuals for individual securities. The results from these equations were the time series of month-by-month values of γ_{1t}, γ_{2t}, γ_{3t}, and γ_{4t}. To get results for other periods, the above steps were repeated for each year.

The relationship between inflation and risky assets was analyzed in Chapter VI by a linear regression having as dependent variable the monthly real return in the value-weighted index and as independent variables the anticipated and the unanticipated inflation. The anticipated inflation was measured by the inflation two months previous to the time being studied. The unanticipated inflation was measured by the real rate of inflation less the anticipated rate of inflation.

Conclusions

From the comparison between the value-weighted index and the equally weighted index, the conclusion was reached that small companies did better than larger ones. This conclusion was supported by the fact that a few large companies represent a very high percentage of the volume traded at the São Paulo Stock Exchange.

The BOVESPA index, despite its construction bias, seemed to be a reasonable representation of the market. When compared with the value-weighted index, which was considered theoretically more sound, the difference was small.

Common stocks did better than preferred, as was expected, except during the bull market of 1971. This meant that during the boom market, less risk was associated with more return. This was evidence of irrationality during this period.

The bull market of 1971 had a tremendous effect on the Brazilian stock market. Since then, the market has not recovered. Finally, the analysis of rates of return for 210 investment strategies during the 10-year period showed that investment in the stock market was not a good hedge against inflation.

The results of the test procedure of Black, Jensen, and Scholes did not show a linear relationship between risk and return. However, because of bias introduced in this test, it was not possible to conclude that the relationship between risk and return was not linear. Nor was it possible, from the results of the procedure of Fama and MacBeth, to reject the hypothesis that the relationship between risk and return was linear. Neither could the hypothesis be

rejected that beta was a complete measure of risk. Despite the fact that the coefficients of beta were greater than zero in all four cases, they were not statistically significant. Therefore, no statistically observable positive relationship between expected real return and risk was found. The results of this test were similar to results of tests by Fama and MacBeth for similar periods of time. Fama and MacBeth found a statistically significant relationship between risk and return only for the entire period of their study--34 years. In addition, no statistically significant relationship was found between real return and anticipated inflation, unanticipated inflation, or total inflation as could be expected for an indexed economy.

APPENDICES

APPENDIX A

METHOD OF COMPUTING THE ORTN VALUE

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METHOD OF COMPUTING THE ORTN VALUE

Law 4357 of July 16, 1964, which created the indexed national treasury bonds (ORTN), made the following stipulations: that the bonds have a nominal value of Cr$10.00 and that they be indexed every three months based on variations in national currency purchasing power.

Therefore, initially, the indexed bonds were corrected only every three months; that is, the ORTN first-month value was maintained during the entire trimester. In September 1965, indexed bonds with monthly indexation were created, gradually replacing the former ones, which were withdrawn in 1973.

Interest, which presently varies from 6 to 8 percent according to the ORTN's term, is paid every six months or annually, through the Banco do Brasil.

Changes in the Formula of the Calculation

a. January 1965 to September 1969

The first method used to estimate the nominal value readjustment of the ORTN represented a moving trimestral average, with a semester time gap and a base period of April, May, and June 1964. The wholesale-price index was used as the adjustment base.

The initial calculation formula was the following:

$$V_t = 10.00 \times \frac{(I_{t-4} + I_{t-5} + I_{t-6}) \times 1/3}{(I_{4.64} + I_{5.64} + I_{6.64}) \times 1/3}$$

where:

V_t = ORTN value in month t

10.00 = ORTN initial value

I_{t-i} = Wholesale-price index estimated for month t-i

$I_{4.64}$ = Wholesale-price index for April 1964

$I_{5.64}$ = Wholesale-price index for May 1964

$I_{6.64}$ = Wholesale-price index for June 1964

From the above formula, the following simplifications can be performed:

$$I_{4.64} + I_{5.64} + I_{6.64} = 2517 + 2568 + 2678 = 7763$$

$$V_t = 10.00 \times \frac{(I_{t-4} + I_{t-5} + I_{t-6})}{7763} =$$

$$V_t = (I_{t-4} + I_{t-5} + I_{t-6}) \times 0.001288$$

b. October 1969 to November 1972

The Fundação Getúlio Vargas, which estimated the wholesale-price index, divided the index into the wholesale-price index of total availability and the wholesale-price index of internal availability. The latter was used to estimate ORTN variations with the period July, August, and September 1969, as the base.

$$V_t = V_{t-1} \times \frac{I_{t-4} + I_{t-5} + I_{t-6}}{I_{t-5} + I_{t-6} + I_{t-7}}$$

$$V_t = (I_{t-4} + I_{t-5} + I_{t-6}) \times 0.073524$$

c. December 1972 to March 1974

Beginning in this period, the index was estimated in a weighting system of two parts: the first represented the actual indexation estimated according to the above formula, using a weighted value of 1/2; the second, also with a weighted value of 1/2, reproduced the inflationary residual foreseen by the government at 12 percent per annum. The nonpublished formula could be expressed as:

$$V_t = 0.5\ V_{t-1} \times \frac{I_{t-4} + I_{t-5} + I_{t-6}}{I_{t-5} + I_{t-6} + I_{t-7}} + 0.5\ V_{t-1} \cdot 1.00949$$

d. April 1974 to July 1975

In this period there was a return to the former system; that is, the weighting system that introduced the desired inflation in the index was withdrawn.

$$V_t = V_{t-1} \times \frac{I_{t-4} + I_{t-5} + I_{t-6}}{I_{t-5} + I_{t-6} + I_{t-7}}$$

e. August 1975 to June 1976

In August 1975, the government included a new alteration in indexation. The concept of accident was included to eliminate from the index price increases provoked by accidental events, such as climatic catastrophes or sudden alterations in imported-merchandise prices.

f. After July 1976

New alterations in the form of the calculation were performed in July 1976. Government authorities, hoping that inflation would initiate a period of decreasing rates, introduced two measures to reduce the impact that fed inflation.

1. The indexation index time gap was reduced to two months.

2. Once again, a weighting system was introduced in the index to reflect both the inflation that actually occurred (80 percent) and the inflation target of 15 percent per annum.

The new formla was expressed as:

$$V_t = V_{t-1} \times 0.8 \left[\frac{I_{t-2} + I_{t-3} + I_{t-4}}{I_{t-3} + I_{t-4} + I_{t-5}} + 0.2 \ (1.011715) \right]$$

where (1.01715) is the adjustment of an inflation rate of 1.1717 percent per month, that is, 15 percent per annum.

SOURCE: ORTN Indexation, Calculation Forms, Special Study, Conjuntura Econômica 28 (March 1978): 92-95; and Luna, "Indexation and Capital Market: The Brazilian Experience."

APPENDIX B

METHOD OF COMPUTING
THE GENERAL PRICE-LEVEL INDEX

APPENDIX B

METHOD OF COMPUTING THE GENERAL PRICE-LEVEL INDEX

The general price-level index is the weighted average of three indices that are as follows:

Name	Weight
Wholesale-price index	6
Consumer-price index	3
Civil-construction-price index	3

On the other hand, the three basic indices mentioned above are calculated as follows:

a. Wholesale-price index

The wholesale-price index is based on the following weighting system:

	Weight
1. Consumer goods	55.8450
Durable	4.5956
Nondurable	51.2494
2. Production goods	44.1550
Raw materials	18.0954
Construction materials	7.7299
Machinery and vehicles	5.9434
Others	12.3863
TOTAL	100.0000

b. Consumer-price index

The consumer-price index is based on the following weighting system:

	Weight
Domestic food	37.5428
Nondomestic food	4.0179
Clothing	5.4440
Housing	14.4632
Housing goods	10.8366
Hygienics and medical care	4.2158
Personal services	13.7784
Public services	9.7013
TOTAL	100.0000

c. Civil-construction price index

The civil-construction price index is based on the following weighting system:

	Weight
Materials	58.9753
Labor	41.0247
TOTAL	100.0000

APPENDIX C

DIVISIONS AND CODES OF THE SECTORS

APPENDIX C

DIVISIONS AND CODES OF THE SECTORS

10.000--Industry

- 11.000--Construction
- 12.000--Mining
- 13.000--Manufacturing Industry
  - 13.010--Food, Tobacco, and Beverages
  - 13.020--Cement
  - 13.030--Electronics
  - 13.040--Wood and Furniture
  - 13.050--Transportation Materials
  - 13.060--Mechanics
  - 13.070--Metalurgic
    - 13.071--General Metalurgic Products
    - 13.072--Forging
  - 13.080--Paper and Graphic
  - 13.090--Chemistry
    - 13.091--Fertilizer
    - 13.092--Oil
    - 13.093--Plastics
    - 13.094--General Chemical Products
  - 13.100--Textiles and Clothing
  - 13.110--Other Manufacturing Industries

20.000--Trade

21.000--Domestic Equipment

22.000--Oil Dealers

23.000--Automotive, Machines, and Equipment

30.000--Services

31.000--Financial Institutions

31.010--Commercial Banks

31.011--Government Banks

31.012--Private Banks

31.020--Investment Banks

31.030--Credit, Financing, and Investment Companies

32.000--Public Utilities

32.010--Communication

32.020--Electrical Energy

32.030--Transportation

90.000--Miscellaneous

APPENDIX D

TYPES OF STOCKS

APPENDIX D

TYPES OF STOCKS

Tape Code	Market Code	Type
01	PP	Nonregistered preferred stock
02	OP	Nonregistered common stock
03	PN	Registered preferred stock
04	ON	Registered common stock
05	PPA	Nonregistered preferred stock Type A
06	PPB	Nonregistered preferred stock Type B
07	PPC	Nonregistered preferred stock Type C
08	OE	Registered common stock with no par value
09	PE	Registered preferred stock with no par value

APPENDIX E

COMPANIES INCLUDED IN THE TAPE

APPENDIX E

COMPANIES INCLUDED IN THE TAPE

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
001	13072	ACESITA	Companhia de Aços Especiais Itabira--Acesita
002	13080	AGGS	AGGS--Indústria Gráficas S.A.
003	13100	ARTEX	Artex S.A.--Fábrica de Artefatos Texteis
004	13030	ARNO	Arno S.A.
005	13072	AÇOS VILARES	Aços Vilares S.A.
006	13010	ANTÁRTICA	Companhia Antártica Paulista Indústria Brasileira BC
007	13093	ATMA	Atma Paulista S.A. Indústria e Comércio
008	13010	ANTARTICA NORDESTE	Indústria e Bebidas Antártica do Nordeste S.A.
009	13072	ANHANGUERA	Aços Anhanguera
010	13010	ANDERSON CLAYTON	Anderson Clayton S.A. Indústria e Comércio
011	13110	ARTHUR LANGE	Arthur Lange S.A.--Indústria e Comércio
012	13010	AÇUCAR UNIÃO	Companhia União dos Refinadores de Açucar
013	90000	AUDI	Audi S.A. Administração e Participação
014	13072	APARECIDA	Indústria Metalúrgica Nossa Senhora Aparecida
015	31012	BRADESCO	Banco Brasileiro de Descontos S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
016	31020	BRADESCO INVESTIMENTO	Banco Bradesco de Investimento S.A.
017	31011	BRASIL	Banco do Brasil S.A.
018	31012	AUXILIAR	Banco Auxiliar S.A.
019	31011	BANESPA	Banco do Estado de São Paulo S.A.
020	31020	COMIND BANCO DE INVESTIMENTO	Comind Banco de Investimento S.A.
021	31012	NOROESTE DO ESTADO	Banco Noroeste do Estado de São Paulo S.A.
022	31012	ITAUBANCO	Banco Itau S.A.
023	31030	REAL DE INVESTIMENTO	Banco Real de Investimento S.A.
024	31012	NACIONAL	Banco Nacional S.A.
025	31012	AMÉRICA DO SUL	Banco América do Sul S.A.
026	31012	MERCANTIL DE SÃO PAULO	Banco Mercantil de São Paulo S.A.
027	31012	UNIBANCO	Unibanco União de Bancos Brasileiros S.A.
028	31030	BMG FINANCEIRA	BMG Financeira
029	31012	REAL	Banco Real S.A.
030	31012	ECONÔMICO	Banco Econômico S.A.
031	31012	COMÉRCIO E INDÚSTRIA S.P.	Banco Comércio e Indústria de São Paulo S.A.
032	31012	FRANCÊS BRASILEIRO	Banco Francês e Brasileiro S.A.
033	31011	NORDESTE BRASIL	Banco Nordeste do Brasil S.A.
034	31020	ITAÚ INVESTIMENTOS	Banco Itaú de Investimentos S.A.
035	31012	BRASIL	Banco Comercial Brasil

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
036	90000	BRASMOTOR	Brasmotor S.A.
037	13071	BUNDY TUBING	Bundy Tubing S.A. Indústria e Comércio
038	13060	BARDELLA	Bardella S.A. Indústrias Mecânicas
039	13110	BAUMER	Baumer S.A.
040	13040	BÉRGAMO	Bérgamo Companhia Industrial
041	13050	BARLEM	Barlem S.A. Empreendimentos Industriais
042	13071	BRASIMET	Brasimet Comércio e Industria S.A.
043	13010	BIC MONARK	Bicicletas Monark S.A.
045	13091	BENZENEX	Benzenex Abudos e Inseticidas
046	13020	BRASILIT	Brasilit S.A.
047	13100	BRASILEIRA DE ROUPAS	Companhia Brasileira de Roupas
048	13010	CACIQUE	Companhia Cacique de Café Solúvel
049	11000	CONSTRUTORA ADOLPHO LINDENBERG	Construtora Adolpho Lindenberg S.A.
050	13072	CIMETAL	Cimetal Siderúrgica S.A.
051	13100	CREMER	Cremer S.A. Produtos Texteis Cirúrgicos
052	13020	CIMENTO GAUCHO	Companhia de Cimento Portland Gaúcho
053	21000	CASA MASSON	Casa Masson S.A. Comércio e Indústria
054	13030	CONSUL	Consul S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
055	23000	COMERCIAL BORDA DO CAMPO	Companhia Comercial da Borda do Campo
056	11000	CONSTRUTORA BETER	Construtora Beter S.A.
057	21000	CASA ANGLO	Casa Anglo Brasileira S.A. Modas e Confecções. Bazar
058	13010	CICA	Companhia Industrial de Conservas Alimentícias Cica
059	11000	CONSURSAN	Consursan Engenharia e Comércio S.A.
060	13060	CBV-INDÚSTRIAS MECÂNICAS	CBV--Indústrias Mecânicas S.A.
061	13050	COBRASMA	Cobrasma S.A.
062	32020	CESP	Cesp--Companhia Energética de São Paulo
063	13020	CIMENTO ITAÚ	Companhia de Cimento Portland Itaú
064	13010	CAFÉ BRASÍLIA	Café Solúvel Brasilia
065	21000	CASA JOSÉ SILVA	Casa José Silva Confecções S.A.
066	13020	CIMENTO CAUÊ	Cimento Cauê S.A.
067	13071	CIMAF	Companhia Industrial e Mercantil de Artefatos de Ferro
068	13010	CITROBRASIL	Citrobrasil S.A.
069	11000	CONCRETEX	Concretex S.A.
070	32020	CEMIG	Centrais Elétricas de Minas Gerais S.A.
071	11000	MENDES JÚNIOR	Construtora Mendes Júnior S.A.
072	13020	CIDAMAR	Cidamar S.A. Indústria e Comércio
073	13010	CERVEJARIA POLAR	Cervejaria Polar S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
074	13010	CONFRIO	Companhia Nacional de Frigoríficos Confrio
075	13091	COPAS	Companhia Paulista de Fertilizantes Copas
076	32030	DOCAS DE SANTOS	Companhia Docas de Santos
077	13010	DREHER	Dreher S.A. Vinhos e Champanhas
078	32030	DOCAS DE IMBITUBA	Companhia Docas de Imbituba
079	11000	DIÂMETRO EMPREENDIMENTOS	Diâmetro Empreendimentos S.A.
080	13050	DF VASCONCELOS	D.F. Vasconcelos S.A. Ótica e Mecânica de alta precisão
081	13040	DURATEX	Duratex S.A.
082	22000	DISTRIBUIDORA IPIRANGA	Distribuidora de Produtos de Petróleo Ipiranga S.A.
084	13030	ERICSSON	Ericsson do Brasil Comércio e Indústria S.A.
085	13110	ESTRELA	Manufatura de Brinquedos Estrela S.A.
086	13071	ELUMA	Eluma S.A. Indústria e Comércio
087	03010	EMÍLIO ROMANI	Emílio Romani S.A.
088	13040	EUCATEX	Eucatex S.A. Indústria e Comércio
089	11000	ECEL	Escritório de Construção e Engenharia Ecel S.A.
090	11000	ECISA	Ecisa Engenharia, Comércio e Indústria S.A.
091	13020	ETERNIT	Eternit S.A.
092	13080	EDITÔRA DE GUIAS LTB	Editôra de Guias LTB S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
094	11000	ENBASA	Enbasa Engenharia Comercial S.A.
095	20000	EMBRAVA	Empresa Brasileira de Varejo S.A.
096	13094	ELE KEIROZ	Produtos Químicos Ele Keiroz S.A.
098	31030	FINANCIADORA BRADESCO	Financiadora Bradesco S.A. Crédito Financiamento e Investimento
099	13072	FERRO LIGAS	Companhia Paulista de Ferro Ligas
100	13091	FERTISUL	Fertisul S.A.
101	13010	FRIGOBRÁS	Frigobrás Companhia Brasileira de Frigoríficos
102	13050	FORD BRASIL	Ford Brasil S.A.
103	11000	FIQUET	Fiquet S.A.
104	13071	FUNDIÇÃO TUPY	Fundição Tupy S.A.
105	13071	FERRO BRASILEIRO	Companhia de Ferro Brasileiro
106	13091	FERTIPLAN	Fertiplan S.A. Adubos e Inseticidas
107	13050	FNV	Fábrica Nacional de Vagões S.A.
108	90000	FERRAGENS E LAMINAÇÃO BRASIL	Ferragens e Laminação Brasil S.A.
109	13050	GEMMER BRASIL	TRW Gemmer do Brasil S.A.
110	13100	GUARARAPES	Confecções Guararapes S.A.
111	13010	GERMANI	Germani Companhia Paranaense de Alimentos
112	13093	GOYANA	Goyana S.A. Indústria Brasileira de Materiais Plásticos
113	11000	HINDI	Hindi Companhia Brasileira de Habitações
114	11000	HELENO FONSECA	Heleno Fonseca Construtécnica S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
115	13071	HERCULES	Hercules S.A. Fábrica de Talheres
116	11000	H.C. CORDEIRO	H. C. Cordeiro
117	13091	IAP	Iap S.A. Indústria de Fertilizantes
118	13010	IGUAÇU CAFÉ	Companhia Iguaçu de Café Solúvel
119	13060	INDÚSTRIAS VILLARES	Indústrias Villares S.A.
120	13100	INDÚSTRIA HERING	Indústria Textil Companhia "Hering"
121	13060	INDÚSTRIA ROMI	Indústria Romi S.A.
122	13071	ENGEMIX	Engemix S.A. Estudos e Projetos de Engenharia
123	13030	IBESA	Pereira Lopes Ibesa Indústria e Comércio S.A.
124	13093	KERALUX	Keralux S.A. Revestimentos Cerâmica
125	13010	KIBON	Kibon S.A. Indústrias Alimentícias
126	13093	KELSONS	Kelson's Indústria e Comércio S.A.
127	32020	LIGHT	Light Serviços de Eletricidade S.A.
128	21000	LOJAS AMERICANAS	Lojas Americanas S.A.
129	21000	LOBRAS	Lojas Brasileiras S.A.
130	13010	LACTA	Industria de Chocolates Lacta
131	13050	LONAFLEX	Lonaflex S.A. Guarnições para freios
132	21000	LOJAS RENNER	Lojas Renner S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
133	32020	LUZ FORÇA SANTA CRUZ	Companhia Luz e Força Santa Cruz
134	13080	LISA	Livros Irradiantes S.A.
135	13050	MARCOPOLO	Marcopolo S.A. Carrocerias e Onibus
136	13010	MOINHO LAPA	Moinho da Lapa S.A.
137	13110	MOINHO SANTISTA	S.A. Moinhos Santista Industrias Gerais
138	13071	METALURGICA GERDAU	Metalurgica Gerdau S.A.
139	13040	MANASA	Manasa Madeireira Nacional S.A.
140	13071	MADEF	Madef S.A. Indústria e Comércio
141	12000	MAGNESITA	Magnesita S.A.
142	13091	MANAH	Manah S.A.
143	13060	MAQUINAS PIRATININGA	Máquinas Piratininga S.A.
144	13080	MELHORAMENTOS SÃO PAULO	Companhia Melhoramentos São Paulo Indústria de Papel
145	21000	MESBLA	Mesbla S.A.
146	13050	METAL LEVE	Metal Leve S.A. Indústria e Comércio
147	13071	MANGELS INDUSTRIAL	Mangels Industrial S.A.
148	13060	MECÂNICA PESADA	Mecânica Pesada S.A.
149	13071	METALÚRGICA ABRAMO EBERLE	Metalúrgica Abramo Eberle S.A.
150	13071	MICHELETTO	Indústrias Micheletto S.A.
151	13071	METALÚRGICA LA FONTE	Metalúrgica La Fonte S.A.
152	13050	NAKATA	Nakata S.A. Indústria e Comércio

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
153	13060	NORDON METALÚRGICA	Nordon Indústrias Metalúrgicas S.A.
154	13094	OXIGÊNIO DO BRASIL	Oxigênio do Brasil S.A.
155	13094	ORNIEX	Orniex S.A.
156	22000	PETRÓLEO IPIRANGA	Companhia Brasileira de Petróleo Ipiranga
157	13030	PIRELLI	Pirelli S.A. Companhia Industrial Brasileira
158	13092	PETROBRÁS	Petróleo Brasileiro S.A. Petrobrás
159	22000	PARAGÁS	Companhia de Gás do Pará Paragás
160	11000	PARANAPANEMA	Paranapanema S.A. Mineração, Indústria e Comércio
162	13010	PERDIGÃO	Perdigão S.A. Comércio e Indústria
163	13071	PREMESA	Premesa S.A. Indústria e Comércio
164	13093	PIRÂMIDES BRASILIA	Pirâmides Brasilia S.A. Indústria e Comércio
165	32020	PAULISTA DE FORÇA E LUZ	Companhia Paulista de Força e Luz
166	21000	PROSDÓCIMO	Prosdócimo S.A. Importação e Comércio
167	13093	PLÁSTICOS MONSANTO	Companhia Brasileira de Plásticos Monsanto
168	11000	PBK EMPREENDIMENTOS IMOBILIÁRIOS	PBK Empreendimentos Imobiliários S.A.
169	13094	PHEBO	Perfumarias Phebo S.A.
170	13010	REALCAFÉ	Realcafé Solúvel do Brasil S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
171	13030	REFRIPAR	Refrigeração Paraná S.A.
172	13030	SEMP	Semp Toshiba S.A.
173	13010	SOUZA CRUZ	Companhia Souza Cruz Indústria e Comercio
174	11000	SERVIX	Servix Engenharia S.A.
175	13072	MANNESMAN	Mannesman S.A.
176	23000	SOPAVE	Sopave S.A. Sociedade Paulista de Veículos
177	13072	SIDERURGICA COFERRAZ	Siderúrgica Coferraz S.A.
178	13030	SHARP	Sharp S.A. Equipamentos Eletrônicos
179	23000	SAVENA	Savena S.A. de Veículos Nacionais, Comércio e Representação
180	13020	SANO	Sano S.A. Indústria e Comércio
182	13010	SCHLOSSER	Companhia Industrial Schlosser S.A.
183	13072	SIDERURGICA NACIONAL	Companhia Siderúrgica Nacional
184	90000	SAMCIL	Samcil S.A. Serviço de Assistência Médica ao Comércio e Indústria
185	13040	SUDESTE	Sudeste S.A. Indústria e Comércio
186	13091	SOLORRICO	Solorrico S.A. Indústria e Comércio
187	13010	SADIA CONCÓRDIA	Sadia Concórdia S.A. Indústria e Comércio
188	13072	SIDERÚRGICA AÇONORTE	Siderúrgica Açonorte S.A.
189	13072	SIDERÚRGICA GUAÍRA	Siderúrgica Guaíra S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
190	13010	SADIA AVÍCOLA	Sadia Avícola S.A.
191	13071	SIFCO DO BRASIL	Sifco do Brasil S.A. Indústrias Metalúrgicas
192	13072	SANTA OLIMPIA	Usina Santa Olimpia Industria de Ferro e Aço S.A.
193	32010	TELESP	Telecomunicações de São Paulo S.A.--Telesp
194	13100	TEKA	Tecelagem Kuenrich S.A.
195	23000	TRANSPARANÁ	Transparaná S.A.
196	90000	TECNOSOLO	Tecnosolo Engenharia e Tecnologia de Solos e Materiais S.A.
197	32010	TELERJ	Telecomunicações do Rio de Janeiro S.A.--Telerj
198	21000	TECHNOS RELÓGIOS	Technos Relógios S.A.
199	21000	ULTRALAR	Ultralar S.A. Aparelhos e Serviços
200	90000	UNIPAR	Unipar União de Industrias Petroquímicas S.A.
201	13110	VIGORELLI	Vigorelli do Brasil S.A. Comércio e Indústria
202	12000	VALE DO RIO DECE	Companhia Vale do Rio Doce
203	32030	VARIG	Varig S.A. Viação Aérea Rio-Grandense
204	13110	VIDRARIA SANTA MARINA	Companhia Vidraria Santa Marina
205	13100	VULCABRÁS	Vulcabrás S.A. Indústria e Comércio
206	11000	VEPLAN	Veplan--Residência, Empreendimentos e Construções S.A.

Tape Code	Sector Classification	Name in the Tape	Full Name of the Company
207	13094	WHITE MARTINS	S.A. White Martins
208	13060	ZANINI	Zanini S.A. Equipamentos Pesados

APPENDIX F

INDEXED NATIONAL TREASURY BONDS (ORTN) AND GENERAL PRICE-LEVEL INDEX VALUES

APPENDIX F

INDEXED NATIONAL TREASURY BONDS (ORTN) AND
GENERAL PRICE-LEVEL INDEX VALUES

Date	Period	ORTN Value	General Price-Level Index Value
1/1/70	1	42.35	211
1/2/70	2	43.30	214
1/3/70	3	44.17	218
1/4/70	4	44.67	219
1/5/70	5	45.08	222
1/6/70	6	45.50	227
1/7/70	7	46.20	231
1/8/70	8	46.61	236
1/9/70	9	47.05	241
1/10/70	10	47.61	245
1/11/70	11	48.51	246
1/12/70	12	49.54	248
1/1/71	13	50.51	252
1/2/71	14	51.44	256
1/3/71	15	52.12	262
1/4/71	16	52.64	266
1/5/71	17	53.25	271
1/6/71	18	54.01	277
1/7/71	19	55.08	281
1/8/71	20	56.18	284
1/9/71	21	57.36	288
1/10/71	22	58.61	291
1/11/71	23	59.79	294
1/12/71	24	60.85	297
1/1/72	25	61.52	302
1/2/72	26	62.26	308
1/3/72	27	63.09	312
1/4/72	28	63.81	316
1/5/72	29	64.66	319
1/6/72	30	65.75	322
1/7/72	31	66.93	326
1/8/72	32	67.89	331
1/9/72	33	68.46	335
1/10/72	34	68.95	338
1/11/72	35	69.61	341
1/12/72	36	70.07	343
1/1/73	37	70.87	349
1/2/73	38	71.57	353
1/3/73	39	72.32	358

Date	Period	ORTN Value	General Price-Level Index Value
1/4/73	40	73.19	363
1/5/73	41	74.03	367
1/6/73	42	74.97	371
1/7/73	43	75.60	374
1/8/73	44	76.48	378
1/9/73	45	77.12	382
1/10/73	46	77.87	388
1/11/73	47	78.40	392
1/12/73	48	79.07	397
1/1/74	49	80.62	408
1/2/74	50	81.47	419
1/3/74	51	82.69	438
1/4/74	52	83.73	461
1/5/74	53	85.10	477
1/6/74	54	86.91	486
1/7/74	55	89.80	492
1/8/74	56	93.75	498
1/9/74	57	98.22	507
1/10/74	58	101.90	514
1/11/74	59	104.10	522
1/12/74	60	105.41	534
1/1/75	61	106.76	546
1/2/75	62	108.38	558
1/3/75	63	110.18	567
1/4/75	64	112.25	577
1/5/75	65	114.49	589
1/6/75	66	117.13	602
1/7/75	67	119.27	615
1/8/75	68	121.31	632
1/9/75	69	123.20	647
1/10/75	70	125.70	661
1/11/75	71	128.43	676
1/12/75	72	113.93	690
1/1/76	73	113.34	712
1/2/76	74	135.90	741
1/3/76	75	138.94	769
1/4/76	76	142.24	797
1/5/76	77	145.83	825
1/6/76	78	150.17	847
1/7/76	79	154.60	879
1/8/76	80	158.55	915
1/9/76	81	162.97	946
1/10/76	82	168.33	969
1/11/76	83	174.40	987
1/12/76	84	179.68	1010
1/1/77	85	183.65	1047

Date	Period	ORTN Value	General Price-Level Index Value
1/2/77	86	186.83	1081
1/3/77	87	190.51	1125
1/4/77	88	194.83	1171
1/5/77	89	200.45	1213
1/6/77	90	206.90	1237
1/7/77	91	213.80	1263
1/8/77	92	219.51	1279
1/9/77	93	224.01	1302
1/10/77	94	227.15	1337
1/11/77	95	230.30	1372
1/12/77	96	233.74	1401
1/1/78	97	238.32	1438
1/2/78	98	243.35	1487
1/3/78	99	248.99	1536
1/4/78	100	255.41	1588
1/5/78	101	262.87	1639
1/6/78	102	270.88	1698
1/7/78	103	279.04	1746
1/8/78	104	287.58	1793
1/9/78	105	295.57	1839
1/10/78	106	303.29	1891
1/11/78	107	310.49	1943
1/12/78	108	318.44	1973
1/1/79	109	326.82	2045
1/2/79	110	334.20	2122
1/3/79	111	341.97	2245
1/4/79	112	350.51	2329
1/5/79	113	363.64	2384
1/6/79	114	377.54	2466
1/7/79	115	390.10	2574
1/8/79	116	400.71	2723
1/9/79	117	412.24	2933
1/10/79	118	428.80	3087
1/11/79	119	448.47	3258
1/12/79	120	468.71	3497
1/1/80	121	487.83	3714

APPENDIX G

THE STOCK MARKET IN 1971

APPENDIX G

THE STOCK MARKET IN 1971

The 1969 economic growth and the process of inflation control intensified the stock market reaction, which had already started in 1968. The BOVESPA Index (initiated in the early part of 1968 based at 100) exceeded 200 at the end of 1968, 400 in late June 1969, and oscillated between 500 and 600 for the period August-December 1969.

Following a period of relative stability, an expansion process was initiated in July 1970 that maintained itself to the middle of 1971. The market growth attracted investors belonging to all levels, through direct stock-exchange operations or through mutual and fiscal funds. The mutual-funds patrimony showed a significant evolution: 243 percent in 1969, 57 percent in 1970, and 150 percent in 1971, reaching the amount of Cr$3.167 million at the end of 1971.

Fiscal funds also represented a high volume of resources. Their assets by November 1969 reached the sum of Cr$260 million and by December 1970 Cr$411 million. At this date, there were 896,000 investors.

The demand for stocks grew faster than the corresponding supply. The number of companies quoted in 1970 and early 1971 was still relatively small, provoking a fast price increase and stimulating speculation.

Volume traded reached extremely high values. The two largest stock markets, those in Rio de Janeiro and São Paulo, negotiated, in

all, 1.2 billion dollars in 1970 and 4.9 billion in 1971; during May 1971 alone, the total reached 767 million dollars. This excess demand, which existed up to the middle of 1971, prompted a reversion, and in 1972 all stock-market indicators showed the market readjustment.

SOURCE: Adroaldo Moura da Silva, Francisco Vidal Luna, and Helio Nogueira da Cruz, Inflação e Mercado de Capitais a Experiência Brasileira (Inflation and the Capital Market: The Brazilian Experience).

APPENDIX H

PARTICIPATION OF LARGE COMPANIES IN THE TOTAL VOLUME TRADED

APPENDIX H

PARTICIPATION OF LARGE COMPANIES IN THE
TOTAL VOLUME TRADED

Company	Participation (%)		
	1974	1975	1976
Petrobrás	21.41	32.41	24.13
Banco do Brasil	12.18	21.06	22.15
Belgo Mineira	13.80	6.97	5.24
Vale do Rio Doce	7.46	7.29	4.22
TOTAL	54.85	67.73	55.74

SOURCE: Anuários da Bolsa de Valores de São Paulo.

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