AN ECONOMETRIC MONETARY MODEL OF THE JORDANIAN ECONOMY

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CHAPTER I

INTRODUCTION

Statement of the Problem

The three most salient developments in the last two decades in the field of monetary economics have been:

1. The formulation of monetary theory as a part of capital theory which treats money as an alternative to real assets.[1]

2. The integration of monetary theory with the theory of economic growth leading to a number of growth models in which the role of money is explicitly incorporated.[2]

3. The analysis of the nature of the connection between financial development and economic growth.[3]

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[1]Harry Johnson, "Recent Development in Monetary Theory," Essays in Monetary Economics (Cambridge: Harvard University Press, 1969), p. 94; Milton Friedman, "Postwar Trends in Monetary Theory and Policy," in Deane Carson, ed., Money and Finance: Readings in Theory, Policy and Institutions (New York: John Wiley and Sons, Inc., 1966), p. 189.

[2]Jerome L. Stein, Money and Capacity Growth (New York: Columbia University Press, 1971), pp. 265-67; Allan H. Meltzer, "Money, Intermediation and Growth," Journal of Economic Literature, VII (1969), pp. 40-56; Jon Harkness, "The Role of Money in a Simple Growth Model: Comment," American Economic Review, LXII (March, 1972), pp. 177-79.

[3]Robert L. Bennett, "Financial Innovation and Structural Change in the Early Stages of Industrialization: Mexico, 1945-59," Journal of Finance, XVII (1963), pp. 666-83; John G. Gurley and E. S. Shaw, "Financial Aspects of Economic Development," American Economic Review, XLV (September, 1955), pp. 515-38; E. S. Shaw, Financial Deepening in Economic Development (New York: Oxford University Press, 1973).

Accordingly, the increased interest in econometric monetary models has become one of the most important developments in contemporary economics. Indeed, there have been a large number of attempts to explain aggregate demand with quantity theory models, where the money supply plays the central role in determining key macroeconomic variables of the economy. As Johnson pointed out, the main issue is "whether the demand for money is sufficiently stable to provide, in conjunction with the quantity of money, a better explanation of observed movements of money income and other aggregates than is provided by models built around income-expenditures relationships."[4] Evidence from the experiences of developed economies suggests that the relationships in the monetary sector are not only stable and predictable, but are necessary for an understanding the behavior in other economic sectors. The evidence also shows that an econometric monetary model has been widely accepted as a standard approach to forecasting and policy simulations.

Despite these developments, very little attention has been given to the construction of econometric monetary models in the less developed countries. However, the construction of such a model may be of substantial use for policy decisions in such countries. Since no econometric monetary model has ever been constructed for the Jordanian economy, it would be worthwhile to examine the role of money, and to integrate some of the recent developments in monetary theory in an econometric model of Jordan. In other words, it is possible that the relationships developed and estimated in econometric monetary models in developed economies are

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[4]Harry Johnson, "Monetary Theory and Policy," in Richard Thorn, ed., Monetary Theory and Policy (New York: Praeger, Inc., 1976), p. 42.

applicable to the less developed economies, with appropriate theoretical modifications. This is the problem to which this study is mainly concerned.

Objectives

This study is an attempt to construct an econometric monetary model of the Jordanian economy. The explicit purposes of this model are to:

a. investigate whether monetary relationships are indeed stable enough to give a reliable explanation of national income;

b. identify the channels through which monetary policy operates on the real sector of the economy by constructing a small-scale real sector model; and,

c. serve as a useful analytical tool to forecast the behavior of the Jordanian economy.

Moreover, special attention is directed to the following substantive issues in regard to quantity theory of money:

a. The principal determinants of the demand for money, including the role of interest rates.

b. The appropriate definition of money.

c. Whether the supply of money is exogenously controlled by the monetary authorities.

Organization of the Study

Following this introduction, Chapter II presents a brief description of the institutional background and general behavior of the Jordanian economy and monetary system. A brief review of monetary

policy during the period under study is also provided. Chapter III is concerned with the estimation of the demand for monetary assets in the context of the Jordanian economy. To achieve this, an attempt is made to examine the relevance of demand for money theory to the monetary conditions of Jordan. (The specification of the structural equations of the monetary sector as well as the real sector of the economy and the theoretical rationale for each equation are presented in Chapter IV.) Chapter V contains the ordinary least squares and two-stage least squares estimates of the structural parameters of the model. In Chapter VI, various kinds of simulation analysis are performed to examine the model's properties, such as dynamic stability, predictive ability and policy implications. Chapter VII, the final chapter, contains a summary of the findings and a discussion of the study's limitations and suggestions for further research.

CHAPTER II

THE JORDANIAN ECONOMY AND MONETARY SYSTEM[1]

This chapter contains a description of some of the institutional background and general behavior of the Jordanian economy and monetary system. The purpose of this chapter is to present an overview of the Jordanian economy with emphasis on the monetary system to make intelligible the monetary models which are encountered in Chapter IV. Thus, the chapter first discusses the general character and past behavior of the Jordanian economy. A description and analysis of the Jordanian financial market then follows. Finally, Jordanian monetary policies are considered.

Salient Features of the Economy

Jordan comprises the former Kingdom of Transjordan and the part of Palestine which remained in Arab hands when hostilities with Israel ended in 1948. The Hashemite Kingdom of Jordan came into existence on April 24, 1950, when the East Bank of Palestine was formally attached to Transjordan.[2] The total area of Jordan is 37,000 square miles. The

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[1]Much of this chapter is extracted from the author's Master's thesis at the University of Maine in 1975. Adeeb K. Haddad. "The Control of the Supply of Money in Jordan" (Unpublished Master's thesis, University of Maine, 1975.)

[2]Raphael Patai, The Kingdom of Jordan (Princeton: Princeton University Press, 1958), pp. 40-45.

population of Jordan in 1972 was 2.4 million, 1.7 million being on the East Bank. The West Bank of Jordan has been under Israeli occupation since the June War of 1967.[3]

The economic structure of Jordan, like most less developed economies, is characterized by heavy dependence on the agricultural sector. Since the activity in the agricultural sector is heavily dependent on weather conditions, the economy is more unstable than those of developed economies. Jordan also depends on foreign aid for generating income, the quantum of which varies according to the type of political grounds between Jordan and the donating countries. Besides, the instability generated by social and political factors entails a change in government policies relating to economic activities.

These economic conditions represent the salient economic features of Jordan. Some data are shown in Table I. The gross national product (GNP) grew at an average annual real rate of 6.1 percent over the period 1956-1975. The rate of growth was not stable, but fluctuated from year to year. The fluctuation of rates was mainly due to political instability following the War of 1967.

The growth in GNP has been largely generated from some sectors such as agriculture, industry and services sectors. Agriculture contributes about 20 percent of gross domestic product (GDP). It provides employment for over one-third of the total labor force, and constitutes 50 percent of the exports of the country.[4] The major agricultural products are

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[3]National Planning Council, Three Year Development Plan 1973-1975, p. 323.

[4]Ibid., pp. 323-326.

TABLE I

MAIN ECONOMIC INDICATORS
(In JD Million)*
(End of Year)

Year	GNP	Exports of Goods	Imports of Goods	Total Govt. Expenditure	Total Govt. Revenues	Foreign Aid	Money Supply	Currency	Foreign Assets
1956	66.91	5.12	24.60	21.30	40.90	14.81	20.24	14.56	25.14
1960	127.14	4.00	41.40	32.82	43.41	26.88	26.09	15.63	30.67
1964	160.62	8.82	49.47	43.62	51.60	28.52	39.76	23.03	52.05
1967	205.95	11.30	54.20	68.18	70.41	53.93	75.24	51.52	92.46
1970	222.50	12.23	65.53	80.70	76.26	40.65	105.46	82.43	97.37
1973	291.34	19.00	107.82	114.70	131.40	64.60	139.25	97.48	106.98
1975	418.90	48.88	232.94	209.43	193.21	140.36	218.51	139.03	174.72

*JD = Jordanian Dinar.

Source: Table XVI and Central Bank of Jordan, Monthly Statistical Bulletin, Relevant Issues.

wheat, barley, and fruits. The production of these crops is subject to wide fluctuations as the result of weather conditions from year to year.

The contribution of the services sector is abnormally high as compared with other countries at similar stages of development. The average share of the services sector in GDP has been ranged between 45 to 63 percent during the period under study. After the War of 1967, this sector started to increase more rapidly than any sector in the economy as a result of the large increase in the public administration and defense sector.[5]

Industry and mining contributed about 16.5 percent of GDP in 1975 as compared with 13.2 percent in 1956.[6] The industrial structure is dominated by small and handicraft enterprise. The mining structure is still in a primary stage of development, and natural resources are very limited. In spite of governmental intervention to promote the development of this sector, it still has chronic problems such as limited supplies of capital goods, shortage of semi-skilled labor, and the small size of the local markets.[7]

On the budgetary side, fiscal development was characterized by large increases in both government expenditures and foreign transfers. The total government expenditures increased by an average annual rate of 12.8 percent over the period under study, while the total government revenues increased at an average annual rate of 8.5 percent. Moreover,

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[5]International Monetary Fund, International Financial Statistics (December, 1976), pp. 211-214.

[6]Ibid., pp. 211-214.

[7]National Planning Council, op. cit., pp. 110-114.

foreign grants showed a sharp increase over the same period. These funds amounted to JD 140 million in 1975 or more than tenfold the level of 1956. Domestic revenues comprised an average of less than 50 percent of the total revenues over the period 1956-1975. The basic source of domestic revenues is indirect taxes which constituted an average of more than 45 percent of domestic revenues. Direct taxes averaged eight percent of domestic revenues.

One of the permanent features of government expenditures is that 70 percent of the total expenditures are devoted to recurring expenditures such as salaries and military expenditures. It may be of interest to note that the Jordanian budget has been characterized over the period 1967-1975 by a consistent deficit, which required domestic borrowing and continued reliance on foreign aid.

Moreover, Jordan's foreign trade showed a large increase in both imports and exports over the period 1956-1975. Total exports averaged about 20 percent of total imports. Although exports rose by an average annual rate of 12.6 percent over the period concerned, the Jordanian trade balance still suffers from a rising and chronic structural deficit which dates back to 1950. This deficit has widened from JD 19 million in 1956 to JD 43 million in 1967, and to JD 184 million in 1975. It should be noted that Jordan depends on imports to meet its domestic demand for a large number of agricultural goods, where imports account for more than half of Jordan's consumption of cereals and animal products. The expansion of imports is thus considered one of the factors which contributed to the rapid growth of the services sector.[8] However, the

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[8]National Planning Council, Five Year Plan 1976-1980, p. 23.

trade deficit is usually financed by foreign aid. Most of the transfer payment is in form of assistance by foreign governments, and the United States of America and Suadi Arabia are the main donors. These transfers are used to cover the deficit in the trade balance and to bridge the wide gap between the total government expenditures and domestic revenues.

All the features of the Jordanian economy--the continued deficits of the central government, the agrarian economy, the great dependence on foreign aid, and the chronic balance of trade problems--have implications for control of the aggregate monetary variables.

Money Market in Jordan

The Nature of the Jordanian Money Market

The money market in Jordan, as in most less developed countries, is characterized by its dual nature. The unorganized money market caters to the needs of the predominant undeveloped or agricultural sector, while the organized money market is confined to the developed urban or industrial sector. There is no link between the two markets. The lenders in the unorganized sector do not have access to the banking system of the organized market. A large part of the loans in the unorganized sector do not carry money interest. The interest rates, where they exist, vary widely from lender to lender, and are much higher than the ones charged by the commercial banks in the organized market. However, interest rates in the organized market are subject to ceilings imposed by the central bank. The imposition of ceilings is not operative in the unorganized market, i.e., funds are loaned by savers to the investors on the basis of personal contract. Therefore, the interest

rate structure does not reflect the market conditions and distorts resource allocation between the economic sectors.[9]

Since agriculture is the predominant sector, the relative importance of the unorganized money market is probably much greater than the organized money market in Jordan. The size of organized money market may be approximated by ratios such as ratio of demand deposits to the total money supply, and the ratio of total bank credit to GNP. The first ratio represents "the liquidity preference approach," and the second ratio represents "the loanable funds approach."[10]

Table II shows that both ratios are very low in Jordan, as compared with the ones in the developed countries.[11] This situation may be mainly due to the lack of banking habits among people, coupled with the absence of banking facilities in the rural areas of Jordan. Accordingly, the smallness of the organized market or the lack of integration between the two markets gives rise to certain peculiar characteristics of the money-using units. The use of checking accounts instead of currency as a medium of exchange is very restricted in the large rural areas of Jordan. This is reflected in the particular composition of money; currency being 65 percent of the money supply over the period 1956-1975. This may suggest that currency could be both the medium of exchange and

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[9]See, for example, H. Myint, "Economic Theory and the Underdeveloped Countries," Journal of Political Economy, 73 (October, 1965), pp. 477-491; Arthur I. Bloomfield, "Monetary Policy in Underdeveloped Countries," Public Policy, eds., C. J. Fredrich and S. E. Harris (Cambridge: Harvard University Press, 1956), pp. 232-273.

[10]U Tun Wai, "Interest Rates in the Organized Money Market of Underdeveloped Countries," IMF Staff Papers, V (August, 1956), pp. 249-278.

[11]More detail about the loanable funds will be given in the following subsection.

the store of value, unlike in the developed economies, where currency is used more as a medium of exchange than a store of value. In other words, liquidity preference may be reflected more in the holding of currency rather than in deposit money.

TABLE II

LIQUIDITY PREFERENCE AND LOANABLE FUNDS RATIOS

Year	$(DD/M_1)\%$	$(CL/GNP)\%$
1956	28.1	12.3
1960	40.1	14.9
1967	31.5	17.5
1973	30.0	20.0
1975	36.4	27.3

Where DD = demand deposits
M_1 = currency in circulation plus demand deposits
CL = commercial banks' loans

Source: Table XVI.

The Organized Money Market

The monetary system of the organized sector in Jordan is dominated by the central bank, and the commercial banks. There are other institutions such as the specialized non-deposit credit institutions, which are semi-governmental. Their assets (liabilities) are too small to warrant serious attention.

Commercial Banks. The banking system in Jordan started in 1950 with four commercial banks, three of which were branches of firms with head offices in London. The Arab Bank was the only Jordanian bank. Foreign banks played a very important part over the period 1950-1955. By the end of 1975, the banking system consisted of ten commercial banks: four of them were Jordanian, the other six were--in terms of nationality--two British, an American, an Iraqi, a Lebanese, and an Egyptian bank. These banks maintained 70 branches, of which 41 branches were located in the capital city of Amman.[12]

The Jordanian commercial banks have been performing the basic banking functions including discounting commercial paper, receiving deposits, granting loans and remitting funds.

After the establishment of the Central Bank of Jordan (CBJ) in 1964, banks were limited by a law regulating the ownership, management, credit to customers, and profits and dividends of commercial banks.[13] Commercial banks were required to maintain with the CBJ, legal reserves equal to a given minimum percentage of their deposit liabilities. The minimum reserve requirement can be changed by the CBJ. The commercial banks were also required to maintain a certain proportion of their deposit liabilities in the form of liquid assets. These liquid assets were: (1) Jordanian currency, notes, and coins, (2) balances held with the CBJ, (3) net credit balances with banks both inside and outside the country, and (4) domestic and foreign government bills.[14]

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[12]National Planning Council, op. cit., p. 65

[13]The Banking Law, Law No. 24 of 1971, Articles 13, 14, 15, 18.

[14]Ibid., Article 17.

The consolidated balance sheet of the commercial banks reveals that their activities and operations have increased (Table III). This expansion is reflected in a continuous increase in the "sources of commercial banks lending power-capital and deposits."[15] These sources increased by an average annual rate of 10.9 percent over the period 1964-1975. The volume of capital and reserves has changed slowly and within narrow limits relative to other sources of lending power. Other liabilities, such as borrowings from the CBJ, are small relative to total liabilities, because the Jordanian commercial banks believe that borrowing from the CBJ impairs their prestige.

The most important change in the liabilities' side was the growth of commercial banks' deposits. Total deposits increased by an average annual rate of 11.2 percent over the period 1964-1975. The rate of growth in demand deposits was much higher than that of the time deposits. The decrease in government deposits at commercial banks after 1964 was a result of the establishment of the CBJ and the transfer of government deposits to that institution.[16]

Changes in the sources of commercial banks' funds were reflected in the use of their lending power. Loans and advances, including bills discounted and investment in government securities were the most important types of assets held by the commercial banks in Jordan. Before 1969, there were no treasury bills and government bonds, and the

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[15]John G. Ranlett, Money and Banking: An Introduction to Analysis and Policy (New York: Wiley and Sons, 1969), p. 69.

[16]International Monetary Fund, op. cit., pp. 211-214.

TABLE III

BALANCE SHEET OF COMMERCIAL BANKS

(In JD Million)
(End of Year)

	1964	1967	1973	1975
Vault Cash	1.27	1.50	2.07	2.89
Balances with CBJ	0.34	16.94	16.76	32.91
Treasury bills and Govt. Bonds	--	--	16.94	24.48
Loans and Discounts	27.66	35.97	58.14	114.25
Other Assets	33.94	16.39	17.69	38.67
Assets=Liabilities	63.21	70.80	111.60	213.20
Capital and Reserves	4.80	6.39	8.01	12.29
Demand Deposits	23.02	30.58	47.44	90.50
Time Deposits	24.05	20.80	37.28	60.25
Borrowings from CBJ	--	--	0.23	0.84
Other Liabilities	11.34	13.03	18.64	49.32

Source: Central Bank of Jordan, Monthly Statistical Bulletin, Relevant Issues.

commercial banks' portfolios consisted only of private discounted bills. At the end of 1975, however, investments in government bills and bonds represented about 11.5 percent of their total assets.

In recent years, commercial banks' credit to the private sector--loans and discounts--has emerged as the single most important form of assets held by the commercial banks. By the end of 1975, it represented about 54 percent of total assets and 76 percent of total deposits. It may, however, be of interest to note that the commercial banks in Jordan, as well as in the other less developed countries, are reluctant to supply long-term loans. Thus, more than half of total commercial banks' credit was for financing the trade sector in Jordan. The agriculture sector, for instance, which accounts for 20 percent of GDP receives a very small proportion of banks' credit. This proportion has increased from 2.1 percent in 1965 to 4.6 percent in 1975.[17] This conservative attitude of the banking system is attributed to the fact that long-term loans involve a higher degree of risk, and the control and supervision by the central banks do not encourage more "risk-taking practice."

Concentration of banking activities is also noted in the urban areas rather than the rural areas in Jordan. In spite of the increase in the number and the branches of the commercial banks in Jordan, the banking services do not cover a substantial part of the population. In 1972, for instance, 95 percent of credit was extended to residents of Amman, and more than 33 percent of credit was extended to 48 clients.[18]

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[17] International Monetary Fund, op. cit., pp. 211-214.

[18] Jawad A. Anani, "A Comparision Between the Effects of Fiscal and Monetary Actions on Economic Activity - Case of Jordan" (Unpublished Ph.D. dissertation, University of Georgia, 1975), p. 74.

An interesting feature that may rise from the banking system activities is that the commercial banks maintain a relatively high ratio of liquid assets to deposits in Jordan. Table IV gives some idea about the commercial banks' preference of liquidity. It reveals that the commercial banks have maintained a relatively high ratio of liquid assets, despite the decline of the liquidity ratio from 54.7 percent in 1956 to 41.4 percent in 1975. The usual purpose of a liquidity ratio is "to increase the effectiveness of credit restraint by limiting the scope for commercial banks' liquidation of treasury bills to support an expansion of bank loans."[19] This is not true of Jordan because there is not much possibility of selling treasury bills and bonds in the open market other than to the CBJ. However, the higher liquidity ratio could be due to the limited size of the money market, the lack of banking habits, the conservative attitude towards extending credit, and the unsettled political conditions in the Middle East.

The table also shows that the total reserve ratio was very high relative to the required minimum reserve ratio. This may be due to the higher level of liquidity ratio. However, the trend of the excess reserve ratio has fallen sharply. This is due to transfer of most of the foreign assets from the commercial banks to the CBJ, and the CBJ has stopped the payment of interest on the commercial banks' reserves.

Central Bank of Jordan (CBJ). In 1950, the Jordan Currency Board was established. The Board was empowered with the sole right to issue currency in Jordan against payment in advance in Sterling in London, and

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[19] P. G. Fousek, Foreign Central Banking, The Instrument of Monetary Policy (New York: Federal Reserve Bank of New York, 1957), p. 59.

TABLE IV

TOTAL, REQUIRED AND EXCESS LIQUIDITY AND RESERVE RATIOS

(Percent)
(End of Year)

Year	Required Liquidity Ratio (1)	Excess Liquidity Ratio (2)	Total Liquidity Ratio (3)=(1)+(2)	Required Reserve Ratio (4)	Excess Reserve Ratio (5)	Total Reserve Ratio (6)=(5)+(4)
1956	-	-	54.7	-	-	-
1967	25	16.1	41.1	7	26.0	33.0
1970	25	12.4	37.4	10	13.2	23.2
1973	25	21.8	46.8	10	9.8	19.8
1975	25	16.4	41.4	12	9.8	21.8

Source: Table XVI and Central Bank of Jordan, Annual Reports, Relevant Issues.

to make available Sterling in London against the surrender of Dinar in Jordan. The Board was required to invest all its assets in Sterling treasury securities issued by governments other than the Jordanian government.[20] The Board was unable to exercise any influence on the supply of money or credit in Jordan, either directly by its own operations or indirectly by influencing or controlling the operations of the commercial banks.[21] Therefore, the traditional instruments of monetary control were absent.

Given that the future development of Jordan required a more comprehensive monetary authority, the government decided to establish a Central Bank in 1960, like the ones existing in other countries. The Central Bank was brought into being by 1960 Law; it is known as the Central Bank of Jordan (CBJ), and started its activities in 1964. Two years after beginning operations, the 1960 Law was amended by the Law of 1966, and then by the Law of 1971. According to the Central Bank Law of 1971, the objectives of the CBJ are "to maintain monetary stability, to insure the convertibility of the Jordanian Dinar, and to promote the sustained growth of the economy of the kingdom in accordance with the general economic policy of the government."[22]

The CBJ has given a "monopoly of note-issue." The CBJ is required to maintain assets against note-issue, the value of which at any time shall not be less than the value of the notes and the coins issued.

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[20]The International Bank for Reconstruction and Development, The Economic Development of Jordan (Baltimore: The John Hopkins Press, 1957). p. 363.

[21]Ibid., p. 366.

[22]The Law of the Central Bank of Jordan, Law No. 23 of 1971, Article 4.

Such assets shall consist of gold and gold coins, convertible foreign currencies, securities issued by a foreign government or by an international finance institution, any foreign exchange assets including credit balances and treasury bills, holdings of special drawing rights, and Jordanian government securities.[23]

The CBJ also acts as the banker and fiscal agent to the government and public entities. It is empowered to deal with debt-instruments issued by the government. It is responsible for managing government accounts and foreign assets, and for keeping government deposits. Moreover, the CBJ is required to make short-term advances to the government not exceeding ten percent of the government domestic revenues for the current fiscal year.[24]

As the bankers' bank and the lender of last resort, the CBJ is empowered to provide the commercial banks with rediscounting facilities, and with advances for fixed periods not exceeding nine months. Also, it has been given the power to regulate the banks' credit, to change the reserve requirement, and to determine the commercial banking system policy.[25]

Furthermore, the CBJ is granted the power of maintaining and managing the gold and the foreign exchange reserves of the country, and regulating the quantity, quality and cost of credit to meet the requirements of economic growth and monetary stability.

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[23]The Law of the Central Bank of Jordan, op. cit., Article 31.

[24]Ibid., Articles 38, 39, 40, 46.

[25]Ibid., Articles 48, 49.

A brief review of policy instruments of monetary management used by the CBJ is given below:

1. Discount Rate (Bank Rate) - The CBJ has been empowered to change the bank rate, at which it is prepared to rediscount approved bills of exchange and other types of commercial papers. Since the establishment of the CBJ in 1964, the bank rate has been changed three times. The rate has ranged between 5 and 5.50 percent over the period 1964-1975.

However, discount operations have not been of much significance as an instrument through which the CBJ has been able to influence the commercial banks' credit and its cost. This is due to the fact that the reserves of the commercial banks were so large as to preclude the need for any regular recourse to the CBJ credit via rediscounts and borrowings.[26] Furthermore, the undeveloped state of the money and capital markets, tends to make interest rates in the organized sector of the market relatively insensitive to changes in the bank rate. Thus, the bank rate is rendered an ineffective tool of monetary controls.

2. Open Market Operations - Open market operations have a direct effect on the volume of banks' reserves, the monetary base and the money supply. Although the CBJ has been given the power to use open market operations as a means of controlling credit and regulating the quantity of money, the CBJ has hardly taken recourse to them. This is, however, not to deny the existence of the government securities transactions between the CBJ and the commercial banks. But due to the narrow and limited securities market these operations were seldom used as a

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[26]See Table III, p. 15 and Table IV, p. 18.

conscious instrument of monetary policy. Thus, the limiting factor is not so much the range of available securities as the size of the market itself.

However, the CBJ had tried to enlarge the scope of the government securities market by encouraging the public to invest in treasury bills. In 1973 the Law allowed that 50 percent of the interest income coming from treasury bills be deductible for income tax purposes. In addition, the CBJ announced its readiness to purchase government bonds from the public at face value at any time, and they are protected against the risks of being lost or destroyed.[27] Thus, the experience of the last three years indicates an increasing citizen willingness to invest in government bills and bonds. The public's holdings of government bills and bonds increased from three percent of total outstanding in 1969 to 24 percent in 1975.[28]

3. Legal Reserve Ratio and Liquidity Ratio - Since the commercial banks are required to maintain a certain percentage of their current and time deposits with the CBJ, changing this ratio influences the lending power of banks. As Goode and Thorn point out, the variable reserve ratio may be useful in less developed countries because changes in bank rate are often less influential than in countries with highly developed financial institutions, and because the development of open market operations is a long run problem.[29] Until 1969, the minimum legal

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[27]Central Bank of Jordan, Tenth Annual Report (1973), p. 106.

[28]Central Bank of Jordan, Monthly Statistical Bulletin, Relevant Issues.

[29]Richard Goode and Richard Thorn, "Variable Reserve Requirements Against Commercial Bank Deposits," IMF Staff Papers, 7 (April, 1959), p. 24.

reserve requirement was seven percent for current and time deposits. Since then reserve requirements changes have been used quite frequently as an instrument of monetary policy. In 1970, the reserve requirement ratio was raised to ten percent to check monetary and credit expansion. In 1974, it was further raised to 12 percent. The liquidity ratio is another restraint on the expansion of banks' credit. The minimum liquidity ratio was 25 percent over the period 1964-1975.

4. Selective Controls - In addition to these quantative controls, selective controls such as moral suasion and preferential treatment of certain types of loans are also available. The basic purpose of selective controls is to provide some degree of flexibility to monetary policy and to regulate the flow of credit to different sectors of the economy. The CBJ has relied mostly on selective control instruments to attain its objectives. Such controls were in the form of fixing margin requirements on loans or fixing quotas on the lending of the banks for some specific purposes.

In summary, even though the CBJ has been given the major instruments of the monetary policy to regulate the volume of credit and the quantity of money, and to manage the country's foreign assets, the monetary policy in Jordan, like most other less developed countries, was restricted mainly to use of selective controls. The reasons given for not using other policy instruments effectively are: (1) the small amount of credit compared to the GNP; (2) the dichotomy between the organized and the unorganized money markets; (3) the excess liquidity in commercial banks' portfolios; (4) the limited government securities market; (5) the immaturity of financial institutions; and (6) the undue

government recourse to borrowing from the CBJ.[30]

Review of Monetary Policy

Fundamentally, the basic objectives of monetary policy do not differ greatly in less developed countries from those in developed countries, despite widely differing economic and social frameworks. The desired goals of Jordanian monetary policy, however, are taken from the objectives of the CBJ specified in the Law of 1971.[31] In order to see the role and the scope of the monetary policy, a brief discussion of the monetary policies that have been pursued in Jordan over the past two decades is presented.

Prior to 1964, commercial banks' activities were not subject to any form of monetary control by the Jordan Currency Board. The Board had no discretionary power to influence the quantity of money and the volume of credit in the country. Its functions were totally automatic and passive. The 100 percent Sterling backing of the currency issued was too restrictive, and it created a rigid link between money supply and foreign assets. Therefore, all the conventional instruments of monetary policy could not be used over the period 1950-1964. During the Board period, the money supply grew at an average annual rate of 7.5 percent. The growth of money supply was attributable to the expansion of the currency. The GNP grew at an average annual real rate of 9.7 percent. The price level was quite stable over the same period; it increased at an average annual rate of 1.7 percent.

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[30]Central Bank of Jordan, Annual Report, Relevant Issues; Arthur I. Bloomfield, op. cit., pp. 242-273.

[31]See subsection 2, p. 19.

At the end of 1964, the CBJ and some specialized non-deposit credit institutions were created. The analysis of monetary policy during the CBJ's existence shows that Jordan has experienced a rapid monetary expansion in terms of the growth of the money supply. The money supply increased at average annual rate of 16.8 percent, more than twice its rate of increase during the Jordan Currency Board period. It should be noted that 90 percent of the growth of the money supply over the period 1964-1975, was accounted for by an expansion of the monetary base, and ten percent by an increase in the monetary multiplier. The control of the monetary base in Jordan, as in many less developed countries, is difficult, when the balance of trade and the government budget show persistent deficits, because the country covers these deficits by securing foreign aid and governmental recourse to CBJ credit.

However, the largest rates of growth of money supply occurred in 1967 and 1973. The increase in these two years was mainly brought about by the increase in currency. The currency component of the money supply comprised more than 60 percent of the money supply over the period 1964-1975. In comparison, the currency component of the money supply of the United States of America has been below 30 percent throughout the twentieth century, but the currency portion of the money supply of the less developed countries is usually over 30 percent.[32] Jordan has the same problem as do many other developing countries; the volume of currency is determined by the public's preference for holding cash rather than by the monetary authorities. As Khazzoom points out, the determinants of the currency ratios in less developed countries are--

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[32]Edward Nevin, Capital Funds in Underdeveloped Countries (New York: St. Martin, 1961), p. 3.

the growth of banking system, the monetization of the economy, urbanization, and the political situation.[33] These appear to be the important factors in Jordan. However, the rapid expansion in the money supply over the period 1964-1975 caused mainly by the increase of foreign assets, which increased by an average annual rate of 11.6 percent, and the claims on private sector, which rose by an average annual rate of 13.8 percent. The government became indebted to the banking system through the introduction of treasury bills in 1969 and government bonds in 1971.

The behavior of the aggregate monetary variables was reflected in the rest of the economy as a whole. The growth in real income averaged 2.7 percent per annum during the period 1964-1975, while the rate of inflation averaged 6.3 percent per annum for the same period. Most of this increase occurred between 1971-1975 when prices increased at an average rate of 9.1 percent per annum. Velocity however, tended to decline, because the increase of money supply was faster than the increase of GNP.

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[33]J. Daniel Khazzoom, The Currency Ratio in Developing Countries (New York: Frederick A. Praeger, Inc., 1966), p. 24.

CHAPTER III

DEMAND FOR MONEY IN JORDAN

This chapter consists of three sections. The first section outlines the important contributions to the theory of demand for money which exist today in the developed countries. In the second section, an attempt is made to examine the relevance of demand for money theory to the monetary conditions of a developing country such as Jordan. The third section presents the single equation estimates of various structural forms of the demand for components of the money stock in Jordan.

Theoretical Issues

Historically, the current concept of the demand for money grew out of the classical "crude" quantity theory of money which is basically a monetary theory of the price level. As Alvin Hansen pointed out, "in its most naive form the (quantity) theory stated that prices varied in direct proportion to the money supply."[1] This theory was accepted by most economists from the Mercantilist era until the time when Alfred Marshall ruled Cambridge.

The quantity theory has taken two different approaches. The first is the Equation of Exchange, usually associated with the name of Irving Fisher, and the second is the Cambridge Cash-Balance Approach.

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[1]Alvin H. Hansen, Monetary Theory and Fiscal Policy (New York: McGraw Hill, 1949), p. 48.

Irving Fisher's Equation of Exchange--velocity of circulation approach--can be expressed as:[2]

$$MV = PT \qquad (1)$$

where M = average amount of money in circulation during a period of time;

V = the velocity of circulation of money;

P = the average price level of all transactions for a period of time;

and T = the physical volume of transactions.

As a result of the development of national accounting, the quantity equation has recently tended to be expressed in terms of income transactions and income velocity rather than gross transactions, and transactions velocity, respectively. The Fisher equation then can be written in income form as:

$$MV = Py \qquad (2)$$

where M is the same as in the Equation of Exchange, V is the average number of times per unit time that the money is used in making the final transactions, P is an average price level of final transactions, and y the level of real income.

The Cambridge Cash-Balance Approach can be stated in the following form:

$$M = K\,Py \qquad (3)$$

where K is the reciprocal of the V in equation (2).

The most important feature of the cash-balance approach is that the left hand side of the equation is the supply of money, while the right hand side is the demand for money. Thus, the quantity theory in its

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[2]Irving Fisher, The Purchasing Power of Money (New York: MacMillan Company, 1922), pp. 8-30.

cash-balance approach "can be regarded as a demand function for money."[3]

However, the classical theory of demand for money was based on the following elements:

1. The demand for money arises from transaction consideration, money being merely a medium of exchange.
2. The interest elasticity of demand for money is zero.
3. The demand for money is unitarily elastic with respect to income.[4]
4. The demand for cash balances is a stable function of income.

Keynes attacked the quantity theory on the grounds that the level of income and velocity are considered constant in the short run and the only equilibrium level is with full employment. Keynes, however, did not break away completely from the classical theory. He approaches the demand for money by examining the motivations of individuals for holding cash. In other words, his demand for money stems from treating money as an asset, emphasizing the store of value aspect of money. The speculative motive is then added to the classical transactions and precautionary motives as another important determinant of the demand for money.[5] He divides the demand for money into two components, M_1 to

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[3]Robert J. Gordon, Milton Friedman's Monetary Framework (Chicago: The University of Chicago Press, 1974), p. 10.

[4]Patinkin has argued that "...the neoclassical contention about monetary elasticity is not inherent in the Cambridge function as such" because a change in P alone generates a real balance effect. Don Patinkin, Money, Interest and Prices (New York: Harper and Row, 1965), second edition, p. 170.

[5]John M. Keynes, The General Theory of Employment, Interest and Money (New York: Harcourt Brace and World, Inc., 1964), pp. 194-209.

satisfy the transactions and precautionary motives and M_2 to satisfy the speculative motive. Corresponding to these two components, there are two liquidity functions; one depends on the level of income, while the other depends on the current rate of interest and the state of expectations.[6] Thus, the complete Keynesian demand for money function is written as:[7]

$$M = M_1 + M_2 = L_1(Y) + L_2(r)^8 \qquad (4)$$

or $M = L(Y,r)$

$$\frac{\partial M}{\partial Y} > 0, \text{ and } \frac{\partial M}{\partial r} < 0.$$

where M = stock of money;

M_1 = transaction balance

M_2 = speculative balance;

Y = national income;

and r = nominal rate of interest.

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[6] Ibid., p. 199.

[7] Ibid., p. 199.

[8] It is clear that the income velocity of money can no longer be a constant. That is if:

$$\text{velocity } V = \frac{Y}{M}$$

$$M_1 = KY$$

and $$M = M_1 + M_2 = L_1(Y) + L_2(r)$$

then $$M = KY + L_2(r)$$

and $$V = \frac{Y}{KY + L_2(r)}$$

$$= \frac{1}{K + \frac{L_2(r)}{Y}}$$

Velocity will vary by variations in the ratio of money demanded as an asset - $L_2(r)$ - to the level of national income.

Although Keynes mentioned the interest rate as a possible determinant of the level of the transactions demand for money, it was not emphasized.[9] More rigorous theoretical examinations of the interest elasticity of transaction demand for money were conducted by Baumol and Tobin.[10]

In the 1950's, the Chicago School led by Friedman reacted to the Keynesian onslaught on monetary policy by restating the classical quantity theory of money. The crucial points in Friedman's "The Quantity Theory of Money--A Restatement"[11] are "that the (modern) quantity theory is a theory of the demand for money, not of output, money income or prices; and that money is an asset or capital good, so that the demand for money is a problem in capital theory."[12] The modern quantity theory differs from the Keynesian theory in starting from the fundamentals of capital theory. It begins with the broadest, most comprehensive possible definition of wealth, including human wealth in the form of the present value of the expected stream of the individual's income. "As in the usual theory of consumer choice, the demand for money (or any other particular asset) depends on three major sets of

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[9]David Laidler, The Demand for Money: Theories and Evidence (Pennsylvania: International Textbook Company, 1969), p. 52.

[10]William Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics (November, 1952), pp. 545-556; James Tobin, "The Interest Elasticity of Transactions Demand for Cash," Review of Economics and Statistics (August, 1956), pp. 241-247.

[11]Milton Friedman, "The Quantity of Money - A Restatement," in M. Friedman, ed., Studies in the Quantity Theory of Money (Chicago: University of Chicago Press, 1956), pp. 3-21.

[12]Harry G. Johnson, "Monetary Theory and Policy," in Richard Thorn, ed., Monetary Theory & Policy (New York: Praeger, Inc., 1976), pp. 45-46.

factors: (a) the total wealth to be held in various forms--the analogue of the budget restraint; (b) the price of and return on this form of wealth and alternative forms; and (c) the tastes and preferences of the wealth-owning units."[13]

Within this framework it is assumed that wealth can be held in five forms: money (M), a commodity or claim that is generally accepted in exchange at a fixed nominal value; bonds (B), claims to time streams of fixed nominal payments; equities (E), claims to pro rata shares of the returns of enterprises; physical non-human goods (G); and human capital (H). These forms of wealth along with rates of return, the price level, and nominal income yield the following demand function for money:[14]

$$M = F\left(P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, Y, u\right) \tag{5}$$

By the homogeneity of the first degree in P and Y assumption, the equation then can be written as:

$$M = F\left(\lambda P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \lambda Y, u\right) \tag{5a}$$

$$= \lambda F\left(P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, Y, u\right)$$

then, if $\lambda = \frac{1}{P}$

$$\frac{M}{P} = F\left(r_b, r_e, \frac{1}{p}\frac{dP}{dt}, w, \frac{Y}{P}, u\right) \tag{6}$$

and, if $\lambda = \frac{1}{Y}$

$$\frac{M}{Y} = F\left(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \frac{P}{Y}, u\right) \tag{6a}$$

$$= \frac{1}{v\left(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w \quad \frac{Y}{P}, u\right)}$$

or,

$$Y = v\left(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \frac{Y}{P}, u\right).M \tag{6b}$$

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[13] Milton Friedman, op. cit., p. 5.

[14] Ibid., p. 8-11.

where M = the nominal stock of money;

P = the general price level;

Y = nominal income;

r_b = the market interest rate in bonds;

r_e = the market interest rate in equities;

w = the ratio of non-human to human wealth;

u = the tastes and preferences;

and v = income velocity.

The significance of Friedman's theory lies in the nature of income that he believes relevant for the theory of demand for money. He argues that the demand for money is a function not solely of present or measured income, but rather a person's total wealth. Since wealth is the discounted present value of the stream of expected future income, the interest rate (r) serves as a link in the relationship between income (Y) and wealth (W), i.e., $W = \frac{Y}{r}$. In other words, Y is considered as the return on all forms of wealth.

Relevant Theory to Developing Countries and Empirical Evidence

Before attempting to formulate the demand for money function for Jordan, it may be appropriate to examine the relevant theory to the monetary conditions of developing countries. Given the controversial analysis about the role of money in developed countries and the absence of systematic analysis of monetary behavior in developing countries, one may pose here the following basic analytic questions. Is it possible that the theoretical relationships developed to explain monetary behavior in the developed economies are applicable to developing

economies? If so, how far is the monetary theory of developed economies applicable to developing economies?

No one would seriously deny that the institutional and structural characteristics of the two types of economy are widely different. But it seems unlikely that such differences would render ineffective the economic theory in developing countries. As Schumpeter points out, within the framework of economic theory "there are tools economists use which are ideologically neutral, automatically evoked in the development of economic analysis, and capable of application to a wide variety of situations . . ."[15]

However, from a monetary analysis point of view, many economists have questioned the applicability of Keynesian liquidity preference theory in developing economies.[16] It has been argued that Keynesian theory is irrelevant to the monetary problems of developing countries because it is geared to the preoccupations of developed countries. This argument stresses the underdeveloped nature of the financial sector of developing countries, particularly the primitive state of money and capital markets. In most developing countries, the variety of financial assets is extremely limited, and the markets for these assets are narrow. Thus, the financial assets that form the transition between money and real assets in countries with fully developed financial

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[15]Joseph Schumpeter, History of Economic Analysis (New York: Oxford University Press, 1954), p. 44.

[16]See, for example, H. Myint, "Economic Theory and the Underdeveloped Countries," Journal of Political Economy, LXXIII (October, 1965), pp. 447-491; Y. C. Park "The Role of Money in Stabilization Policy in Developing Countries," IMF Staff Papers, XX (July, 1973), pp. 381-393; J. J. Polak, "Monetary Analysis of Income Formation and Payments Problems," IMF Staff Papers, XI (November, 1957), pp. 1-49.

markets play a very minor role in the asset structure of developing countries.

In addition, the quoted interest rates in many developing countries do not reflect money market conditions because they are exogenously determined by institutional arrangements. In these conditions, it is argued that the desired holdings of money are predominantly transactions balances which are likely to be inelastic with the interest rates on financial assets. Accordingly, many economists contend that the unsophisticated classical quantity theory may well be applicable to developing countries.[17]

Whether the quantity theory is relevant to the monetary conditions of developing countries depends upon the following fundamental empirical issues: (1) the most appropriate definition of money; and (2) the variables that enter the demand for money function in a manner so as to maintain a stable demand for money over time. These empirical issues and others are now examined in light of empirical studies from a number of developing countries.

The question of definition of money arises from treating money as asset. Harry Johnson views the debate over the appropriate definition of money as being caused by ". . . the transition from the conception of money as a medium of exchange to money as a store of value."[18] This transition results from a wide recognition of substitutability between

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[17]See, for example, C. H. Wong, "Demand for Money in Developing Countries," Journal of Monetary Economics, 3 (1977), pp. 59-86; U Tun Wai, "Interest Rates in the Organized Money Market of Underdeveloped Countries," IMF Staff Papers, V (August, 1956), pp. 249-278; Y.C. Park, op. cit., pp. 386-387.

[18]Harry Johnson, op. cit., p. 47.

money and the financial assets. However, the debate as to what to include in, and what to exclude from a definition of money is a problem of empirical evidence rather than a direct counterpart of the theoretical concept.[19] For instance, Selden argues that the definition of money which includes time deposits is more appropriate. He finds that the long run trend of velocity in the United States has been one of secular decline as income has grown. He explains this phenomenon by indicating that money is a luxury good with an income elasticity greater than one.[20] Friedman also finds money to be a luxury good with income elasticity of 1.8.[21]

Significant results concerning the definition of money are reported by Meltzer.[22] His findings strongly indicate that the demand to hold currency plus demand deposits is at least as stable as in alternative demand functions. Thus, there appears to be no reason for broadening the definition of money to include time deposits or liabilities of financial intermediaries.

Unlike the developed countries, the broader definition of money, which includes time deposits beside currency and demand deposits, is not

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[19]See, for example, George G. Kaufman, "More on an Empirical Definition of Money," The American Economic Review, LIX (March, 1969), pp. 78-87; David Laidler, The Demand for Money, Theories and Evidence, op. cit., pp. 89-99.

[20]Richard T. Selden, "Monetary Velocity in the United States," in Friedman, ed., Studies in the Quantity Theory of Money (Chicago: University of Chicago Press, 1956), pp. 230-231.

[21]Milton Friedman, "The Demand for Money: Some Theoretical and Empirical Results," Journal of Political Economy, 67 (August, 1959), pp. 327-351.

[22]Allan Meltzer, "The Demand for Money: The Evidence from the Time Series," Journal of Political Economy, 71 (June, 1963), pp. 219-246.

so relevant to the developing countries where the role of interest rates and the speculative motive are very weak, and the quoted interest rates do not change in response to market forces.

Furthermore, the money market in most developing countries is characterized by its dual nature. This makes it impossible for a large part of the population to deal with banks so that transactions are financed with currency rather than with bank balances. In other words, currency is mainly used for transactions in the rural areas while in the urban areas large transactions are carried on in checks. However since currency constitutes a major part of money holdings, and currency and demand deposits are not used interchangeably in most developing countries, it is quite appropriate to specify separate functions for currency and demand deposits. On the other hand, it is necessary to know the behavior of time deposits because every monetary analysis must rely on the movement of funds among the three components with resultant variations in the supply of money. Therefore, a separate function for time deposits is proposed to be undertaken.

The other important issue is the specification of the relevant variables in the demand function for money. Again, the question of the choice of any variable over the others is mainly due to empirical rather than theoretical considerations.

The first argument is the role of income or wealth as one of the determinants of the demand for money. Harry Johnson points out that,

> In principle one can regard current income as corresponding to transactions demand for money. This is to be contrasted with wealth which can be measured either by the value of people's assets or by the permanent income concept. In principle one could expect to bring both into the analysis.[23]

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[23]Harry G. Johnson, Macroeconomics and Monetary Theory (London: Gray-Mills Publishing Ltd., 1971), p. 125.

Meltzer finds that the inclusion of income in the demand for money equation does little to improve the explanatory ability of the function. Also he concludes that the demand for money function is more stable when a wealth rather than income constraint is used. On the other side of the spectrum, Goldfeld finds that the wealth variable is unimportant when used with the income variable alone, while the latter retains its significance. He suggests that the explanatory ability of the demand function for money would be improved by using the income variable.[24]

Unlike the developed countries, the choice between income or wealth is ruled out because of the absence of estimates of total wealth in developing countries. But, one can say, if wealth is an appropriate variable, and income is properly considered as the return on wealth, thus as Johnson indicates, income is an appropriate variable also. However, most of the empirical studies in less developed countries show that income is the most important determinant of the demand for money function.[25]

On the other hand, if income is considered the only variable in the demand for money function, this implies that the economy will function under the tenets of a quantity theory equation. In fact, the simple version of the quantity theory, which includes income as the only variable in explaining the demand for money, would become inapplicable to the developing economies if the income velocity is unstable over time.

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[24]Stephen M. Goldfeld, "The Demand for Money Revisited," in Richard Thorn, ed., op. cit., pp. 217-219.

[25]See, for example, Paul B. Trescott, Thailand's Monetary Experience (New York, Praeger Publishers, Inc., 1971); Y.C. Park, op. cit.; C. H. Wong, op. cit.

It has been observed that the income velocity of money is subject to short run decline in most less developed countries.[26] This is certainly expected in the light of progressive monetization of the economy. In Jordan, as in most less developed countries, a sizable proportion of income originates through non-monetary transactions and barter trade. This proportion generally declines with economic development. Therefore, the demand for money increases partly because of the income growth and partly because of a rise in the degree of monetization. It is therefore, very important to take into account the degree of monetization in specifying the demand for money function in Jordan as well as the most developing countries.

What would be the most relevant variable for the degree of monetization? The best variable that can represent the degree of monetization is the marketed portion of the national income. But most developing countries and definitely Jordan, do not have data on that breakdown. Thus a proxy variable must be employed. Some writers have proposed the ratio of value added of non-agricultural sector to total value added of national product.[27] But Jordan as well as most developing countries does not have data on that separately. Since there is no exact measure available, the ratio of demand deposits to money stock (currency plus demand deposits) is used as a proxy measure of degree of monetization.

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[26] Y. C. Park, "The Variability of Velocity: An International Comparison," IMF Staff Papers, XVII (November, 1970), pp. 620-636.

[27] See, for example, B. B. Bhattacharya, "Demand and Supply of Money in a Developing Economy: A Structural Analysis for India," Review of Economics and Statistics, 56 (March, 1974), pp. 502-510; A. G. Chandavarkar, "Monetization of Developing Economies," IMF Staff Papers, XXIV (November, 1977), pp. 693-714.

An increase in this ratio indicates an increase in banking activity and monetization.[28]

Beside the above, the role of interest rates as a determinant of the demand for money has become more controversial than that of income. For instance, Friedman found that there is no empirical relation between the demand for money and the rate of interest. But this is contrary to his theoretical work, in which he includes interest rate as a determinant of the demand for money. On the contrary, when a similar test was carried by Laidler, the interest rate was included in the cycle average regression, and this inclusion was found to confirm the importance of the interest rate as a determinant of the demand for money.[29] Also, Meltzer found that demand function for money is a stable function of the long term interest rate and non-human wealth. They are of almost equal importance in explaining the demand for real cash balances. Another strong result related to interest rates was conducted by Laidler. He concludes that,

> Whether one thinks of the demand for money function as being constrained by income, wealth or expected income, whether one cares to define money to include time deposits or exclude them, whether one chooses to ignore the identification problem or deal with it, whether one uses a short rate of interest, a

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[28]See, for example, Wayne W. Snyder, "Money in a Developing Economy: A Case Study of Pakistan, 1953-1961," Review of Economics and Statistics, XLVI (November, 1964), pp. 413-420, also, "Money in a Developing Economy: A Reappraisal," Review of Economics and Statistics, LII (February, 1970), pp. 54-61. He used a similar measure, the ratio of deposits to currency as an implicit measure of growth in banking activities and monetization. Richard C. Porter, "Income Velocity of Pakistan's Second Plan," Pakistan Development Review, I (Summer, 1961), pp. 22-51. He also used a similar measure, the ratio of currency to money stock as an indicator of monetization.

[29]David Laidler, "The Rate of Interest and the Demand for Money," Journal of Political Economy, 74 (December, 1966), pp. 545-555.

> long one, the return on financial intermediaries' liabilities or the yield on corporate equities, there is an overwhelming body of evidence in favor of the proposition that the demand for money is stably and negatively related to the rate of interest.[30]

Unlike the developed countries, there is no conclusive evidence as to whether the demand for money is affected by either short term or long term interest rates in developing countries. Empirical studies made by Biswas,[31] Gujarati,[32] and Singh[33] show that the demand for money is not sensitive to either short term or long term interest rates. On the other hand, Gupta,[34] and Sastry[35] found that the elasticity of the demand for money with respect to long term interest rates is statistically significant. On the basis of the results of these studies, one cannot determine that the interest rate affects the demand for money in developing countries.

However, the choice of a representative rate of interest from a wide range of interest rates is a difficult problem. Most developing countries do not have available data for each kind of interest rate.

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[30]David Laidler, The Demand for Money: Theories and Evidence, op. cit., p. 97.

[31]D. Biswas, "The Indian Money Market: An Analysis of Money Demand," Indian Economic Journal, IX (January, 1962), pp. 308-323.

[32]D. Gujarati, "The Demand for Money in India," Journal of Development Studies, 5 (October, 1968), pp. 59-64.

[33]B. Singh, "Price Stability and Money Supply During Fourth Five-Year Plan," Indian Economic Journal, XVII (April, 1970), pp. 469-481.

[34]K. Gupta, "The Demand for Money in India: Further Evidence," Journal of Development Studies, 6 (January, 1970), pp. 159-168.

[35]V. Sastry, "Demand for and Supply of Money in India," Indian Economic Journal, X (July, 1962), pp. 29-38.

With these constraints in view, the interest rate on saving deposits is selected as a representative interest rate for the demand for monetary assets in Jordan.

Estimation of Demand Function for Money in Jordan

Having chosen the relevant variables in the total demand for money function for developing countries, it is now the purpose of this section to specify the equations of the demand for components of the money stock and to run the regression tests.

Following the arguments presented in the previous section, the demand for monetary assets is determined separately for its components. The study of demand function for components of the money stock is important because it provides additional information on the behavior of the observed money stock. Each component has different policy implications. Demand deposits and time deposits are liabilities of commercial banks while currency is a liability of the Central Bank of Jordan. deLeeuw and Cooper have examined the demand functions for the components of the money stock in order to analyze the behavioral changes in money stock.[36]

Basically, in the demand function for each component there are two determinants; the gross national product and the interest rate on saving deposits. Another explanatory variable, which is the ratio of demand

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[36]Frank deLeeuw, "A Model of Financial Behavior," in J. S. Dusenburry, et al., eds., The Brookings Quarterly Econometric Model of the United States (Chicago: Rand McNally, 1965), pp. 465-530; J. Phillip Cooper, Development of the Monetary Sector, Prediction and Policy Analysis in the FRB-MIT-Penn Model (Mass.: D.C. Heath and Company, 1974), pp. 44-57.

deposits (DD) to the supply of money (M_1), is used to measure the degree of monetization.

Initially, the single equation least squares regression method is employed to estimate the parameters of the various demand functions. In the empirical tests, linear relations are stipulated either in natural number or in the logarithm of variables considered.

Demand for Currency

The format of the demand for currency equation is as follows:

(1) $CC = CC(Y, Z, RS)$

$CC_1 > 0, CC_2 < 0, CC_3 < 0$

where CC = currency in circulation;

Y = gross national product at current prices;

Z = degree of monetization proxy, defined as the ratio of demand deposits (DD) to money stock (M_1);

and RS = interest rate on saving deposits.

The regression estimates of equation (1) are given below:

(1.1) $CC = 32.9105 + 0.3618\ Y - 141.0716\ Z + 0.7283\ RS$
$\qquad\qquad\qquad\quad (0.0379) \quad (17.8407) \quad (5.4373)$

$\bar{R}^2 = 0.982$, DW = 1.828, SE = 5.346

(1.2) $CC = 30.9225 + 0.3570\ Y - 140.4593\ Z$
$\qquad\qquad\qquad\quad (0.0131) \quad (16.7395)$

$\bar{R}^2 = 0.983$, DW = 1.800, SE = 5.189

(1.3) $\text{Log } CC = -4.2322 + 1.1374 \log Y - 1.1248 \log Z + 0.6162 \log RS$
$\qquad\qquad\qquad\quad (0.1276) \qquad (0.1307) \qquad (0.3705)$

$\bar{R}^2 = 0.977$, DW = 1.792, $\rho = 0.196$, SE = 0.103

(1.4) $\text{Log } CC = -4.4618 + 1.3301 \log Y - 1.1599 \log Z$
$\qquad\qquad\qquad\quad (0.0625) \qquad (0.1401)$

$\bar{R}^2 = 0.969$, DW = 1.722, $\rho = 0.213$, SE = 0.107

The numbers in the parentheses below the coefficients are the corresponding standard errors. $\bar{R}^2$ is the multiple correlation coefficient adjusted for degrees of freedom. DW is the Durbin-Watson d-statistic. SE is the standard error of estimate for the equation. ρ is the first-order autocorrelation value where a serial correlation correction is made.

In equation (1.1) the t-statistic for the interest rate coefficient indicates that the interest rate is insignificant with unexpected sign. The consistent lack of statistical significance and the unexpected positive sign of the interest rate variable support the a priori contention that the interest rate in Jordan as in most developing countries is not an important determinant of the demand for currency. The regression coefficient for the monetization variable is with expected negative sign and it is very significant according to the t-test. This contention is supported by the fact that the proportion of currency in the money stock has been declining over the period under study. Accordingly, a simple function relating demand for currency to gross national product and degree of monetization appears to work better than the one which includes the interest rate variable. The interest rate variable is, therefore, dropped from the demand function for currency.

The comparison between the linear forms and log-linear forms (equations 1.3 and 1.4) reveals that both forms have similar results except the coefficient of the interest rate in the log form (equation 1.3) is statistically significant with wrong sign instead of being insignificant with wrong sign in the linear form (equation 1.1). For simplicity, the linear form is therefore chosen for the demand for currency in the aggregate model.

Demand for Demand Deposits

The following specification is used for the demand for demand deposits function:

(2) $DD = DD(Y, Z, RS)$

$DD_1 > 0, DD_2 > 0, DD_3 < 0$

where DD = demand deposits at banks;

Y = gross national product at current prices;

Z = degree of monetization proxy, defined as the ratio of demand deposits (DD) to money stock (M_1);

and RS = interest rate on saving deposits.

The regression results using equation (2) are:

(2.1) $DD = -34.3309 + 0.1681\ Y + 38.8376\ Z + 3.5822\ RS$
$\qquad\qquad\qquad\qquad (0.0322) \quad (18.7599) \quad (4.5121)$

$\bar{R}^2 = 0.935$, DW = 1.506, $\rho = 0.271$, SE = 4.343

(2.2) $DD = -24.4270 + 0.1909\ Y + 35.6953\ Z$
$\qquad\qquad\qquad\qquad (0.0131) \quad (16.6362)$

$\bar{R}^2 = 0.949$, DW = 1.554, $\rho = 0.183$, SE = 4.320

(2.3) $\log DD = -3.2802 + 1.1397 \log Y + 0.3511 \log Z + 0.6022 \log RS$
$\qquad\qquad\qquad\qquad (0.1140) \qquad (0.1105) \qquad (0.2875)$

$\bar{R}^2 = 0.968$, DW = 1.766, SE = 0.099

(2.4) $\log DD = -3.5143 + 1.3293 \log Y + 0.3151 \log Z$
$\qquad\qquad\qquad\qquad (0.0959) \qquad (0.1474)$

$\bar{R}^2 = 0.951$, DW = 1.592, $\rho = 0.165$, SE = 0.103

The linear regression results show that the demand for demand deposits is simply dependent upon income and the degree of monetization. The insignificant coefficient of the interest rate with wrong sign in the demand deposits function is not surprising since the demand deposits in Jordan as in most developing countries are not related to

the interest rate. Therefore, the elimination of interest rate from equation (2.2) improves the goodness of fit and the DW statistic, as well as the level of significance of the monetization variable.

The comparison between the linear forms and log-linear forms (equations 2.3 and 2.4) reveals that both forms have similar results except the coefficient of the interest rate in the log form (equation 2.3) is statistically significant with wrong sign instead of being insignificant with wrong sign in the linear form (equation 2.1). For simplicity, the linear form is therefore chosen for the demand for demand deposits in the aggregate model.

One important aspect that deserves attention is that an increase in Z, the degree of monetization variable, leads to a decrease in the demand for money (currency plus demand deposits). This is not surprising since changes in the supply of money do not come about through changes in the level of demand deposits as in financially mature economies but through changes in the quantity of currency. Specifically, government expenditures go principally for wages and salaries in the form of cash, few of which are made by checks. Credit supplied to exporters is simultaneously withdrawn in the form of cash to purchase goods from the rural sector, which is the predominant sector in most developing countries. Besides, the use of checking accounts is not a familiar phenomenon to the average person or even the average business firm. Accordingly, the demand for money is reflected more in the holding of currency rather than in deposit money. This is to say that the dominance of the currency in the total money supply is reflected in the coefficient of Z in the currency equation, which is much greater than the one in the demand deposits function.

Demand for Time Deposits

The following form is used for the demand for time deposits function:

(3) $TD = TD(Y, Z, RS)$

$TD_1 > 0, TD_2 > 0, TD_3 > 0$[37]

where TD = time deposits at banks;

Y = gross national product at current prices;

Z = degree of monetization proxy, defined as the ratio of demand deposits (DD) to money stock (M_1);

and RS = interest rate on saving deposits.

The regression results are presented below:

(3.1) $TD = -22.3722 + 0.1316\ Y + 3.9401\ Z + 4.1543\ RS$
$\qquad\qquad\qquad\qquad\quad (0.0132) \quad (6.3578) \quad (1.8772)$

$\bar{R}^2 = 0.987$, DW = 1.732, $\rho = 0.108$, SE = 1.824

(3.2) $TD = -19.9249 + 0.1331\ Y + 3.7780\ RS$
$\qquad\qquad\qquad\qquad\quad (0.0126) \quad (1.7636)$

$\bar{R}^2 = 0.987$, DW = 1.576, SE = 1.794

(3.3) $\log TD = -6.0774 + 1.6205 \log Y + 0.0459 \log Z + 0.3327 \log RS$
$\qquad\qquad\qquad\qquad\quad (0.1630) \qquad (0.1813) \qquad (0.4549)$

$\bar{R}^2 = 0.973$, DW = 1.543, $\rho = 0.397$, SE = 0.123

(3.4) $\log TD = -6.1199 + 1.5249 \log Y + 0.3095 \log RS$
$\qquad\qquad\qquad\qquad\quad (0.1575) \qquad (0.4332)$

$\bar{R}^2 = 0.974$, DW = 1.531, $\rho = 0.324$, SE = 0.119

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[37] By definition time deposits include both savings and fixed deposits. Theoretically, time deposits should be positively related to income and their own yields. In the absence of a weighted average of all the relevant rates for the whole period under study, interest rate on saving deposits is considered to be the most appropriate rate for the time deposits function. Moreover, this rate and fixed deposits are directly related. Therefore, the interest elasticity of the demand for time deposits should be positive.

At the first glance, the regression results seem to be highly satisfactory. The goodness of fit in each equation is very high and all the coefficients bear the expected signs. An interesting phenomenon is that time deposits are not related to the degree of monetization. This contention is supported by the fact that time deposits are one form of liquid assets for the urban dwellers rather than a medium of exchange in a developing country such as Jordan. Accordingly, a function relating demand for time deposits to income and interest rate appears to yield more satisfactory results than the one which includes the monetization variable as shown in equation (3.2). All the signs of coefficients are in conformity with theory: positive signs for both income and interest rate. The t-statistic for the coefficient of interest rate is statistically significant at 5 percent level.

However, comparison of these results with those in log-linear forms (equations 3.3 and 3.4) reveals that the linear regression results are superior to those for the log-linear regression results. For instance, the coefficients of interest rate are insignificant in the log-linear regressions. Therefore, the log-linear form is ruled out for the demand for time deposits.

Our findings can be summarized as follows: first, the interest rate variable is significant enough to justify its inclusion into the structural equation for the time deposits as an explanatory variable. Second, the proxy variable for the degree of monetization is an important argument in the demand functions for demand deposits and currency in a developing country like Jordan. The variable yields a consistent sign which is theoretically expected.

Elasticities of the Demand for Monetary Assets Components

To complete the single equation analysis, the sensitivity of the demand for monetary assets to changes in their determinants should be considered. Usually, the constant elasticities in the log form functions are represented by the coefficients of the variables themselves, while the point elasticities in the linear form are computed at the point of means of the variables. The partial point elasticities are computed in the following fashion. Let the regression equation be

$$Y = a_0 + a_1 X_1 + a_2 X_2$$

then elasticity of Y with respect to X_i is defined as:[38]

$$E_{(Y, X_i)} = \frac{\partial Y}{\partial X_i} \cdot \frac{X_i}{Y} \qquad i = 1, 2$$

The coefficients of X_i's (a_1 and a_2) are taken as the partial derivative of X_i's over Y and the mean values of X_i's and Y are used for X_i's and Y in the equation respectively. That is, the elasticities of Y at the point of the means of each of the independent variables are given as:

$$E_{(Y, X_1)} = a_1 \frac{\bar{X}_1}{\bar{Y}}$$

$$E_{(Y, X_2)} = a_2 \frac{\bar{X}_2}{\bar{Y}}$$

The point elasticities and constant elasticities are presented in Table V. The elasticities of demand for currency, demand deposits and

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[38] R. S. Pindyck and D. L. Rubinfeld, Econometric Models and Economic Forecasts (McGraw-Hill, Inc., 1976), pp. 72-73.

time deposits with respect to income in the two versions of elasticity are close to each other. On the other hand, the income elasticity of demand deposits and currency in the two versions of elasticity appears to be higher than unity, leading to the conclusion that money is, to some extent, a "superior good" or a "luxury good." Even though the demand for currency and demand deposits equations resemble the classical type of demand for money function, the applications of the demand for money function with unitary elasticity do not seem to be appropriate in Jordan.

TABLE V

ELASTICITIES OF DEMAND FOR CURRENCY, DEMAND DEPOSITS AND TIME DEPOSITS

Equation Number	Equation Form	Dependent Variable	Independent Variable		
			Y	Z	RS
1.2	linear	CC	1.360	-0.981	-
2.2	linear	DD	1.504	0.519	-
3.2	linear	TD	1.314	-	0.722
1.4	log-linear	CC	1.330	-1.160	-
2.4	log-linear	DD	1.329	0.315	-
3.4	log-linear	TD	1.525	-	0.310*

* Not significant.

The elasticity of demand for demand deposits with respect to the degree of monetization is 0.315 in the log equation and 0.519 in the linear equation. The elasticity of the demand for currency with respect to the degree of monetization, is slightly less than unity in absolute value in the linear equation and greater than unity in absolute value in the log equation. The results of the linear equations suggest that as the banking activity and monetization are increasing period after period, the demand for demand deposits will be more responsive than the demand for currency. These findings have some implications for monetary policy. As demand deposits become a more important factor relative to currency, the banking sector will occupy a more important position in monetary activities and the private sector which is not directly under the control of the central bank will occupy a less important position. Thus, policy makers can foresee easier monetary management in the future, at least in this respect.

Finally, the elasticity of demand for time deposits with respect to the interest rate is less than unity in the linear form and insignificant in the log form.

CHAPTER IV

THE ECONOMETRIC MONETARY MODEL: CONSTRUCTION AND SPECIFICATION

Introduction

The model is specified in money terms of levels of variables. It will be estimated on an annual basis for the period 1956-1975. Since the model centers on the monetary aspects of key macroeconomic variables, it can be described as a "monetary model." This model takes into account the appropriate link between the monetary and real sectors as shown below. In the monetary sector, the behavior of each monetary asset is separately specified.[1] This specification helps the model to incorporate the role of the private as well as the role of the banking system in determining the size of monetary assets. Also, the monetary sector contains behavioral equations for the interest rate on saving deposits, the commercial bank behavior and the demand for bank credit. In the real sector, effective demand is determined by a consumption function,

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[1] In this context, the model is similar to the models developed by James Boughton, Eduard Brau, Thomas Naylor and William Yohe, "A Policy Model of the United States Monetary Sector," Southern Economic Journal, XXXV (April, 1969), pp. 333-346; K. Imam, "A Structural Model of Pakistan's Monetary Sector," Pakistan Development Review, X (Fall, 1970), pp. 359-379; and Wayne Snyder, "Money in a Developing Economy: A Case Study of Pakistan, 1953-1961," Review of Economics and Statistics, XLVI (November, 1964), pp. 413-420.

an investment function, imports function, government expenditures and exports.

The model specified for Jordan consists of 11 behavioral equations and 7 identities, with the monetary sector containing seven behavioral equations and five identities, and the real sector four behavioral equations and two identities. The choice of variables for the model is guided strongly by the econometric experimentation in identifying variables that theory does not specifically identify. That is, for each structural equation, various forms of specification are examined and theory is used to support the different specifications of each equation.[2] The equations of the monetary system which are concerned with the portfolio of the public and the banks are based on the theory of portfolio choice. The equations of the real sector are based on recent developments in macroeconomic theory. Due to the peculiarities of the Jordanian economy, necessary modifications are taken into account. Some of the equations contain lagged values of dependent variables for one period. This serves to dynamize the model. The model is presented below:

I. Monetary Sector Equations

A. Public's Demand for Money, Near-Money and Credit:

$$CC = a_o + a_1 Y + a_2 Z + U_1 \qquad (1.2)$$

$$DD = b_o + b_1 Y + b_2 Z + U_2 \qquad (2.2)$$

$$TD = c_o + c_1 Y + c_2\ RS + U_3 \qquad (3.2)$$

$$CL = d_o + d_1\ IM + d_2 Y + d_3\ RV + U_4 \qquad (4)$$

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[2] See, for example, Patric Hendershott, "Recent Development of the Financial Sector of Econometric Models," Journal of Finance, XXIII (March, 1968), pp. 41-65.

B. Commercial Banks' Behavior:

$$VC = e_o + e_1 VC_{-1} + e_2 D + U_5 \quad (5)$$

$$EL = h_o + h_1 D + U_6 \quad (6)$$

$$RL = r(DD + TD + OD) \quad (7)$$

$$RS = j_o + j_1 RS_{-1} + j_2 RV + U_7 \quad (8)$$

C. Identities:

$$LA = EL + RL \quad (9)$$

$$D = DD + TD + OD \quad (10)$$

$$M_1 = CC + DD \quad (11)$$

$$M_2 = CC + DD + TD \quad (12)$$

II. Real Sector Equations

$$C = v_o + v_1 YD + v_2 C_{-1} + U_8 \quad (13)$$

$$I = m_o + m_1 CL + m_2 Dum + U_9 \quad (14)$$

$$IM = n_o + n_1 Y + n_2 CL + n_3 FR + n_4 Dum + U_{10} \quad (15)$$

$$T = t_o + t_1 Y + U_{11} \quad (16)$$

$$YD = Y - T \quad (17)$$

$$Y = C + I + G + X - IM \quad (18)$$

The endogenous variables are:

DD = demand deposits held by the public

CC = currency held by the public

TD = time deposits held by the public

CL = bank credit to the private sector

VC = cash held by commercial banks (vault cash)

EL = excess liquid assets of commercial banks

RL = required liquid assets of commercial banks

RS = interest rate on saving deposits

LA = total liquid assets of commercial banks

D = total deposit liabilities of commercial banks

M_1 = money stock (narrowly defined)

M_2 = money stock (broadly defined)

C = private consumption expenditures

I = gross investment expenditures

IM = total imports

T = tax revenue (direct and indirect taxes)

YD = disposable income

Y = gross national product

The exogenous and lagged variables are:

Z = degree of monetization proxy, defined as the ratio of demand deposits (DD) to money stock (M_1)

RV = interest rate on commercial banks' loans

r = required liquidity ratio

OD = other commercial banks' deposits

FR = foreign aid

Dum = Dummy variable taking the value of 1 in 1967 and the value of 0 otherwise

G = government consumption expenditures

X = total exports

VC_{-1} = cash held by commercial banks lagged one period

RS_{-1} = interest rate on saving deposits lagged one period

C_{-1} = private consumption expenditures lagged one period

All the variables are in money terms in millions of Dinar. Interest rates are in percent.

Monetary Sector

Before discussing the specification of the structural equations of the monetary sector, it would be useful to consider the monetary policy transmission mechanism in the economy. The monetary transmission mechanism is the manner in which actions by the monetary authority produce effects that interact with the real sector to bring about changes in income and in the price level.

In a Keynesian income-expenditure model, monetary policy operates through changes in the rate of interest. The change in the interest rate affects aggregate private expenditure which in turn, has a multiplier effect on the level of income. In other words, Keynesian theory indicates that money supply changes work indirectly by affecting the rate of interest, aggregate demand, and then the income level. The magnitude of the interest rate change alone is not, however, an important measure of the efficiency with which monetary policy is transmitted to the expenditure for output, especially if the "feedback" effects from the real sector are taken into account.

Friedman and others argue that those effects quickly reverse any drop in the level of interest rates induced by expansionary monetary policy.[3] Monetarists believe however, that the supply of money is the main channel of transmission in the economy, i.e., the link between the changes in money supply and spending is more direct than the round about transmission mechanism of Keynesian models. Alternatively, monetarists

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[3]Milton Friedman, "The Lag in the Effect of Monetary Policy," Journal of Political Economy, 69 (October, 1961), pp. 456-459; Warren Smith, "A Neo-Keynesian View of Monetary Policy," in Warren Smith and R. Teigen, eds., Readings in Money, National Income, and Stabilization Policy (Illinois: Richard Irwin, Inc., 1974), Third Edition, p. 352.

feel that changes in money supply work directly by affecting prices, interest rates and spending on goods and services.[4]

Tobin has also presented a hypothesis of monetary transmission based on portfolio choice. He postulates that changes in the money supply lead to changes in interest rates, which are followed by substitutions in asset portfolios; then finally, total spending is affected. The main difference between his hypothesis and the monetarists' is that he argues that interest rates are the key element of the transmission mechanism, influencing decisions to hold money versus alternative financial assets as well as decisions to invest in real assets.[5] However, both monetarists and non-monetarists base their theories of the transmission mechanism on the portfolio approach, but the portfolio of assets in the non-monetarists analysis is limited to money and financial assets, whereas the monetarist portfolio is based on the concept of total wealth as outlined in Friedman's statement of the quantity theory of money in the previous chapter. Therefore, the impact of monetary policy in the non-monetarist framework affects aggregate demand via changes in the relevant interest rate that determines investment expenditures, and these expenditures in turn affect the level of consumption and income. According to the monetarist framework, monetary

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[4]Milton Friedman and Anna Schwartz, "Money and Business Cycles," Review of Economics and Statistics, 45 (February, 1963), pp. 59-64; Leonall Anderson and Jerry Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis, 50 (November, 1968), pp. 13-17.

[5]William Brainard and James Tobin, "Pitfalls in Financial Model Building," American Economic Review, LVIII (May, 1968), pp. 103-105; James Tobin, "Money, Capital, and Other Stores of Value," American Economic Review, LI (May, 1961), pp. 30-33.

policy has a direct effect not only upon investment expenditures, but also upon consumption expenditures, i.e., a change in money stock produces direct impact on a whole spectrum of capital and consumer goods.

Another possible link between the monetary sector and the real sector is the "availability of credit" mechanism.[6] This channel influences aggregate demand through consumption, and investment expenditures. Variations in the volume of bank credit transmit the effects of monetary policy changes throughout the economy.

Among the three channels of monetary influences, the availability of credit channel may be the most direct and powerful source of transmission of monetary changes to the real sector in developing countries. The explanation for this is that in an undeveloped capital market, interest rates charged to borrowers by the commercial banks, are controlled by institutional forces, not by market forces, and tend not to change even when there is a change in the demand for funds. Hence, the commercial banks (lenders) ration the available supply of credit among the would-be borrowers by various nonprice considerations such as variations in the standards of "credit-worthiness" of borrowers and the vague notion of "customer relationship." As Modigliani points out, the demand for credit is limited "not by the borrowers' willingness to borrow at the given rate but the lenders' willingness to lend, or more precisely, by the funds available to them to be rationed out among the would-be borrowers."[7] Therefore, the effectiveness of monetary policy

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[6]See,for example, Stephen Goldfeld, Commercial Bank Behavior and Economic Activity (Amsterdam: North Holland Publishing Company, 1966), p. 16, 63; Warren Smith, op. cit., pp. 351-352.

[7]Franco Modigliani, "The Monetary Mechanism and Its Interaction With Real Phenomena," Review of Economics and Statistics, XLV (February, 1963), p. 98.

in affecting expenditure outlays depends upon the availability and rationing decision of credit rather than its cost. Accordingly, it is argued that while the cost of credit "does not matter" in affecting aggregate demand in developing countries, the availability of credit does.

In view of these considerations, the present model has been designed to take into account the role of commercial banks' loans to the private sector as a link in the actual transmission mechanism of monetary policy in Jordan. Banks' loans (CL) appear in two of the real sector equations--equations (14) and (15)--thereby establishing the link from the monetary sector to the real sector. Also, the "feedback" effects from the real sector to the monetary sector through (CL) can be shown in equation (4).

The specification of the structural equations of the monetary sector is presented below.

Public's Demand for Money, Near-Money and Credit

The public's demand for monetary assets and credit consists of four behavioral equations: demands for currency, demand deposits, time deposits and bank credit. The equations are now presented.

Currency, Demand Deposits and Time Deposits. Equations 1.2, 2.2 and 3.2 have been specified in the previous chapter. They are respectively the demand functions for currency, demand deposits and time deposits. The choice of those three equations for the aggregate model has been based on statistical and economic properties.

Bank Credit. Bank credit is the most important source of earnings

for commercial banks. It is also the main source of credit in the economy. The demand for bank credit reflects in part, the demand for goods and services, and the movements of these goods and services are facilitated by the availability of credit. The simplest way is to treat the demand for bank credit as a function of GNP.

In addition, some other variables are considered more specifically linked with bank credit. Traditionally, commercial banks tend to concentrate heavily on short term loans to finance foreign trade and domestic commerce. Such loans are likely to be more profitable than other types of loans. Loans for production purposes to industry and agriculture constitute only a small proportion of bank credit in Jordan. This proportion ranges between 7 and 12 percent over the period under study.[8] Accordingly, the imports variable may be considered another explanatory variable to explain the demand for bank credit. A third variable which affects the demand for bank credit is the rate of interest on loans. This rate represents the cost of borrowing which has an inverse relationship with the demand for credit for obvious reasons.

Accordingly, the following equation is specified to explain the demand for bank credit.

$$CL = d_0 + d_1 IM + d_2 Y + d_3 RV \qquad (4)$$

$$d_1 > 0,\ d_2 > 0,\ d_3 < 0$$

where CL = commercial banks' loans to the private sector;

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[8] International Monetary Fund, International Financial Statistics (December, 1976), pp. 211-214.

IM = imports;

Y = gross national product at current price;

and RV = interest rate on commercial banks' loans.

On the other hand, the supply of bank credit is controlled by banks through changes in the loan rate (RV). RV is determined differently than in developed countries. For instance, Boughton asserts that RV is basically determined by discount rate and the ratio of bank credit to total deposits. RV responds positively to changes in the discount rate and to the credit-deposts ratio.[9] Sommariva argues that RV is a function of income, monetary base, interest rate on saving and time deposits and interest rate on bonds.[10]

Unlike the developed countries, it was argued in Chapter II that lending rates in Jordan as well as in most developing countries do not change in response to market forces because they are exogenously determined by institutional arrangements in the organized credit market and by personal agreements in the unorganized credit market. On the other hand, the lending activities of the organized market are always constrained by some nonprice considerations, not by the borrowers' willingness to borrow at the given loan rate. Hence, the link between the loan rate and the lending activities is very small or perhaps zero. Moreover, the lending rate in the present study represents the ceiling imposed by the monetary authorities because a weighted average of the

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[9]James Boughton, Monetary Policy and the Federal Funds Market (North Carolina: Duke University Press, 1972), p. 110, 115.

[10]A. Sommariva, "Some Theoretical Implications of the Model of the Bank of Italy," Tudschrift Voor Economie, XVIII, No. 2 (1973), pp. 219-221.

quoted loan rate on each type of credit is not available.[11] Besides, this ceiling has been changed only once during the period under study. Under these conditions, one cannot rely on the RV to represent the supply equation for bank credit in Jordan. Therefore, the supply of credit is dropped from the model, and RV is made exogenous to the system.

Commercial Banks' Behavior

The analysis of the commercial banks' behavior is essentially a study of their asset portfolio. A typical commercial bank holds a large number of different assets in its portfolio. Each asset has a unique set of characteristics, for example, its liquidity, reversibility, predictability of return, risk, taxability, etc. Loans are the most important assets in the commercial banks' portfolio.

Three behavioral equations are considered in the analysis of the commercial banks' behavior. Behavioral equations determine respectively the demands for vault cash and excess liquid assets. The third determines the level of the interest rate on saving deposits. The equation for excess reserves is not considered in the model because of the absence of time series data about the required and total reserves before 1964. Instead, the excess liquid assets are taken to depict the actual situation of the banking system activities for the whole period under study.[12] Behavioral equations for government securities and

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[11] See Appendix A for sources of data.

[12] Liquid assets in Jordan consist of Jordanian currency, balances held with the CBJ, net credit balances with banks both inside and outside the country, and domestic and foreign government bills. The Banking Law, Law No. 24 of 1971, Article 17.

borrowed reserves are also dismissed because of the lack of time series data on them. The specification of the demand for and supply of bank credit has been discussed in the first sub-section. The equations of the banking system are now presented.

Vault Cash. Holding an asset in the form of vault cash implies a return foregone, but it is necessary in order to meet the requirements of day-to-day normal withdrawals. Thus, cash held by the banks depends mainly upon the amount of banks' deposits. The second explanatory variable is the previous period's vault cash. A related interpretation of one period lagged of vault cash is that there is normally a discrepancy between actual and desired stocks outstanding, i.e., a stock adjustment model. Furthermore, cash held by the banks is negatively associated with lending rate. A rise in the lending rate may lead the banks to economize on their cash holdings which do not earn any interest. This argument is irrelevant to Jordan, because the demand for vault cash is not sensitive to the lending rate. Accordingly, the demand for vault cash equation can be formulated as follows:

$$VC = e_o + e_1 VC_{-1} + e_2 D \qquad (5)$$

$$0 < e_1 < 1,\ 0 < e_2 < 1$$

where VC = cash held by commercial banks (vault cash);

VC_{-1} = vault cash lagged one period;

and D = total deposit liabilities of commercial banks.

Excess Liquid Assets. The demand for total liquid assets is determined as the sum of required liquid assets and excess liquid assets.

Excess liquid assets play a substantial role in determining the commercial banks' portfolio in Jordan. Data reveal the presence of a large difference between legal reserves and liquidity reserves required by the Central Bank of Jordan on one hand and those actually maintained by the commercial banks on the other hand.[13]

Theoretically, there are two major determinants of banks' demand for excess liquid assets. First, since banks act as risk averting profit maximizers, expected alternative net yields of various banks' assets are considered among the main determinants of the banks' demand for those liquid assets.[14] Goldfeld employs a similar assumption. He argues that preferences for assets are assumed to be consistant with rational maximizing behavior by banks, i.e., banks' demand for liquid assets depend positively on its own yields and negatively on all other yields.[15]

The second important determinant is the deposit liabilities of the commercial banks. Meltzer argues that there is a close relationship between banks' demand for excess liquid reserves and deposits even in a banking system without legal reserves. He assumes that,

> Given the distribution of deposits, the amount of precautionary reserves held is based on a probability distribution for the expected drain. All reserves above the amount required on the basis of the probability distribution are excess reserves. That is, there is a relation between the change

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[13] See Chapter II, p. 18.

[14] George Morrison, "Portfolio Behavior of Banks" (Unpublished Ph.D. dissertation, University of Chicago, 1962), quoted in A. Meigs, Free Reserves and the Money Supply (Chicago: The University of Chicago Press, 1962), p. 47.

[15] Stephen Goldfeld, op. cit., p. 7, 69-71; Ronald Teigen, "Demand and Supply Functions for Money in the United States: Some Structural Estimates," Econometrica, XXXII (October, 1974), pp. 504-506.

in reserves and the change in deposits for any given assumption about this distribution.[16]

Given the above determinants, the formulation of the demand for excess liquid assets equation is as follows:

$$EL = f_o + f_1 r^a + f_2 r^b + f_3 r^c + f_4 D$$

$$f_1 > 0,\ f_2 < 0,\ f_3 < 0,\ 0 < f_4 < 1$$

where EL = excess liquid assets;

r^a = an implicit own rate;

r^b = the loan rate;

r^c = rate on other assets such as investment abroad and governments bonds;

and D = total deposit liabilities of commercial banks.

Due to the particular structure of the money and capital markets in the developing countries, economists of these countries generally agree that commercial banks' deposit liabilities are the main determinant of the demand function of liquid assets. This is true for Jordan since the demand for liquid assets is not sensitive to the lending rate. Therefore, the demand function for excess liquid assets has been postulated as follows:

$$EL = h_o + h_1 D \qquad (6)$$

$$0 < h_1 < 1$$

Required Liquid Assets. Required liquid assets are defined as:

$$RL = r\,(DD + TD + OD) \qquad (7)$$

where RL = required liquid assets;

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[16] Allan Meltzer, "The Behavior of the French Money Supply, 1938-1954," Journal of Political Economy, 67 (June, 1959), p. 278; Karl Brunner and Allan Meltzer, "Some Further Investigations of the Demand and Supply Functions of Money," Journal of Finance, XIX (May, 1964), pp. 249-252.

r = legal liquid asset ratio on total deposit liabilities;

DD = demand deposit liabilities;

TD = time deposit liabilities;

and OD = other deposit liabilities such as inter-bank deposits.

It should be mentioned that required liquid asset ratio has never varied since the establishment of the Central Bank of Jordan in 1964. It is 25 percent for total deposits. For analytical purpose, we have therefore assumed the same ratio for the period before 1964. Consequently, the required liquid asset identity can be written as:

$$RL = .25\ (DD + TD + OD) \tag{7a}$$

Interest Rate on Saving Deposits. It is a challenge to incorporate interest rates into an econometric monetary model for a developing country such as Jordan. Unfortunately, all the interest rates do not reflect the actual monetary movements, due to the nonexistence of well organized money and capital markets and the existence of institutional rigidity in the quoted interest rates. Note in the present context that the variable RS is the average rate paid by the commercial banks on saving deposits, not the ceiling imposed by the monetary authorities, so that RS is endogenous to the system.[17]

However, the interest rate function has been specified in the simplest possible way since it was not sensitive to many variables in the model. That is, the interest rate depends on the lagged value of itself and the interest rate on banks' loans.

$$RS = j_0 + j_1\ RS_{-1} + j_2\ RV \tag{8}$$

$$0 < j_1 < 1,\ 0 < j_2 < 1$$

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[17]See Appendix A for sources of data.

where RS = interest rate on saving deposits;

RS_{-1} = interest rate on saving deposits lagged one period;

and RV = interest rate on banks' loans.

The fact that the interest rate on saving deposits has been chosen as a representative interest rate is intended to signify the existence of some relationship with the monetary assets.

Identities

Various identities are stated to close the system in the monetary sector. Total liquid assets are the sum of excess liquid assets and required liquid assets:

$$LA = EL + RL \tag{9}$$

Total deposit liabilities of commercial banks are the sum of demand deposits (DD), time deposits (TD), and other deposits (OD):

$$D = DD + TD + OD \tag{10}$$

This identity is only a balancing equation on the liabilities side of the commercial banks' portfolio.

The following equation shows that the supply of money narrowly defined is the sum of currency held by the public (CC) and demand deposits held by the public at the commercial banks (DD):

$$M_1 = CC + DD \tag{11}$$

The following identity similarly shows that the supply of money broadly defined is:

$$M_2 = CC + DD + TD \tag{12}$$

where TD = time deposits held by the public at the commercial banks.

Real Sector

The main purpose of the model is to construct an econometric monetary model of the Jordanian economy. The real sector is, however, essential in determining whether monetary relationships are indeed stable enough to give a reliable explanation of national income, and to indicate the channels through which monetary policy operates on the real sector of the economy. However, in the absence of accurate time series data on the capital stock, wages, employment and depreciation, a simple real sector model is developed which permits analysis of the basic interactions of the monetary mechanism with real economic phenomena.

The specification of the structural equations of the real sector is presented below.

Consumption

The consumption function is essentially a Keynesian contribution. Keynes argued that consumption is a stable function of current income, and that the marginal propensity to consume is less than one and greater than zero. His function is not generally accepted.

A quite different approach is developed by Friedman.[18] He rejects the usual concept of income on which the consumers base their behavior, and replaces it with what is called "permanent income." A similar rejection is also made for the concept of consumption. Friedman's hypothesis is that permanent consumption is proportional to permanent

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[18]Milton Friedman, Theory of Consumption Function (New Jersey: Princeton University Press, 1957).

income. The observed income of any period is the sum of the permanent and the transitory components.[19] He assumes that the transitory elements of income and consumption are uncorrelated with their corresponding permanent components and also with each other. Specifically, his hypothesis is expressed as:

$$C_p = KY_p$$

where C_p = permanent consumption;

Y_p = permanent income;

and K is a function of the interest rate (i), the ratio of non-human wealth to permanent income (w), and a number of factors such as tastes, age, family composition, etc. (U). That is, $K = F(i, w, U)$.

Thus, the aggregate consumption function can be rewritten as:

$$C_p = F(i, w, U)\, Y_p$$

In contrast to Friedman's hypothesis, recent studies by Moroney and Mason, and Christ assert that consumption is a function of disposable income and consumption lagged one period.[20] Nevertheless, consumption lagged one period in their consumption functions is similar to Friedman's hypothesis by making consumption dependent on all past values of disposable income with geometrically declining weights.

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[19] A similar theory was developed by Ando and Modigliani. They argue that the proportion of income saved depends on the lifetime average income making savings relatively insensitive to income. A. Ando and F. Modigliani, "The Life Cycle's Hypothesis of Savings: Aggregate Implication and Tests," American Economic Review (March, 1963), pp. 55-84.

[20] J. R. Moroney and J. M. Mason, "The Dynamic Impacts of Autonomous Expenditures and the Monetary Base on Aggregate Income," Journal of Money, Credit and Banking (November, 1971), pp. 793-808; Carl Christ, Econometric Models and Methods (New York: John Wiley and Sons, Inc., 1966), p. 582.

Furthermore, Chang, in his dissertation on Taiwan, found that disposable income and consumption lagged one period as the determinants of private consumption are statistically significant.[21]

With respect to Jordan, consumption expenditures are divided into private and public. For purpose of policy simulations public consumption is treated as an exogenous variable. Private consumption is postulated to depend on the disposable income and private consumption lagged one period as follows:

$$C = v_o + v_1 YD + v_2 C_{-1} \qquad (13)$$
$$0 < v_1 < 1,\ 0 < v_2 < 1$$

Where C, YD and C_{-1} denote private consumption, disposable income and private consumption lagged one period, respectively. Disposable income is gross national product (Y) minus net taxes (T).

Investment

Perhaps the most familiar investment function is the Keynesian marginal efficiency of investment function. According to this approach, the decision to invest depends on the internal rate of return and the current rate of interest. Keynes defined the marginal efficiency of investment as "being equal to the rate of discount which would make the present value of the series of annuities given by the returns expected from the capital-asset during its life just equal to its supply price."[22] In simple terms, the Keynesian theory of investment is, however, defined

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[21]Peter Chang, "A Macroeconometric Forecasting Model of Taiwan" (Unpublished Ph.D. dissertation, Oklahoma State University, 1977.)

[22]John M. Keynes, op. cit., p. 135.

as an inverse relationship between investment expenditures and the interest rate.

Another theory, which is known as the "accelerator principle," has been developed. The naive form of it postulates a certain fixed relationship between the desired capital stock and output.[23] This was later developed into a stock adjustment and a capacity utilization version by Goodwin and Chenery.[24]

However, investment functions have taken different forms. For instance, Klein asserts that gross investment is a function of capital stock, interest rate and lagged profit.[25] According to the new classical theory of investment as expounded by Jorgenson, gross investment is a function of output, the user cost of capital and the stock of capital.[26]

In view of the above, investment is one of the most difficult areas for empirical study in developing countries. The difficulties of getting a satisfactory model of investment activities in the rural sector, and the lack of adequate and comprehensive data prevent disaggregating the investment function according to various types of

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[23]J. M. Clark, "Business Acceleration and the Law of Demand," Journal of Political Economy (March, 1917), pp. 217-235.

[24]R. M. Goodwin, "The Non-Linear Accelerator and the Persistence of Business Cycle," Econometrica (January, 1951), pp. 1-17; H. B. Chenery, "Over Capacity and the Acceleration Principle," Econometrica (January, 1952), pp. 1-28.

[25]Lawrence Klein, Economic Fluctuations in the United States 1929-1941 (New York: John Wiley and Sons, Inc., 1950).

[26]Dale Jorgenson, "The Theory of Investment Behavior," in Robert Ferber, ed., Determinants of Investment Behavior (New York: National Bureau of Economic Research, 1967), pp. 129-155.

investment in Jordan. Instead, a single behavioral equation is used, which determines the demand for investment for gross business investment, as well as inventory investment. The following equation explains the behavior of the combined aggregate of public and private gross investment:

$$I = m_o + m_1 CL = m_2 Dum \qquad (14)$$

$$m_1 > 0,\ m_2 < 0$$

where I = gross investment expenditures;

CL = banks' loans to the private sector;

and Dum = proxy for the War of 1967 taking the value 1 for the year 1967 and the value 0 otherwise.

In this equation, it is, however, shown that the banks' loans play an important role in determining investment activities, i.e., the more funds available the more investment is undertaken. On the other hand, banks' loans represent the establishment of the transmission mechanism of the monetary policy throughout the economy, i.e., the impact of the monetary policy is transmitted to the real sector through the banks' loans.

Imports

The basic assumption that underlies import demand relations is that variation in imports are primarily caused by variations in real income and relative prices. In the model, however, the basic assumption is modified in the light of some characteristics of the Jordanian economy. The special feature of the economy is that the Jordanian trade balance has suffered from a rising and chronic structural deficit since 1948. The large trade deficit has been mainly financed by foreign aid.

Hence, the foreign aid variable can be used to explain the demand for imports:

As noted in Chapter II, the foreign trade sector in Jordan depends heavily on commercial banks' loans. Thus, the addition of the commercial banks' loans plays an important role in determining demand for imports. On the other hand, commercial banks' loans represent a channel of the transmission mechanism of the monetary policy in Jordan. That is, the impact of monetary policy affects aggregate demand via changes in the volume of bank credit that determines imports, and these imports in turn influence aggregate demand. In addition, a dummy variable taking the value of 1 in 1967 is added to capture the relative effect of War 1967 upon imports.

Accordingly, the following equation is specified to explain the demand for imports:

$$IM = n_0 + n_1 Y + n_2 CL + n_3 FR + n_4 Dum \qquad (15)$$

$$n_1 > 0,\ n_2 > 0,\ n_3 > 0,\ n_4 < 0$$

where IM = total imports;

Y = gross national product at current price;

CL = banks' loans to the private sector;

FR = foreign aid;

and Dum = proxy for the War of 1967 taking the value 1 for the year 1967 and the value 0 otherwise.

Taxes

In the present model, a simple relationship between the aggregate taxes and the gross national product is postulated. This relation follows from the basic economic assumption of linear relation between

the tax yield and its base. Thus, the tax equation is specified as:

$$T = t_0 + t_1 Y \qquad (16)$$

$$0 < t_1 < 1$$

where T is direct and indirect taxes.

Income Identities

There are two income identities. First, disposable income is defined as:

$$YD = Y - T \qquad (17)$$

where YD, Y, and T denote disposable income, income and taxes, respectively.

Second, gross national product identity is defined as the sum of private consumption (C), gross investment (I), government expenditure (G) and net trade balance (X-IM). This can be written as:

$$Y = C + I + G + X - IM \qquad (18)$$

CHAPTER V

MODEL ESTIMATION AND TESTING

Introduction

In the previous chapter, the structural equations of the model and the theoretical rationale for each equation were presented. In the model there are 18 structural relationships: 11 behavioral equations and 7 identities. Also, there are 18 endogeneous variables and 11 exogeneous and lagged dependent variables, making the system complete.

It is the purpose of this chapter to estimate and test the structural equations of the model. Initially, ordinary least squares (OLS) is employed to estimate the parameters of the various functions. Since the essence of the economic theory is the interdependence of economic phenomena and the determination of the values of economic variables by the simultaneous interaction of relationships, it is generally recognized that there are pitfalls in attempting to estimate the parameters of a single structural equation taken from a multi-equation model. This is due to the fact that a minimum assumption for the consistency of OLS--that the explanatory variables are independent of the error term--cannot be maintained if the equation to be estimated is one of a system of simultaneous structural equations.[1] Therefore, to

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[1]Jan Kmenta, Elements of Econometrics (New York: The MacMillan Co., 1971), pp. 550-552.

take account of the simultaneous nature of the equations in the model to be estimated and to get consistent estimates of the structural coefficients, the model is estimated by two-stage least squares (TSLS).

The model is estimated for the period 1956-1975 on an annual basis, due to the unavailable data on key real sector variables for intervals smaller than a year. The data are presented in Appendix A. The SAS program is adopted for the estimation of the model.[2]

At the very outset, it is necessary to define the criteria used in testing the model. First, the adjusted multiple correlation coefficient $\bar{R}^2$ instead of the multiple correlation coefficient R^2 is used to measure the explanatory power (goodness of fit) of the regression equation.[3]

Second, the standard errors are presented in parentheses below the estimated coefficients. Since there are only 20 observations in the present study, the estimated coefficient is considered statistically significant at the five percent level if its accompanying t-statistic exceeds 2.09 in an absolute value for two-tailed test.

Third, the Durbin-Watson (DW) statistic is used to detect first-order autocorrelation (ρ) in the disturbance term. This test was designed for a small sample under the assumption of a single equation model with exogenous independent variables. However, it is invalid for regressions that contain lagged dependent variables among the regressors

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[2]A. Barr, J. Goodnight, J. Sall and J. Helwig, A User's Guide to SAS (North Carolina: Sparks Press, 1976).

[3]The value of $\bar{R}^2$ is defined as: $\bar{R}^2 = 1 - (1 - R^2)\,[(N-1)/(N-K)]$, where N is the number of observations and K is the number of parameters. The value of R^2 is actually larger than the value of $\bar{R}^2$ except when $K = 1$ in which case $R^2 = \bar{R}^2$. Henri Theil, Principle of Econometrics (New York: John Wiley and Sons, Inc., 1971), pp. 178-179.

or for simultaneous equation system.[4] An alternate test has been developed by Durbin, which involves the calculation of a test statistic (h) for a large sample with lagged dependent variable in a single equation model. If the errors are not serially correlated, h is distributed normally with mean zero and standard deviation one.[5] The h statistic is derived as:

$$h = (1 - 1/2\ DW)\sqrt{\frac{N}{1 - N\ V(\hat{b}_1)}}$$

Since $(1 - 1/2\ DW) \approx r$

then $$h \approx r\sqrt{\frac{N}{1 - N\ V(\hat{b}_1)}}$$

where DW is the Durbin-Watson statistic, r is the estimated first-order autocorrelation coefficient of the residuals, N is the number of observations in the sample, $V(\hat{b}_1)$ is the estimate of variance of b_1, and b_1 is the coefficient of the lagged dependent variable.[6]

The chapter first discusses the ordinary least squares estimates of the structural equations of the model. Secondly, this is followed by the two-stage least square estimates of the parameters and a comparison of the estimates obtained with the two estimation procedures.

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[4] J. Johnston, Econometric Methods, Second Edition (New York: McGraw-Hill, Inc., 1972), pp. 249-251.

[5] J. Durbin, "Testing for Serial Correlation in Least Squares Regression when Some of the Regressions are Lagged Dependent Variables," Econometrica (May, 1970), pp. 410-421.

[6] For example of the application of this test see, P. Rao and R. Miller, Applied Econometrics (California: Wadsworth Publishing Company, Inc., 1971), pp. 123-125; J. Johnston, op. cit., pp. 312-313.

Ordinary Least Squares Estimates

In this section, a brief discussion of the empirical results obtained by using OLS is presented along with statistical information on other variables that were tried but found insignificant. The standard error for each variable, adjusted coefficient of determination ($\bar{R}^2$), Durbin-Watson statistic (DW) and the standard error of estimate for the equation (SE) are provided below each estimated equation. Besides, the following are listed below the relevant estimated equation: first-order autocorrelation (ρ) where a serial correlation correction is made, and the h-statistic where a lagged dependent variable is present among the regressors in an equation.

Monetary Sector

The monetary sector of the model is made up of seven behavioral equations and five identities. Four of the behavioral equations determine the demand for the components of the monetary assets and bank credit, while the other three equations determine the commercial banks' behavior. The estimated equations of this sector are now presented.

Demand for Currency (CC).

$$CC = \underset{}{30.9225} + \underset{(0.0131)}{0.3570}\ Y - \underset{(16.7395)}{140.4593}\ Z \qquad (1.2)$$

$\bar{R}^2 = 0.983$, DW = 1.800, SE = 5.189

The demand for currency depends directly upon the income (Y) and inversely upon the degree of monetization (Z). These variables account for almost all the variance in the dependent variables as seen from the size of the coefficient of determination. Both the explanatory

variables are very significant and their coefficients carry the expected signs. The interest rate on saving deposits is another explanatory variable that was tried for this equation but found unacceptable, as shown in Chapter III.

Demand for Demand Deposits (DD).

$$DD = -24.4270 + \underset{(0.0131)}{0.1909}\ Y + \underset{(16.6362)}{35.6953}\ Z \qquad (2.2)$$

$\bar{R}^2 = 0.949$, DW = 1.554, $\rho = 0.183$, SE = 4.320

The demand for demand deposits is determined by income (Y) and the degree of monetization (Z). The positive influence of Z represents the increase in banking activities and monetization. The coefficient of Z is significant at the five percent level. As noted in Chapter III, the inclusion of the interest rate on saving deposits yields insignificant results. Therefore, the interest rate variable is dropped from the demand function for demand deposits.

Demand for Time Deposits (TD).

$$TD = -19.9249 + \underset{(0.0126)}{0.1331}\ Y + \underset{(1.7636)}{3.7780}\ RS \qquad (3.2)$$

$\bar{R}^2 = 0.987$, DW = 1.576, SE = 1.794

The demand for time deposits is related positively to income (Y) and interest rate on saving deposits (RS). Both the explanatory variables have the expected signs and their coefficients are significant at the five percent level. In addition, the degree of monetization variable was tried for this equation but was found insignificant, as shown in Chapter III.

Demand for Bank Credit (CL).

$$CL = 40.3298 + 0.3162\ IM + 0.1022\ Y - 5.9852\ RV \qquad (4)$$
$$\qquad\qquad (0.0545) \quad (0.0321) \quad (3.7905)$$

$\bar{R}^2 = 0.983$, DW = 1.788, SE = 3.375

$$CL = 15.5224 + 0.3395\ I + 0.1834\ Y - 3.1768\ RV \qquad (4a)$$
$$\qquad\qquad (0.1646) \quad (0.0477) \quad (5.8911)$$

$\bar{R}^2 = 0.957$, DW = 1.677, SE = 5.277

Equation (4) or (4a), which explains the demand for bank credit to the private sector (CL), is one of the most important structural relations in the model. It is expected to provide one of the important links between the monetary sector and real sector. In the first equation, the demand for bank credit depends directly on imports (IM) and income (Y), and inversely on the lending rate (RV). The regression results strongly support this hypothesis. The three explanatory variables account for 98 percent of the variance in bank credit. The regression coefficients are significant at the five percent level, except for the lending rate, which is significant at the twelve percent level.

In equation (4a), the investment variable is used instead of imports variable. A comparison between the above two results shows that $\bar{R}^2$ is slightly higher in equation (4), and the t-statistic for RV is significant in equation (4a) at a much higher level than the 12 percent level in equation (4). In addition, the t-statistic for IM is much higher than the t-statistic for I, i.e., bank credit is more correlated with imports than with investment. This contention is supported by the fact that commercial banks in Jordan tend to concentrate heavily on short term loans to finance foreign trade. Loans for investment

purposes to industry and agriculture constitute about twelve percent of bank credit.[7] Accordingly, the regression results suggest that imports can be used to explain adequately bank credit. Furthermore, lagged endogenous variable (CL_{-1}) and interest rate on saving deposits (RS) were tried but they were dound to be insignificant.

Vault Cash (VC).

$$VC = \underset{}{0.3835} + \underset{(0.1917)}{0.4337}\ VC_{-1} + \underset{(0.0029)}{0.0101}\ D \qquad (5)$$

$$\bar{R}^2 = 0.787,\ DW = 2.153,\ h = -0.665,\ SE = 0.322$$

$$VC = \underset{}{0.4861} + \underset{(0.3845)}{0.0423}\ RV + \underset{(0.0041)}{0.0139}\ D \qquad (5a)$$

$$\bar{R}^2 = 0.671,\ DW = 1.454,\ \rho = 0.292,\ SE = 0.368$$

$$VC = \underset{}{1.4338} + \underset{(0.3707)}{0.1328}\ RV + \underset{(0.2014)}{0.4489}\ VC_{-1} + \underset{(0.0039)}{0.0110}\ D \qquad (5b)$$

$$\bar{R}^2 = 0.725,\ DW = 2.201,\ h = -1.029,\ SE = 0.332$$

In equation (5), vault cash (VC) depends directly upon the size of the commercial banks' deposits (D) and vault cash lagged one year (VC_{-1}). Both the explanatory variables are significant at the five percent level and their coefficients are properly signed. The lagged dependent variable (VC_{-1}) shows the movement towards desired vault cash. The computed h-statistic shows that the hypothesis of no serial correlation in the errors at the five percent level of significance is not rejected.

The presence of the quoted interest rate on loans (RV) in equation (5a) yields insignificant results. The interest rate coefficient is insignificant with wrong sign, and $\bar{R}^2$ is lower than the one in equation

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[7] International Monetary Fund, International Financial Statistics (December, 1976), pp. 211-214.

(5). The equation was found to be suffering from serial correlation in its original form at five percent level and was corrected using the AUTOREG procedure.[8] Similarly, equation (5b) shows that the coefficient of RV is insignificant with unexpected positive sign, and $\bar{R}^2$ is lower than the one in equation (5). Therefore, the quoted interest rate on loans is dropped from the demand for vault cash in the aggregate model.

Excess Liquid Assets (EL).

$$EL = 3.2369 + \underset{(0.0264)}{0.1384}\ D \qquad (6)$$

$\bar{R}^2 = 0.751$, DW = 1.423, $\rho = 0.174$, SE = 2.808

$$EL = 3.4559 + \underset{(0.0542)}{0.1279}\ D + \underset{(2.5844)}{0.0755}\ RS \qquad (6a)$$

$\bar{R}^2 = 0.702$, DW = 1.449, $\rho = 0.298$, SE = 3.055

Equation (6) determines the demand for excess liquid assets (EL) as a function solely of total deposits (D). Although the explanatory power of 75 percent is not as high as in previous equations, it does not necessarily indicate the lack of real relationship between EL and D. As noted in Chapter IV, there are theoretical grounds for believing that EL is positively related to D. This argument is supported by the high significant coefficient of D.

The inclusion of the interest rate on saving deposits (RS) in equation (6a) yields unacceptable results, The $\bar{R}^2$ is not improved, and the t-statistic for the interest rate coefficient is insignificant with unexpected sign. Accordingly, a simple function relating demand for excess liquid assets with total deposits appeared to work better than

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[8]A. Barr, J. Goodnight, J. Sall and J. Helwig, op. cit., pp. 66-69.

the one which includes the interest rate variable. Therefore, the interest rate variable is dropped from the demand for excess liquid assets in the aggregate model. The interest rate on loans (RV) and the ratio of bank credit (CL) to total deposits (D) were also tried, but were found to be insignificant.

Interest Rate on Saving Deposits (RS).

$$RS = \underset{}{-4.5750} + \underset{(0.1596)}{0.7727}\ RS_{-1} + \underset{(0.2826)}{0.6515}\ RV \qquad (8)$$

$$\bar{R}^2 = 0.865,\ DW = 1.740,\ h = 0.830,\ SE = 0.251$$

$$RS = \underset{}{-6.2903} + \underset{(0.2054)}{0.5006}\ RS_{-1} + \underset{(0.2838)}{0.8575}\ RV + \underset{(3.6508)}{1.4603}\ CL/D \qquad (8a)$$

$$\bar{R}^2 = 0.883,\ DW = 2.248,\ h = -1.347,\ SE = 0.233$$

In equation (8), the interest rate on saving deposits (RS) depends directly upon the interest rate on saving deposits lagged one year (RS_{-1}) and the lending rate (RV). The low standard error of estimate for the equation and reasonably good explanatory power characterize the regression results in the equation. Both the explanatory variables are significant at the five percent level and their coefficients bear the expected signs. In addition, the positive effect of the lagged dependent variable (RS_{-1}) indicates the movement towards desired interest rate. The computed h-statistic indicates that the hypothesis of no serial correlation in errors at the five percent level of significance is not rejected.

The introduction of loans-deposits ratio (CL/D) in equation (8a) shows a slight increase in the explanatory power from 87 percent to

88 percent.[9] However, the coefficient of CL/D is not significant at any of the acceptable levels. This is not surprising since RS was not sensitive to many variables in the model. Accordingly, RS has been specified in the simplest possible way, that is, RS depends on the lagged value of itself and the interest rate on loans (RV).

Real Sector

The real sector of the model is composed of six equations. Four of the equations are behavioral equations while two are identities. The estimated equations of this sector are now presented.

Private Consumption (C).

$$C = \underset{}{12.3816} + \underset{(0.0816)}{0.4472}\ YD + \underset{(0.1241)}{0.4203}\ C_{-1} \qquad (13)$$

$$\bar{R}^2 = 0.992,\ DW = 2.045,\ h = -0.121,\ SE = 5.377$$

$$C = \underset{}{8.5484} + \underset{(0.1056)}{0.5140}\ YD + \underset{(0.1242)}{0.4240}\ C_{-1} - \underset{(0.1086)}{0.1082}\ M_1 \qquad (13a)$$

$$\bar{R}^2 = 0.992,\ DW = 2.199,\ h = -0.535,\ SE = 5.378$$

In equation (13), disposable income (YD) and one year lagged consumption (C_{-1}) are the two explanatory variables which account for almost all the variance in consumption. The coefficient of YD is significantly different from zero at the five percent level and has the expected sign. Similarly, the coefficient of the lagged dependent variable is also significantly different from zero at the five percent level

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[9] Equation (8a) is similar to the one derived by James Boughton, Eduard Brau, Thomas Naylor and William Yohe, "A Policy Model of the United States Monetary Sector," Southern Economic Journal, XXXV (April, 1969), pp. 333-346.

and has the expected sign. In addition, the positive effect of the lagged dependent variable shows the movement towards desired consumption. The computed h-statistic indicates that there is no serial correlation at the five percent level of significance.

In equation (13a), the money stock (M_1) is included to reflect the effects of monetary changes on aggregate demand. That is, since the money supply is regarded as a component of total wealth, a change in the money stock leads to a change in aggregate wealth and causes a change in consumption through the wealth effect. However, the regression results show that the coefficient of M_1 is with unexpected negative sign and it is insignificant according to the t-test. Accordingly, a function relating consumption with disposable income and one year lagged consumption appeared to work better than the one which includes the money supply variable. Therefore, M_1 is dropped from the consumption function in the aggregate model. Furthermore, currency in circulation (outside money) as a part of total wealth was tried in the consumption function, but was also found to be insignificant with wrong sign. Also, the dummy variable which represents the effect of 1967 War, was tried but found insignificant.

Gross Investment (I).

$$I = \underset{}{1.7925} + \underset{(0.0610)}{0.9726}\ CL - \underset{(5.8620)}{10.2589}\ Dum \qquad (14)$$

$$\bar{R}^2 = 0.936,\ DW = 2.137,\ SE = 6.844$$

$$I = \underset{}{1.6574} + \underset{(0.1585)}{0.9543}\ CL + \underset{(0.2014)}{0.0254}\ I_{-1} - \underset{(5.2720)}{10.1660}\ Dum \qquad (14a)$$

$$\bar{R}^2 = 0.921,\ DW = 2.194,\ h = -0.998,\ SE = 7.052$$

Equation (14) shows that the gross investment (I) is a function of

bank credit (CL) and dummy variable representing the effect of 1967 War. The two explanatory variables account for 94 percent of the variance in gross investment. The coefficient of CL appears as theoretically expected (positive): the more funds available the more investment is undertaken. Also, it can be shown from the equation that the bank credit variable is an important determinant affecting investment activities. The dummy variable, which is introduced to take care of the effect of 1967 War, is significantly different from zero at the ten percent level.

The introduction of lagged investment (I_{-1}) in equation (14a) reveals that the coefficient of I_{-1} is not significant at any of the acceptable levels. The size of the coefficient is not significantly different from zero. This indicates that the actual investment is never equal to demand for it. Accordingly, a function relating demand for gross investment with bank credit and dummy variable appeared to work better than the one which includes the lagged investment one year. Therefore, the lagged investment variable is dropped from the investment function. Furthermore, the quoted interest rate on loans (RV) and income (Y) were tried for the investment function but were found to be insignificant.

Imports (IM).

$$IM = \underset{}{-2.8332} + \underset{(0.0583)}{0.1554}\ Y + \underset{(0.3005)}{0.7437}\ CL + \underset{(0.1476)}{0.7439}\ FR - \underset{(5.3902)}{32.3588}\ Dum \qquad (15)$$

$\bar{R}^2 = 0.992$, DW = 2.223, SE = 4.836

$$IM = \underset{}{-17.3340} + \underset{(0.0547)}{0.1648}\ Y + \underset{(0.2919)}{0.6614}\ CL + \underset{(0.1446)}{0.6659}\ FR + \underset{(0.1075)}{0.1920}\ RM$$

$$- \underset{(5.2451)}{29.7326}\ Dum \qquad (15a)$$

$\bar{R}^2$ = 0.993, DW = 2.408, SE = 4.517

In equation (15), the demand for imports (IM) is a function of income (Y), bank credit (CL) and foreign aid (FR), as well as a dummy variable representing the effect of 1967 War. These variables account for 99 percent of the variance of the dependent variable. As expected, the availability of credit plays an important role in the determination of the level of imports. Furthermore, the appropriateness of the foreign aid variable in the equation is supported by the fact that Jordan has been having chronic and large deficits in its balance of trade. All the explanatory variables have the expected signs and the coefficients of the explanatory variables are significant at the five percent level.

In equation (15a), import prices (RM) are added to capture the relative effect of foreign prices on imports, i.e., a rise in foreign prices would result in a decrease in demand as imports become more expensive. However, the regression results show that the t-statistic for foreign prices is significant at ten percent level with unexpected positive sign. Therefore, the foreign price variable is dropped from the demand function for imports. Furthermore, the export prices-import prices ratio was tried but found insignificant.

Taxes (T).

$$T = \underset{(0.0035)}{-0.1329 + 0.1070\ Y} \qquad (16)$$

$\bar{R}^2$ = 0.980, DW = 2.052, SE = 1.454

Equation (16) is a simple regression of tax yields (T) to income (Y). Ninety eight percent of the variance in the dependent variable is

explained by Y, and its regression coefficient is significant at the five percent level.

By considering the above analysis, the structural estimates obtained by the method of OLS, which are presented in Table VI, are selected the best among a group of fittings for each of the behavioristic equations. These structural estimates are compared with those derived by the TSLS in the next section.

It may, however, be of interest to indicate that the model is estimated in a log-linear form. The estimation results are in Appendix B. The comparisons of these results with those in the linear form Table VI reveal that both forms have almost similar regression results in the equations of the demand for currency, the demand for demand deposits, the interest rate on saving deposits and taxes, whereas the linear form fares much better than the log-linear form for the rest of the estimated equations. Therefore, there is no particular reason to accept the log-linear form in preference to the linear form for the whole model.

Two-Stage Least Squares Estimates

This section contains the two-stage least squares (TSLS) regression results. The structural form of the model which was developed in Chapter IV, is used as the specification form for the simultaneous equation estimator. Thus, the simultaneous equation model consists of 11 behavioral equations and 7 identities. It also contains 18 endogenous variables and 11 exogenous and lagged dependent variables. All 11 behavioral equations in the model are over identified by the order condition, and the remaining 7 identities are identified. Hence, it is

TABLE VI

STRUCTURAL EQUATION ESTIMATES BY OLS

$$CC = 30.9225 + 0.3570\ Y - 140.4593\ Z \qquad (1.2)$$
$$\qquad\quad (0.0131)^* \quad (16.7395)^*$$

$$\bar{R}^2 = 0.983,\ DW = 1.800,\ SE = 5.189$$

$$DD = -24.4270 + 0.1909\ Y + 35.6953\ Z \qquad (2.2)$$
$$\qquad\quad (0.0131)^* \quad (16.6362)^*$$

$$\bar{R}^2 = 0.949,\ DW = 1.554,\ \rho = 0.183,\ SE = 4.320$$

$$TD = -19.9249 + 0.1331\ Y + 3.7780\ RS \qquad (3.2)$$
$$\qquad\quad (0.0126)^* \quad (1.7636)^*$$

$$\bar{R}^2 = 0.987,\ DW = 1.576,\ SE = 1.794$$

$$CL = 40.3298 + 0.3162\ IM + 0.1022\ Y - 5.9852\ RV \qquad (4)$$
$$\qquad\quad (0.0545)^* \quad (0.0321)^* \quad (3.7905)$$

$$\bar{R}^2 = 0.983,\ DW = 1.788,\ SE = 3.375$$

$$VC = 0.3835 + 0.4337\ VC_{-1} + 0.0101\ D \qquad (5)$$
$$\qquad\quad (0.1917)^* \quad (0.0029)^*$$

$$\bar{R}^2 = 0.787,\ DW = 2.153,\ h = -0.665,\ SE = 0.322$$

$$EL = 3.2369 + 0.1384\ D \qquad (6)$$
$$\qquad\quad (0.0264)^*$$

$$\bar{R}^2 = 0.751,\ DW = 1.423,\ \rho = 0.174,\ SE = 2.808$$

$$RS = -4.5750 + 0.7727\ RS_{-1} + 0.6515\ RV \qquad (8)$$
$$\qquad\quad (0.1596)^* \quad (0.2826)^*$$

$$\bar{R}^2 = 0.865,\ DW = 1.740,\ h = 0.830,\ SE = 0.251$$

$$C = 12.3816 + 0.4472\ YD + 0.4203\ C_{-1} \qquad (13)$$
$$\qquad\quad (0.0816)^* \quad (0.1241)^*$$

$$\bar{R}^2 = 0.992,\ DW = 2.045,\ h = -0.121,\ SE = 5.377$$

$$I = 1.7925 + 0.9726\ CL - 10.2589\ Dum \qquad (14)$$
$$\qquad\quad (0.0610)^* \quad (5.8620)$$

$$\bar{R}^2 = 0.936,\ DW = 2.137,\ SE = 6.844$$

TABLE VI (Continued)

$$IM = -2.8332 + 0.1554\ Y + 0.7437\ CL + 0.7439\ FR - 32.3588\ Dum \quad (15)$$
$$\qquad\qquad (0.0583)^* \quad (0.3005)^* \quad (0.1476)^* \quad (5.3902)^*$$

$$\bar{R}^2 = 0.992,\ DW = 2.223,\ SE = 4.836$$

$$T = -0.1329 + 0.1070\ Y \quad (16)$$
$$\qquad\qquad (0.0035)^*$$

$$\bar{R}^2 = 0.980,\ DW = 2.052,\ SE = 1.454$$

Note: The notation * indicates the estimated coefficients are significantly different from zero at the five percent level.

concluded that the entire system is indentifiable.[10]

The simultaneous equation model is estimated for the period 1956-1975. The SAS program which was adopted for the OLS estimates is also adopted for the simultaneous equation estimation model. The structural estimates obtained by the method of TSLS are presented in Table VII in identical order to that which was used for the structural estimates obtained by the method of OLS in Table VI. The regression results obtained by the TSLS technique are compared with those derived by the OLS technique.

An important feature of the results is that TSLS estimates do not suggest any change in the specification of the equations since the goodness of fit (explanatory power), the level of significance and the coefficients of parameters remain almost unchanged as compared with the OLS estimates. In terms of explanatory power, all of the estimation results indicate that $\bar{R}^2$ ranges between 0.93 to 0.99 except for the equations 5, 6 and 8 for which those are 0.79, 0.75 and 0.87 respectively. All the explanatory variables carry the expected signs, and all coefficients are significant at the five percent level in both methods of estimation, except for the lending rate (RV) in equation (4) and the dummy variable in equation (14), which are significant at the 12 and 10 percent levels respectively. There is no appreciable difference in the coefficients obtained by the two methods of estimation.

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[10]The order condition for identification is that the number of predetermined variables excluded from an equation but included in the model must be no less than the number of endogenous variables in the equation minus one, i.e., $K^{**} \geq G^{\Delta} - 1$. Where K^{**} = the number of predetermined variables excluded from the equation and G^{Δ} = the number of endogenous variables included in the equation. However, the order condition for identification is a necessary condition, not a sufficient condition. Jan Kmenta, op. cit., pp. 539-543.

TABLE VII

STRUCTURAL EQUATION ESTIMATES BY TSLS

$$CC = 30.3399 + \underset{(0.0132)^*}{0.3588}\ Y - \underset{(16.7509)^*}{139.7517}\ Z \qquad (1.2)$$

$\bar{R}^2 = 0.982$, DW = 1.797, SE = 5.192

$$DD = -23.3574 + \underset{(0.0115)^*}{0.1882}\ Y + \underset{(14.6784)^*}{33.2471}\ Z \qquad (2.2)$$

$\bar{R}^2 = 0.951$, DW = 1.455, SE = 4.390

$$TD = -21.5599 + \underset{(0.0132)^*}{0.1293}\ Y + \underset{(1.8583)^*}{4.4219}\ RS \qquad (3.2)$$

$\bar{R}^2 = 0.987$, DW = 1.552, SE = 1.802

$$CL = 41.1512 + \underset{(0.0564)^*}{0.3055}\ IM + \underset{(0.0333)^*}{0.1090}\ Y - \underset{(3.8001)}{6.1284}\ RV \qquad (4)$$

$\bar{R}^2 = 0.982$, DW = 1.780, SE = 3.379

$$VC = 0.3829 + \underset{(0.1918)^{*-1}}{0.4363}\ VC_{-1} + \underset{(0.0029)^*}{0.0101}\ D \qquad (5)$$

$\bar{R}^2 = 0.788$, DW = 2.142, SE = 0.323

$$EL = 3.7230 + \underset{(0.0216)^*}{0.1281}\ D \qquad (6)$$

$\bar{R}^2 = 0.753$, DW = 1.324, SE = 2.905

$$RS = -4.5750 + \underset{(0.1596)^{*-1}}{0.7727}\ RS_{-1} + \underset{(0.2826)^*}{0.6515}\ RV \qquad (8)$$

$\bar{R}^2 = 0.865$, DW = 1.740, SE = 0.251

$$C = 12.4509 + \underset{(0.0861)^*}{0.4496}\ YD + \underset{(0.1308)^{*-1}}{0.4167}\ C_{-1} \qquad (13)$$

$\bar{R}^2 = 0.992$, DW = 2.049, SE = 5.377

$$I = 1.6653 + \underset{(0.0611)^*}{0.9762}\ CL - \underset{(5.8501)}{10.2596}\ Dum \qquad (14)$$

$\bar{R}^2 = 0.937$, DW = 2.138, SE = 6.845

TABLE VII (Continued)

$$IM = \underset{}{-4.3453} + \underset{(0.0648)^*}{0.1797}\ Y + \underset{(0.2842)^*}{0.6112}\ CL + \underset{(0.1559)^*}{0.7825}\ FR - \underset{(5.5070)^*}{33.1737}\ Dum \qquad (15)$$

$\bar{R}^2 = 0.993$, DW = 2.277, SE = 4.867

$$T = \underset{}{-0.1733} + \underset{(0.0035)^*}{0.1072}\ Y \qquad (16)$$

$\bar{R}^2 = 0.980$, DW = 2.056, SE = 1.454

Note: The Standard Errors are presented in parentheses below the estimated coefficients. The notation * indicates the estimated coefficients are significantly different from zero at the five percent level. $\bar{R}^2$ is the multiple correlation coefficient adjusted for degrees of freedom. DW is the Durbin-Watson statistic for the test of first-order autocorrelation in the disturbance terms. SE is the standard error of estimate for the equation.

In summary, the model in general appears to be well specified considering the conditions under which monetary system works in Jordan. The regression results have been quite satisfactory. On the other hand, the model is considered adequate enough to demonstrate the linkage between the monetary and the real sectors of the economy via the commercial banks' loans. However, the next task is to evaluate the performance and the properties of the model. The TSLS estimates which take account of simultaneous equations bias, are used for the evaluation of the model.

CHAPTER VI

MODEL SIMULATION ANALYSIS

Introduction

The real test of a multi-equation model, perhaps more than the desirable properties tested by $\bar{R}^2$ and standard errors of coefficients, lies in its predictive ability. As Klein points out

> The real test of the validity and usefulness of any theory is its ability to predict. In economics we formulate theories of how people behave under a general variety of circumstances. The econometric test is to observe behavior, measure the theoretical parameters from the observations and then predict behavior in non-observed situations. [1]

In order to test the validity of the postulated relationships and to see how well they hold, the model is subjected to simulation technique. Simulation is simply "the mathematical solution of a simultaneous set of difference equations."[2] It suggests how the model may provide information which will be helpful to policy makers, and how the model can be used for stabilization analysis.

In the case of an econometric model which is linear in the variables, the simulation is achieved by finding the reduced form of the

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[1] Lawrence Klein, A Textbook of Econometrics (New York: Row, Peterson and Company, 1956), p. 249. Also Carl Christ, "Aggregate Econometric Models," American Economic Review, 46 (1956), pp. 401-403.

[2] R. S. Pindyck and D. L. Rubinfeld, Econometric Models and Economic Forecasts (McGraw-Hill, Inc., 1976), p. 310.

model. In the reduced form, the endogenous variables are represented as the function of predetermined variables only. The reduced form is obtained from the structural linear form as shown below.

The structural form can be written as:

$$AY + BX = U \qquad (1)$$

where A = the coefficient matrix of the endogenous variables (NxN);

Y = the column vector of the endogenous variables (Nx1);

B = the coefficient matrix of the predetermined variables (NxK);

X = the column vector of the predetermined variables (Kx1);

and U = the vector of disturbance terms (Nx1).

The reduced form is derived by pre-multiplying the matrices by the inverse of the matrix A, i.e.,

$$A^{-1} AY + A^{-1} BX = A^{-1} U \qquad (2)$$

then the reduced form of the system is

$$Y = -A^{-1} BX + A^{-1} U \qquad (3)$$

or, $$Y = \Pi X + V \qquad (3a)$$

where $\Pi = -A^{-1} B$, i.e., the multiplier matrix;[3]

and $V = A^{-1} U$.

However, the above analytical approach is convenient for a small linear model. As econometric models become larger, an analysis of their dynamic behavior becomes more difficult and less straightforward. Thus, for a large linear model and a non-linear model, the simultaneous equations must be simulated on a computer program.[4] The present model

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[3]More detail about the multiplier analysis will be given in the policy simulation section.

[4]See, for example, R. S. Pindyck and D. L. Rubinfeld, op. cit., pp. 311-312, 344-346.

is simulated on a computer program because two of the equations are non-linear.

In this chapter, three aspects of simulation analysis are involved: (1) stability of the model (dynamic stability), (2) performance of the model, and (3) dynamic multipliers and policy simulations.

Dynamic Stability of the Model

In order to test the model for stability, the dynamic simulation procedures start with observed lagged values for year prior to the first year of the sample period and the actual values of the exogenous variables over the sample period. The model then generates its own current and lagged values of the endogenous variables through a solution process. The convergence of the system is achieved through an iterative process. This process is repeated for obtaining the solution values of the successive periods.

The MACROSIM[5] program is used to test the estimated model for stability. In this program, the dynamic simulation is specified to allow a dynamic system to run unconstrained simulation for 50 time periods, each run with all lagged endogenous variables being appropriately updated. The simultaneous solution of the system provides the time paths for each of the endogenous variables in the model.

The results of the stability analysis are provided in Table VIII. The time paths for all the endogenous variables are plotted in Appendix C. It is clear from these results that the simulated values of the endogenous variables tend to approach equilibrium values during the

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[5]Donald Hester, A Macro-Simulation Program and Monte Carlo Sample Generator, User's Manual (Wisconsin: The University of Wisconsin, 1969).

TABLE VIII

SUMMARY OF DYNAMIC STABILITY OF THE MODEL

Exogenous Variables		Endogenous Variables	
Variable	Initial Value (First Run-50 Time Period Simulation)	Variable	Equilibrium Value
		DD	3.828
RV	8.250	CC	25.290
RS_{-1}	3.000	TD	6.282
VC_{-1}	1.800	CL	10.295
OD	7.960	RS	3.519
C_{-1}	50.010	VC	1.003
X	10.210	EL	6.038
FR	14.810	RL	4.517
G	16.820	LA	10.555
Dum	0.000	D	18.070
Z	0.280	M_1	29.117
		M_2	35.399
		C	86.843
		I	11.715
		IM	30.604
		T	10.009
		YD	84.975
		Y	94.984

first run (i.e., 50 time period simulation). The time paths of the economic variables are monotonic and essentially linear in character. The behavior of the model is stable. Furthermore, the results of simulation provide some basis for confidence in the tracking ability of the model in estimating the economic response to some economic variables over the time path. That is, without ascertaining that the model is stable, any economic implications drawn from the model would lose their significance.

Evaluation of Model Performance

After testing the model for stability, the next task is to test the performance of the model. In doing so, ex post simulation and ex post forecasting are conducted. The former refers to the simulation within the sample period, while the latter refers to forecasting beyond the sample period up to the present time. Besides, quantitative criteria are constructed for judging the system's performance.

Performance Test Criteria

Since most of the performance tests concentrate on how well the simulated (or forecasting) values retrace the actual data during and after the estimated period, quantitative criteria are necessary. The reason why the quantitative measurements are desirable is pointed out by Stekler:

> A method that utilizes information about the absolute discrepancy between the forecast and the observed changes should be employed, for this also permits comparison of a particular model's forecast with the accuracy of other forecasting procedures and naive methods.[6]

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[6] H. O. Stekler, "Forecasting with Econometric Models: An Evaluation," Econometrica, 36 (July, 1968), p. 438.

However, in the econometric literature, there are many criteria to measure quantitatively the discrepancy between predicted and actual values of the endogenous variables. The criteria that are most often used are:[7] mean absolute error (MAE), mean absolute percent error (MAPE), root mean square error (RMSE), and root mean square percent error (RMSPE). These quantitative measures are discussed below:

1. Mean Absolute Error (MAE) - The MAE is a measure of the absolute value of deviation of the simulated (or forecasted) value from its actual (historical) value. It can be defined as:

$$MAE = \frac{1}{N} \sum_{n=1}^{N} \left| Y_t^p - Y_t^a \right| \qquad (1)$$

where Y_t^p = the simulated (forecasted) value of the endogenous variable (Y_t);

Y_t^a = the actual value;

and N = the number of periods in the simulation (number of observations).

2. Mean Absolute Percent Error (MAPE) - If the mean absolute deviations are expressed in terms of percent, the measure becomes mean absolute percent error (MAPE), i.e., the MAPE is a measure of the absolute value of percent deviation of the simulated value from its actual value. It can be expressed as:

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[7] Henri Theil, Applied Economic Forecasting (Amsterdam: North-Holland Publishing Company, 1966), pp. 27-28; R. S. Pindyck and D. L. Rubinfeld, op. cit., pp. 314-319; Phillip Howrey, L. R. Klein and M. McCarthy, "Notes on Testing the Predictive Performance of Econometric Models," International Economic Review, 15 (January, 1974), pp. 373-382.

$$MAPE = \frac{1}{N} \sum_{n=1}^{N} \left| \frac{Y_t^p - Y_t^a}{Y_t^a} \cdot 100 \right| \qquad (2)$$

3. Root Mean Square Error (RMSE) - The RMSE is a measure of the deviation of the simulated value from its actual value, with larger value denoting greater deviation and poorer forecasting fit of the model. The magnitude of this error must be evaluated by comparing it with the average size of the variable in question. It can be written as:

$$RMSE = \frac{1}{N} \sqrt{\sum_{n=1}^{N} (Y_t^p - Y_t^a)^2} \qquad (3)$$

4. Root Mean Square Percent Error (RMSPE) - If the sum squared deviations are expressed in terms of percent, the measure becomes the root mean square percent error (RMSPE), i.e., the RMSPE is a measure of percent deviation of forecasting value from its actual value. It can be defined as follows:

$$RMSPE = \frac{1}{N} \sqrt{\sum_{n=1}^{N} \left[\left(\frac{Y_t^p - Y_t^a}{Y_t^a} \right) \cdot 100 \right]^2} \qquad (4)$$

It may be of interest to point out that MAE and MAPE measure errors in terms of absolute level to avoid the problem of positive and negative errors canceling, but RMSE and RMSPE measure errors in terms of level to penalize large individual errors. In fact, RMSE and RMSPE are used more often in simulation performance.[8]

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[8] R. S. Pindyck and D. L. Rubinfeld, op. cit., pp. 316-317.

Ex Post Simulation

As mentioned earlier, the ex post or historical simulation is performed in order to evaluate the model's ability to replicate the actual data. By simulating the model during the period for which the model was estimated, a comparison of the actual data series with the simulated series for each endogenous variable can provide a useful test of the validity of the model. However, when all equations are simulated simultaneously, errors may accumulate and a bad simulation fit may result. "Of course, no model is expected to fit the data exactly: the question is whether the residual errors are sufficiently small to be tolerable and sufficiently unsystematic to be treated as random."[9]

To perform the ex post simulation test the revised MACRSIM program is adopted. This testing procedure is accomplished by simulating the estimated model over the sample period 1956-1975 and by comparing the actual values of the endogenous variables with the values generated by the simulation. The simulation error measures are presented in Table IX. These measures are given for all the endogenous variables. In addition, actual and simulated values for all the endogenous variables are plotted in Appendix D.

It is clear from the table that the components of the monetary assets are not predicted badly; the MAPE errors are of 18.47 percent for demand deposits, 9.94 percent for currency in circulation and 13.87

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[9]Charles C. Holt, "Validation and Application of Macroeconomic Models Using Computer Simulation," in J. S. Dusenburry, et al., eds., The Brookings Quarterly Econometric Model of the United States (Chicago: Rand McNally, 1965), p. 639.

TABLE IX

RESULTS OF EX POST SIMULATION

	MAE (value)	MAPE (percent)	RMSE (value)	RMSPE (percent)
DD	2.80	18.47	0.82	6.51
CC	3.16	9.94	0.86	3.05
TD	1.33	13.87	0.36	4.60
CL	2.53	8.78	0.74	2.48
RS	0.29	8.25	0.07	2.01
VC	0.21	12.11	0.07	4.02
EL	2.71	31.10	0.71	8.87
RL	0.90	9.11	0.26	2.84
LA	3.25	15.67	0.86	4.21
D	3.61	9.11	1.06	2.84
M_1	5.53	10.98	1.50	3.07
M_2	6.28	9.71	1.70	2.62
C	5.83	4.66	1.55	1.32
I	4.52	13.38	1.38	3.60
IM	4.22	5.85	1.08	1.47
T	1.23	6.97	0.36	1.95
YD	5.95	4.51	1.53	1.29
Y	6.53	4.40	1.67	1.28

percent for time deposits. The computed values of M_1 and M_2 are fairly close to their actual values, with MAPE of 10.98 percent for M_1 and 9.71 percent for M_2. However, the simulation test produces mixed results for the assets in the portfolio of the commercial banks. Credit to the private sector, required liquid assets and vault cash are well predicted. Their simulated values deviate from the actual values by 8.78, 9.11 and 12.11 percent, respectively. On the other hand, the simulation test yields poor result for excess liquid assets. The MAPE is about 31.10 percent. This deviation is due primarily to the greater difficulty involved in the specification of its function. The MAPE errors for interest rate on saving deposits and total deposits are about 8.25 and 9.11 percent, respectively.

On the other hand, the simulation of real sector is quite satisfactory. The prediction errors appear to be within very reasonable limits, i.e. the computed values of the real sector variables are reasonably close to their actual values. The largest MAPE of prediction is 13.38 percent in the case of investment variable followed by taxes with MAPE of 6.97 percent. For the rest of real sector variables, MAPE is in the 4.40 to 5.85 percent range.

In addition, a clear perception about the performance of the model in simulation can be given from the root mean square percent error statistic (RMSPE). Table X summarizes the RMSPE distribution for the whole model. The results indicate that 89 percent of the euqations have RMSPE errors of less than five percent while more than half of them have RMSPE errors of less than three percent. Only one equation has RMSPE errors of more than seven percent.

TABLE X

RMSPE DISTRIBUTION

Error Distribution	Number of Equations	Percent
1 - 1.99%	5	27.8
2 - 2.99%	5	27.8
3 - 3.99%	3	16.7
4 - 4.99%	3	16.7
5 - 6.99%	1	5.5
over 7%	1	5.5
Total	18	100.0

In summary, it is clear from the foregoing discussion that poor predictive performance was confined to only two relationships in the entire model, namely, demand deposits and excess liquid assets. This may not be all that serious when the RMSPE and also the other measures of forecasting accuracy suggest that the model overall tracks the historical time path of the variables fairly well. However, on the whole, the performance of the model is quite satisfactory and it can be employed to forecast beyond the sample period.

Ex Post Forecasting

A good structural model is also expected to perform well in predicting the behavior of the system beyond the sample period. In the econometric literature, two types of forecasts are generally

considered: the ex post forecast and the ex ante forecast.[10] The prediction beyond the sample period up to the present time is known as ex post forecast. This type of forecasting does not give any information about the future but it is quite useful for testing the behavior of the model outside the sample period. The ex ante forecast is utilized only in forecasting the endogenous variables for the future periods. It is a conditional forecast based on the projected future values of the exogenous variables rather than on the historical values. Since the information necessary for the projection of the future values of the exogenous variables is not available, the ex ante forecast is not provided in this study.

The year 1976 is the only year for which all the variables included in the model are now available. Therefore, an ex post forecast is performed for that year to determine the degree to which the model is able to replicate the actual data outside the sample period. Table XI presents the predicted values, the actual values, the error, and MAPE measure for each endogenous variable. It is clear from the table that many predictions derived from the individual equations for the year 1976 are quite good. Large errors of 57.26 percent in the prediction of excess liquid assets are not, however, unexpected since it was found earlier that the ex post simulation yielded large errors in this equation.

One important aspect that deserves attention is that the predicted value of demand deposits is less than the actual value while the

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[10] See, for example, J. Phillip Cooper, Development of the Monetary Sector, Prediction and Policy Analysis in the FRB-MIT-Penn Model (Mass.: D.C. Heath and Company, 1974), pp. 97-120; R. S. Pindyck and D. L. Rubinfeld, op. cit., pp. 312-314.

TABLE XI

EX POST FORECAST RESULTS FOR 1976

Variable	Actual	Predicted	Error	MAPE (%)
DD	102.09	100.88	-1.21	1.18
CC	161.50	187.98	26.48	16.40
TD	95.34	77.92	-17.42	18.27
CL	175.65	153.69	-21.96	12.50
RS	5.25	5.21	-0.04	0.79
VC	3.44	3.55	0.11	3.29
EL	18.09	28.45	10.36	57.26
RL	52.91	48.25	-4.66	8.80
LA	71.00	76.70	5.70	8.03
D	211.64	193.01	-18.63	8.80
M_1	263.59	288.86	25.27	9.59
M_2	358.93	366.78	7.85	2.19
C	360.70	368.29	7.59	2.10
I	150.12	136.27	-13.85	9.23
IM	339.54	303.21	-36.33	10.70
T	69.90	63.21	-6.69	9.57
YD	474.30	528.04	53.74	11.33
Y	544.20	591.25	47.05	8.65

Note: All the variables are in millions of Dinar. Interest rate variable (RS) is in percent.

predicted value of currency in circulation is more than the actual value. This is to say that since the estimated equations of both variables contain the same predetermined variable DD/M_1, the under predicting demand deposits contributed to the over prediction of currency in circulation. The MAPE errors are 1.18 percent for demand deposits and 16.40 percent for currency in circulation. Time deposits and bank credit register MAPE errors of 18.27 and 12.50 percent, respectively. For the rest of the monetary variables, the range of MAPE errors extends from 0.79 percent for interest rate on saving deposits to 9.59 percent for M_1.

On the other hand, the real sector variables perform generally better than the monetary sector variables beyond the sample period. They display a range of MAPE errors of 2.10 percent for consumption to 11.33 percent for disposable income. On the whole, the model performs fairly well beyond the estimated period.

Sensitivity Test of the Model

The model performance is further tested by examining the reaction of the model to any change in the initial period used for simulation. Actually, if the model approximately represents the real world, then the model should not be very sensitive to any change in the initial period of simulation. That is, if the model was estimated using data from 1956 to 1975, then it should not matter very much whether the simulation is begun in 1956 or 1960.[11] For this kind of test, a number of simulation runs should be made with the initial period of simulation being

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[11] R. S. Pindyck and D. L. Rubinfeld, op. cit., p. 319.

altered from run to run. Each run generates time paths for all endogenous variables in the model. For each such run, the time paths generated may be compared with corresponding time paths of the original initial simulation period, and observed differences may be related to the change in the initial period of simulation that was used.

In the present study, the sensitivity tests are performed by simulating the estimated model for two different initial periods; namely 1960-1975 and 1964-1975. These alternative initial periods are arbitrarily selected as examples of sensitivity tests. The revised MACRSIM is used to conduct two simulation runs over the periods 1960-1975 and 1964-1975. The results of these runs - period B and period C - and the original initial period of simulation run - period A -, and the comparison results are given in Table XII. The MAPE and RMSPE are chosen for comparison since these errors criteria are more relevant. It is clear from the table that the model in period B and period C as well as in period A tracks the historical time path of the variables fairly good. However, the comparison of period B and period C results with those in the original initial simulation period - period A - indicates that monetary sector variables as evaluated by MAPE and RMSPE are rather sensitive to changes in the initial simulation period; especially for excess liquid assets and demand deposits. This finding seems to further substantiate the a priori contention that the ex post simulation yielded large errors for these variables. On the other hand, the real sector variables as evaluated by MAPE and RMSPE seem to be rather insensitive to changes in the initial simulation period.

TABLE XII

SENSITIVITY RESULTS

	Period A 1956-1975		Period B 1960-1975		Period C 1964-1975		Differences Period A-Period B		Differences Period A-Period C	
	MAPE	RMSPE	MAPE	RMSPE	MAPE	RMSPE	MAPE	RMSPE	MAPE	RMSPE
DD	18.47	6.51	10.92	3.30	9.37	3.39	7.55	3.21	9.10	3.12
CC	9.94	3.05	7.66	2.57	7.91	3.08	2.28	0.48	2.03	-0.03
TD	13.87	4.60	9.19	3.51	9.48	3.45	4.68	1.09	4.39	1.15
CL	8.78	2.48	7.27	2.21	7.19	2.60	1.51	0.27	1.59	-0.12
RS	8.25	2.01	7.41	1.97	9.47	2.98	0.84	0.04	-1.22	-0.97
VC	12.11	4.02	9.44	3.16	9.29	3.46	2.67	0.86	2.82	0.56
EL	31.10	8.87	34.27	11.51	36.67	13.24	-3.17	-2.64	-5.57	-4.37
RL	9.11	2.84	6.51	1.93	4.48	1.51	2.60	0.91	4.63	1.33
LA	15.67	4.21	13.58	4.28	14.53	5.05	2.09	-0.07	1.14	-0.84
D	9.11	2.84	6.53	1.93	4.49	1.51	2.58	0.91	4.62	1.33
M_1	10.98	3.07	8.40	2.62	7.95	2.95	2.58	0.45	3.03	0.12
M_2	9.71	2.62	7.62	2.28	6.02	2.06	2.09	0.34	3.69	0.56
C	4.66	1.32	3.55	1.05	3.39	1.12	1.11	0.27	1.27	0.20
I	13.38	3.60	14.94	4.37	14.67	4.94	-1.56	-0.77	-1.29	-1.04
IM	5.85	1.47	5.83	1.68	5.85	1.92	0.02	-0.21	0.00	-0.45
T	6.97	1.95	6.53	2.08	5.09	2.00	0.44	-0.13	1.88	-0.05
YD	4.51	1.29	3.37	1.00	2.83	0.95	1.14	0.29	1.68	0.34
Y	4.40	1.28	3.23	0.99	2.68	0.89	1.17	0.29	1.72	0.39

Dynamic Multipliers and Policy Simulation

The next step is to determine the nature of the effects produced in the model when policies are changed. If the structural relationships are well-defined, a change in any of the policy instruments generates predictable reaction in the system. For this purpose, the model is further tested by using the dynamic multiplier analysis. This test involves shocking the entire system with a change in one or more of the policy instruments.

In econometric literature, there are three types of dynamic multipliers in terms of time dimension: impact (short run) multipliers, interim multipliers and total (long run) multipliers. The impact multipliers measure the immediate (first period) impact of each exogenous variable on each endogenous variable. The interim multipliers indicate the effects on each endogenous variable over a given time period. The sum of all interim multipliers over time is the total multipliers.[12] These dynamic multipliers provide an additional check on the stability of the system. The system is considered stable if the interim multipliers become smaller and smaller in absolute value and converge to zero over time or, the total multipliers are finite.[13]

In the present study, four policy variables are considered. These variables represent lending rate (RV); government expenditures (G); tax

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[12]For a detailed discussion of dynamic multipliers, see Arthur S. Goldberger, Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model (Amsterdam: North-Holland Publishing Co., 1959), pp. 83-99.

[13]J. R. Moroney and J. M. Mason, "The Dynamic Impacts of Autonomous Expenditures and the Monetary Base on Aggregate Income," Journal of Money Credit and Banking (November, 1971), pp. 807-808.

rate (t_1); and the foreign aid (FR). RV is the only monetary policy variable which can be manipulated by the monetary authority, and G, t_1 and FR are the non-monetary variables.[14] Each of these instruments is examined separately in order to evaluate the relative importance of monetary and non-monetary effects on the endogenous variables. Table XIII summarizes the impact and total multipliers for these policy variables.

Interest Rate on Bank Credit (RV)

The effects of an increase of the ceiling loan rate on the entire system follow quite readily from the structural parameters of the model. Since the loan rate enters the interest rate on saving deposits equation with a positive sign, an increase of one percentage point in the ceiling loan rate brings an increase of 0.65 and 2.87 percent in interest rate on saving deposits in the short run and long run, respectively. As the interest rate on saving deposits increases, the time deposits increase by 2.38 million Dinar in the short run and 11.82 million Dinar in the long run. Consequently, the demand for currency in circulation and demand deposits decreases, because the public switches from currency and demand deposits to interest bearing assets. The net result is, thus, a reduction in M_1 in both short run and long run, and an expansion in M_2 in both short run and long run as shown in Table XIII. Furthermore, an increase in the ceiling loan rate has a positive

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[14]The required liquid assets ratio multipliers are not considered, because the variation of this ratio has a very limited effect on the model. Rising the required liquid assets ratio in the present system affects only the distribution of total liquid assets of the commercial banks.

TABLE XIII

IMPACT AND TOTAL MULTIPLIERS*

	Δ RV = 1%		Δ G = 1 Unit		Δ t_1 = 1%		Δ FR = 1 Unit	
	Impact	Total	Impact	Total	Impact	Total	Impact	Total
DD	-0.735	-1.239	0.267	0.450	-0.107	-0.278	-0.181	-0.308
CC	-1.401	-2.361	0.509	0.858	-0.204	-0.530	-0.345	-0.586
TD	2.376	11.824	0.184	0.309	-0.074	-0.191	-0.124	-0.211
CL	-8.322	-8.862	0.286	0.482	-0.115	-0.298	0.103	-0.032
RS	0.652	2.866	0.000	0.000	0.000	0.000	0.000	0.000
VC	0.017	0.190	0.005	0.014	-0.002	-0.008	-0.003	-0.010
EL	0.210	1.356	0.057	0.097	-0.023	-0.060	-0.039	-0.067
RL	0.411	2.647	0.113	0.190	-0.045	-0.117	-0.076	-0.129
LA	0.621	4.002	0.170	0.287	-0.068	-0.177	-0.115	-0.196
D	1.642	10.585	0.450	0.759	-0.181	-0.469	-0.305	-0.519
M_1	-2.135	-3.599	0.776	1.309	-0.311	-0.808	-0.526	-0.894
M_2	0.242	8.224	0.960	1.618	-0.385	-0.998	-0.651	-1.106
C	-1.567	-4.528	0.570	1.646	-0.629	-1.633	-0.384	-1.128
I	-8.124	-8.651	0.279	0.471	-0.112	-0.290	0.101	-0.031
IM	-5.788	-6.598	0.430	0.725	-0.172	-0.447	0.680	0.478
T	-0.418	-0.705	0.152	0.256	0.830	0.642	-0.104	-0.176
YD	-3.485	-5.875	1.267	2.136	-1.399	-2.119	-0.860	-1.462
Y	-3.903	-6.581	1.419	2.392	-0.569	-1.476	-0.963	-1.638

*1 Unit = one million Dinar. 1% = one percentage point.

effect on the vault cash and liquid assets of the commercial banks in both short run and long run. The unexpected positive impacts on these assets were caused by the positive relationship between loan rate and time deposits, where the latter is the main determinant of the demand for vault cash and excess liquid assets in the present model.

On the other hand, the cost of borrowing from the commercial banks is among the determinants of the demand for bank credit by the private sector, which being affected, the effect is transmitted to the real sector through the gross investment and imports functions. A rise in the ceiling loan rate generates a reduction in bank credit for the private sector, which in turn results in a sizeable fall in the level of income through a reduction in the demand for gross investment and imports.

In short, a rise of one percentage point in the ceiling loan rate leads to some positive and some negative net interim effects. The signs of these net interim effects are consistent with the corresponding impact and total multipliers. In general, since most loan rate multipliers are negative, an increase in the ceiling loan rate has a contractive effect on the economy.

Government Expenditures (G)

Government expenditures enter the model as positive value in the gross national product identity. Therefore, the main chore of the adjustment in the entire system is carried by the gross national product. A one million Dinar increase in government expenditures in the first period brings an increase of 1.42 and 2.39 million Dinar in gross national product in the same period and in the long run, respectively.

Consequently, an increase of 0.57 and 0.28 million Dinar in the same year and an increase of 1.65 and 0.47 million Dinar in the long run are generated in the private consumption and gross investment, respectively. Also, a change in government expenditures by one million Dinar leads to a change in imports by 0.43 million Dinar in the short run and by 0.72 million Dinar in the long run in the same direction. Consequently, the bank credit is affected in the same direction. Furthermore, the impacts of an increase in the government expenditures increase the supply of money, presumably because this increase in the government expenditures is largely financed by borrowing from the Central Bank of Jordan. Consequently, the budget deficit will increase. A change in government expenditures exerts relatively minor positive effects on vault cash and excess liquid assets in the short run as well as in the long run.

It becomes quite clear from the foregoing discussion that the impact and total multipliers which measure the simulated response of the system to the change in the government expenditures have the anticipated signs. All the government expenditure multipliers are positive, but all the impact multipliers are smaller than the corresponding long run multipliers. Accordingly, the government expenditure has positive net interim effects on the economy. In other words, the increase in government expenditures has an expansionary impact on the economy.

Tax Rate (t_1)

The response of the system to a sustained increase of the tax rate can be traced out through the structural equations of the model. Since the tax rate is the coefficient of gross national income in the tax

revenue equation, an increase in this coefficient by one percentage point brings 0.83 and 0.64 million Dinar increase in tax revenue in the short run and the long run, respectively. A rise in tax revenue generates a reduction in both disposable income and gross national income leading to decrease of different proportions in both monetary and real variables of the model as shown in Table XIII. However, since all the tax rate multipliers are negative except for tax revenue, an increase in tax rate has a contractive impact on the economy.

Foreign Aid (FR)

Foreign aid is determined primarily by the donating countries. It can be treated as a policy variable under the assumption of continuity of good political relations between Jordan and the donors. Foreign aid is mainly used to cover the large deficit in the trade balance. That is, the deficit is equal to the total value of imports minus the total value of exports plus the net transfer. Without foreign aid, the deficits in the trade balance would probably not have reached such extreme levels. However, foreign aid enters the model with a positive sign in the import function. Therefore, the adjustment process in the entire system is mainly carried by the imports. A one million Dinar increase in foreign aid in the first year brings an increase of 0.68 and 0.48 million Dinar in imports in the same year and in the long run, respectively. A rise in imports produces an increase of 0.10 million Dinar in the short run and a decrease of 0.03 million Dinar in the long run in bank credit to the private sector. Consequently, the same effects are brought to the gross investment.

On the other hand, a rise in imports, which is brought by an increase in foreign aid, causes a loss of foreign assets, a contraction of banks' deposits, and thus an automatic decrease in the money stock. This is to say that when the government finances its imports by using foreign aid it has in the banking system, the money supply will contract. The loss of banks' reserves will force the banks to contract their deposit creation, thus causing the money supply to decrease automatically.[15] Accordingly, the present study shows that a rise in imports brings a decrease of 0.12 and 0.20 million Dinar in the total liquid assets of commercial banks in the short run and the long run, respectively. Consequently, a decrease of 0.18 and 0.12 million Dinar in the short run and a decrease of 0.31 and 0.21 million Dinar in the long run are generated in the demand deposits and time deposits, respectively. The net result is, thus, a reduction in M_1 and M_2 in both short run and long run as shown in Table XIII. Similarly, both impact and total multipliers indicate that a rise in imports causes a reduction in the gross national product leading to decrease of different proportions in the real sector variables. Accordingly, it can be concluded that increase in foreign aid has a contractive effect on the present system. This is not unexpected for Jordan since the most part of foreign aid goes to defense and public administration sector and imported consumption goods.

In conclusion, the increase in ceiling loan rate, tax rate and foreign aid produce contractive effects on the economy, while the increase in government expenditures produces stimulating effects on the

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[15] See, for example, J. Fleming and L. Boissonneault, "Money Supply and Imports," IMF Staff Papers, VIII (May, 1961), pp. 235-240.

economy. Interest rate on saving deposits is insensitive to these policy variables changes except for the ceiling loan rate change. Furthermore, the quantitative evidence provided in Table XIII indicates that the impact of a percentage point change in the monetary policy variable is more effective than the impact of a percentage point (or a unit) change in a non-monetary policy variable in the short run and the long run with regard to all the endogenous variables.

The preceding estimates of four policy variables offer some preliminary guidance towards formulation of economic policy in Jordan. Any combination of policy measures for a given set of economic objectives can be obtained by simulation procedures. In the present study, only the combination of two policy variables are arbitrarily chosen as examples of policy simulation. The policy configurations however, are as follows:

1. An increase in government expenditures by one million Dinar and an increase in tax rate by one percentage point.
2. An increase in government expenditures by one million Dinar and a decrease in tax rate by one percentage point.
3. An increase in government expenditures by one million Dinar and an increase in ceiling loan rate by one percentage point.
4. An increase in government expenditures by one million Dinar and a decrease in ceiling loan rate by one percentage point.

Table XIV summarizes the short run and the long run impacts of these policy combination changes on the major endogenous variables. It is clear from these results that policy combination (4) (expansionary monetary and non-monetary policy variables) is the most effective policy in stimulating the economy. It produces an expansionary impact of 5.30 million Dinar and an expansionary total effect of 8.96 million

TABLE XIV

SUMMARY OF THE POLICY SIMULATIONS*

	ΔG = 1 Unit, Δt_1 = 1%		ΔG = 1 Unit, Δt_1 = - 1%		ΔG = 1 Unit, ΔRV = 1%		ΔG = 1 Unit, ΔRV = -1%	
	Impact	Total	Impact	Total	Impact	Total	Impact	Total
CL	0.164	0.175	0.395	0.774	-8.012	-8.299	8.589	9.301
M_1	0.462	0.509	1.079	2.109	-1.338	-2.269	2.898	4.879
M_2	0.569	0.621	1.380	2.610	1.210	9.803	0.711	-6.595
C	-0.057	0.012	1.190	3.278	-0.984	-2.862	2.117	6.117
I	0.165	0.179	0.394	0.757	-7.805	-8.118	8.384	9.112
IM	0.251	0.271	0.598	1.159	-5.308	-5.843	6.201	7.304
Y	0.845	0.901	1.969	3.832	-2.462	-4.167	5.304	8.955

*1 Unit = one million Dinar. 1% = one percentage point.

Dinar in gross national product. On the other hand, policy combination (3) (contractionary monetary policy and expansionary non-monetary policy) is the most effective policy in contracting the economy. It produces a contractive impact of 2.46 million Dinar and a contractive total effect of 4.17 million Dinar in gross national product.

These findings suggest that any non-monetary policy must be accompanied by a monetary policy in order to exert a significant influence on the behavior of the economic units throughout the whole system. This is to say that the infeasibility of other monetary policy instruments does not deprive the model of its usefulness for policy purposes; it has shown clearly the effectiveness of only one monetary policy instrument on aggregate demand and the level of income.

Monetary Transmission Process

All the monetary models have as their goal understanding the link between the monetary sector and the real sector. In the monetary sector, the policy and intermediate monetary variables and the effects of the real variables determine the final monetary variables. In the real sector, the behavior of the economy is determined by the given final monetary variables and the exogenuous variables of the real sector. In this analytical scheme, the monetary models emphasize the workings of the monetary sector in order to see how the individual instrumental monetary variables forward their effects into the final monetary variables which influence the real sector, and how the real sector reacts back upon the monetary sector. In other words, the monetary models wish to identify the actual transmission mechanism of monetary

policy building it into the structural equations of the monetary sector and subjecting it to econometric estimation.[16]

In the present model, the wealth effect channel has been tried as a link in the actual transmission mechanism of monetary policy in Jordan, but it was found that the money supply does not exert a measurable influence on aggregate demand through the consumption expenditures. Instead, the availability of credit channel has been found to be the most direct and powerful source of transmission of monetary changes to the real sector in Jordan. This channel influences aggregate demand through the investment and import functions. As mentioned before, the ceiling loan rate (RV) is the only monetary policy variable which is manipulated by the monetary authority. This policy variable transmits its effect into the final monetary variable (CL), which in turn influences the aggregate demand through the demand for gross investment (I) and imports (IM), and the real sector reacts back upon the monetary sector through CL, as shown in Figure 1.

Table XV describes the actual effects on the major endogenous variables of a sustained one percentage point decrease in the monetary policy variable (RV) beginning in the first year of simulation. This simulation takes into account the effects from the policy controlled

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[16]Aggregate macroeconomic models are concerned with the "direct effect" of monetary policy. They aim to estimate directly the effects of the final monetary variables on national income without using the structural equations of the monetary sector, i.e., they are uncomplicated by feedback from the real sector to the monetary sector. Frank deLeeuw and Edward Gramlich, "The Channels of Monetary Policy," Federal Reserve Bulletin, LV (June, 1969), pp. 485-488; Gary Fromm and Paul Taubman, Policy Simulations with an Econometric Model (Washington, D.C.: The Brookings Institution, 1968), pp. 84-97.

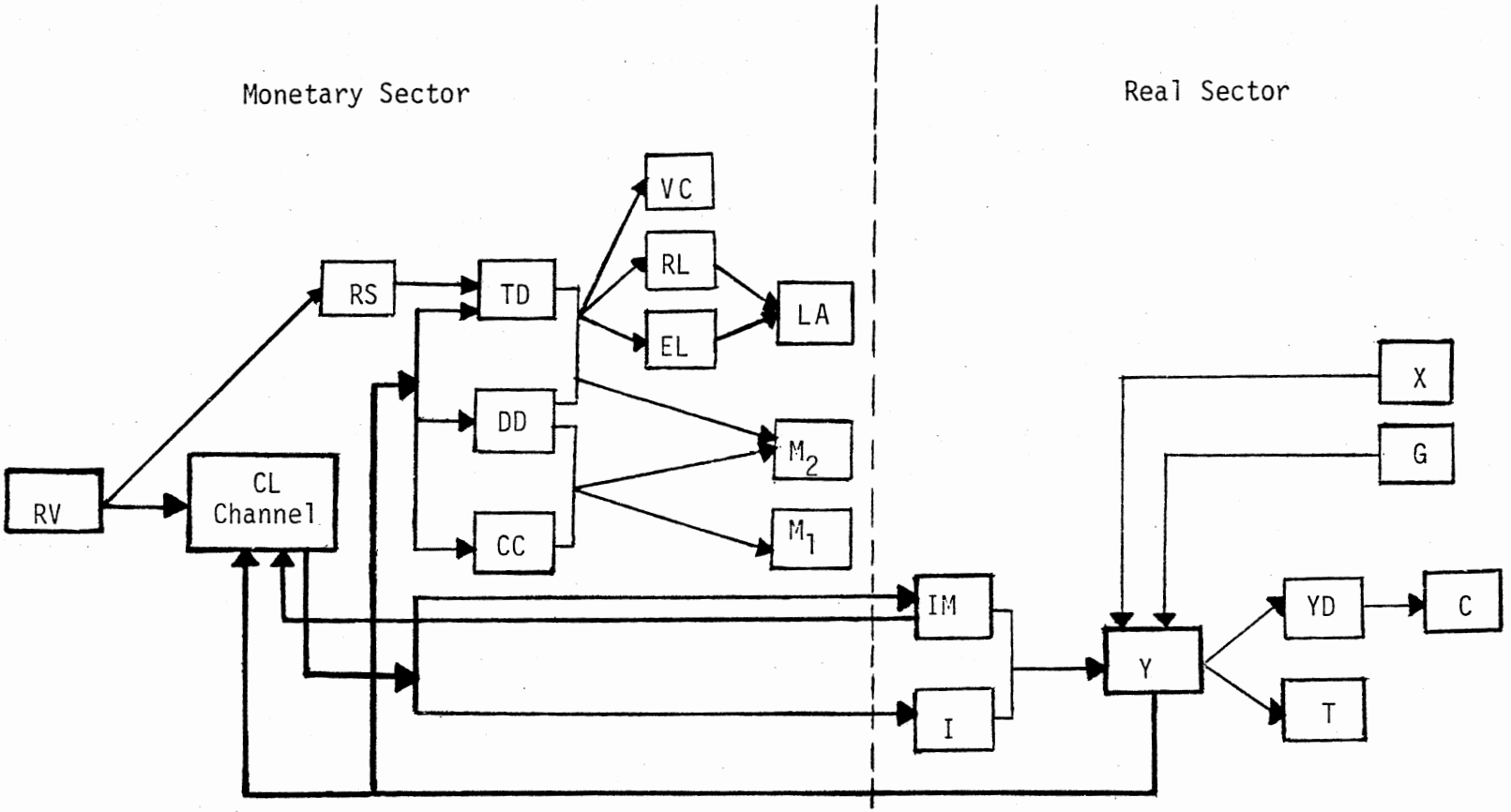

Figure 1. Flow Chart of the Monetary Transmission Process

TABLE XV

EFFECTS OF A ONE PERCENTAGE POINT DECREASE IN RV

Period	C	I	IM	Y	CL	M_1
0	1.567	8.124	5.788	3.903	8.322	2.135
1	1.025	0.182	0.281	0.926	0.187	0.507
2	0.670	0.119	0.184	0.605	0.122	0.331
3	0.438	0.078	0.120	0.396	0.080	0.217
4	0.287	0.051	0.079	0.259	0.052	0.142
5	0.189	0.033	0.052	0.170	0.034	0.093
6	0.125	0.022	0.034	0.113	0.023	0.061
7	0.084	0.017	0.023	0.078	0.015	0.042
8	0.053	0.009	0.015	0.047	0.010	0.026
9	0.034	0.006	0.009	0.031	0.007	0.018
10	0.022	0.005	0.007	0.020	0.005	0.013
11	0.015	0.003	0.004	0.014	0.003	0.007
12	0.010	0.002	0.003	0.009	0.002	0.005
13	0.006		0.001	0.005		0.002
14	0.003			0.003		
15						
16						
17						
18						
19						
Total Effect	4.528	8.651	6.598	6.581	8.862	3.599

variable through the final monetary variable (CL) to the real sector and the feedback effects from the real sector to the monetary sector. It is clear from the results that the immediate response to one percentage point decrease in RV is a 3.90 million Dinar increase in the gross national product (Y) in the same year, and it is followed by an increase of 0.93 million Dinar in the next year. In the third year, the effect drops to 0.61 million Dinar in Y. This response, however, shrinks in size until the fourteenth year.

The table shows that while investment and imports are responsible for much of the early effect on the gross national product, their importance gradually declines over time. This pattern can be attributed largely to the bank credit (CL) channel. In periods immediately following the policy variable change, the impact responses for CL drop sharply from 8.32 million Dinar in the first year to 0.19 million Dinar in the second year and to 0.12 million Dinar in the third year. The total positive effect for CL amounts to 8.86 million Dinar, which does not substantially deviate from its impact effect. These results could be due to the feedback effect, in which the rise in money income stimulates the interest rates and tends to reverse their initial movements. Specifically, the initial fall in RV will stimulate the aggregate spending and the demand for credit. The rise in the demand for credit will tend to reverse the initial fall in interest rate. If aggregate spending is continually stimulated, demand pressures will force up the price level and the interest yields.[17] Accordingly, the system

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[17] See, for example, Roger Spencer, "Channels of Monetary Influence: A Survey," Federal Reserve Bank of St. Louis, 56 (November, 1974), pp. 15-17.

response to the change in RV gradually dampens (or dies out) over time because of the feedback effects through the monetary mechanism - the rises in interest rates stimulated by the rise in money income.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

The purpose of this study, as stated in Chapter I, was to construct an econometric monetary model of the Jordanian economy. The model was designed to take into account the role of commercial banks' loans to the private sector as a link in the actual transmission mechanism of monetary policy in Jordan. The conceptual validity of the model was ensured by relating it to the various economic theories developed in advanced economies. Following the construction and estimation of the model, the dynamic stability and predictive ability of the model within and beyond the estimated period have been tested. In addition, the policy implications of the model have been analyzed.

The model specified for Jordan consisted of 11 behavioral equations and 7 identities, with the monetary sector containing seven behavioral equations and five identities and the real sector four behavioral equations and two identities. It was estimated for the period 1956-1975 on an annual basis. OLS and TSLS were used in estimating the parameters of the structural equations of the model. In the monetary sector, separate behavioral equations have been presented for the demand for currency, demand deposits and time deposits. The disaggregation of the demand for monetary assets provided interesting insights into the nature

of forces that determine their demand. It has been found that the proxy variable for the degree of monetization has proved to be an important variable in the demand functions for demand deposits and currency. This variable yielded a consistent sign which is theoretically expected. This is to say that as the economy became more monetized the public's preference tended to shift away from holding currency to demand deposits. Furthermore, the demand for currency and demand deposits was best explained by income. The income elasticity of demand for currency and demand deposits appeared to be higher than unity, leading to the conclusion that money is, to some extent, a luxury good in Jordan.

On the other hand, the demand for time deposits has been found to be strongly related to the level of income and weakly related to the degree of monetization. The weak relation between the degree of monetization and the time deposits is supported by the fact that time deposits are one of the convenient forms of liquid assets for the urban people rather than a medium of exchange in Jordan. It has also been found that the interest rate on saving deposits is significant enough to justify its introduction into the equation of time deposits.

Besides specifying the demand functions for monetary assets, the monetary sector contains behavioral equations for the interest rate on saving deposits, the commercial bank behavior and the demand for bank credit. The interest rate on saving deposits is found to be dependent on the lagged value of itself and the quoted lending rate since it was not sensitive to many variables in the model. The demand for bank credit is found to be directly related to the movements of gross national income and imports and inversely related to the quoted lending

rate. The volume of cash that the commercial banks are willing to hold in their vaults is determined by their total deposits and vault cash lagged one period. The demand for excess liquid assets of the commercial banks is governed by their total deposits.

In addition to the monetary sector model, a simple model of income formation has been developed. Effective demand is determined by a consumption function, an investment function, imports function and government expenditures and exports. The construction of the real sector equations is, however, intended to identify the channels through which monetary policy operates on the real sector of a developing economy. The results of the real sector confirm the hypothesis that the monetary sector variables exert considerable influences on the aggregate demand through the financing of imports and investment. Specifically, bank credit appears to play an important role in determining the demand for imports and investment, thereby establishing the link from the monetary sector to the real sector. Also, the "feedback" effects from the real sector to the monetary sector were transmitted through the demand function for bank credit. The volume of bank credit was best explained by income, imports and lending rate.

The regression results obtained for the whole model have been quite satisfactory. The TSLS estimates do not suggest any change in the specifications of the equations since the explanatory power, the level of significance, the coefficients of parameters and the DW statistic remain almost unchanged as compared with the OLS estimates. All the estimation results indicate that $\bar{R}^2$ ranges between 0.93 and 0.99 except for the equations of interest rate on saving deposits, excess liquid assets and vault cash for which those are 0.87, 0.75 and 0.79

respectively. All the explanatory variables carry the expected signs, and all the coefficients are significant at five percent level, except for the interest rate on loans in the demand for bank credit equation and the dummy variable in the investment function, which are significant at 12 and 10 percent levels, respectively.

The model was tested for stability. The results of dynamic simulation indicate that the model is stable, as evidenced by the fact that the simulated values of the endogenous variables approach the equilibrium values over time. It would also appear from calculating the dynamic multipliers that even a change in any policy variable would not distort the equilibrium growth trend of the economy. That is, since the total multipliers are finite the model is considered stable.

Furthermore, policy simulations have shown that changes in policy variables exert significant influences on the behavior of the economic units throughout the whole system. Exogenous increases in ceiling loan rate, tax rate and foreign aid produce contractive effects on the economy, while the exogenous increase in government expenditures produces stimulating effects on the economy. Interest rate on saving deposits is found to be insensitive to those policy variables except for the ceiling loan rate change.

The model performance was further evaluated in terms of ex post simulation, ex post forecast and sensitivity analysis. With regard to ex post simulation and ex post forecast, the predictive error measurements indicate that the model tracks the historical time path of the variables within and beyond the sample period fairly well. The poor predictive performance is, however, confined to only two equations of the entire model, namely, excess liquid assets and demand deposits.

With regard to sensitivity test, the overall model performance appears to be rather stable, although some variables are sensitive to change in the initial simulation period.

Conclusions

The model in general appears to be well specified considering the peculiarities of the economy and the conditions under which the monetary system works in Jordan. The model is also considered adequate to demonstrate the linkage between the monetary sector and the real sector of the economy via the commercial banks' loans. Moreover, the results obtained from the various simulation tests indicate that the model is useful for policy analysis and also for forecasting in the future. Nevertheless, since no model is perfect, modifications and adjustments are often needed in order to improve the ability of the model to forecast in the future. In other words, the model's ability to forecast can be maintained if the model is continuously adjusted and re-estimated by using more recent data and information as they become available. However, it is hoped that this study has been a starting point for further research in Jordan as well as the other Arab countries.

Limitations and Suggestions for Further Research

Any econometric model is subjected to certain limitations as well as suggestions for further studies. A major limitation in this study is that some of the behavioral relations, especially in the real sector, have been formulated in highly aggregative forms. This limitation results from the lack of continuous and consistent time series data on a large number of important areas, such as wages, employment, sectoral investment, capital stock, depreciation, etc. These areas are

among the important areas that could benefit from further research and study. In addition, inadequacy of time series data on interest rates has dictated certain simplifications in specifying some of the behavioral relations. An improvement in the quality of data would result in a better specification of the behavioral relations and better results. Furthermore, the model was estimated on an annual basis while for many practical problems it might be useful to have a model over intervals smaller than a year. Accordingly, a construction of quarterly model is recommended.

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APPENDIXES

APPENDIX A

DATA EMPLOYED IN STUDY

Sources of Data

The data for the variables listed in Table XVI are basically obtained from the following sources:

(A) Central Bank of Jordan, Monthly Statistical Bulletin, Relevant Issues, Amman, Jordan.

(B) Currency Control Department, Banking and Foreign Exchange Statistics, Relevant Issues, Amman, Jordan.

(C) Department of Statistics, National Accounts in Jordan, 1952-1976, March, 1978, Amman, Jordan.

(D) International Monetary Fund, International Financial Statistics, Relevant Issues, Washington, D.C.

The monetary sector data for the period 1955-1963 are taken from (B) and (D), and for the period 1964-1976 are taken from (A) and (D). Official time series for interest rate on saving deposits are not, however, available for the years prior to 1971. The data for the period 1955-1970 are prepared by the Economic Research Department, Central Bank of Jordan. For the period 1971-1976, the data are taken from (A). Moreover, the data for interest rate on banks' loans for the period under study represent the ceilings imposed by the government because the average rates for various types of loans are not available. These ceilings are taken from the memoranda issued in the Official Gazette. However, the available data on interest rates represent the weakest time series used in this study.

The last group of variables are the real sector ones. The data on gross national income and its components are published on an annual basis in several publications. The data for the period 1955-1967 are derived from (C) and (D). For the period 1968-1976, the data are derived from (A) and (D). The unit price indexes of exports (RX) and

imports (RM) are from the United Nations, Yearbook of International Trade Statistics.

Finally, all the variables are in money terms in millions of Dinar. Interest rates are in percent. The annual data are used in this study.

TABLE XVI

ORIGINAL DATA

Year	M_1	M_2	CC	DD	TD	D	OD	CL	FR	VC	LA
1955	17.49	20.57	11.13	6.36	3.08	14.55	5.11	6.84	15.44	1.80	10.29
1956	20.24	22.95	14.56	5.68	2.71	16.35	7.96	8.26	14.81	2.22	10.58
1957	22.20	25.70	14.71	7.49	3.50	19.44	8.45	10.04	16.89	0.92	12.09
1958	24.33	27.97	15.16	9.17	3.64	22.46	9.65	10.15	23.91	1.17	15.57
1959	24.24	28.94	15.27	8.97	4.70	24.04	10.37	12.35	25.53	0.71	14.99
1960	26.09	30.96	15.63	10.46	4.87	27.59	12.26	15.84	26.88	0.77	15.04
1961	28.92	35.60	16.97	11.95	6.68	30.91	12.28	18.06	26.28	1.00	16.08
1962	33.47	43.04	19.04	14.43	9.57	39.09	15.09	20.29	25.21	1.19	21.50
1963	36.85	48.03	20.40	16.45	11.18	34.26	6.63	24.87	24.14	1.36	14.76
1964	39.76	53.57	23.03	16.73	13.81	47.07	16.53	27.66	28.52	1.27	23.62
1965	47.12	64.11	26.35	20.77	16.99	42.13	4.37	31.24	29.46	1.14	15.66
1966	56.03	75.82	30.33	25.70	19.79	50.70	5.21	36.41	34.09	1.57	19.21
1967	75.24	94.08	51.52	23.72	18.84	51.38	8.82	35.97	53.93	1.50	21.10
1968	87.98	108.82	63.55	24.43	20.84	52.69	7.42	37.31	54.48	1.77	21.21
1969	96.22	118.84	71.29	24.93	22.62	55.06	7.51	42.37	47.34	1.86	19.74
1970	105.46	129.13	82.43	23.03	23.67	55.44	8.74	42.72	40.65	1.99	20.72
1971	108.00	135.11	83.01	24.99	27.11	58.21	6.11	43.90	36.61	1.59	25.57
1972	115.02	146.47	81.47	33.55	31.45	71.21	6.21	46.99	68.28	1.91	36.31
1973	139.25	176.06	97.48	41.77	36.81	84.72	6.14	58.14	64.60	2.07	39.71
1974	170.22	216.75	115.49	54.73	46.53	109.66	8.40	78.93	86.85	2.48	43.03
1975	218.51	277.75	139.03	79.48	59.24	150.75	12.03	114.25	140.36	2.89	62.38
1976	263.59	358.93	161.50	102.09	95.34	211.64	14.21	175.65	127.85	3.44	71.00

TABLE XVI (Continued)

Year	EL	RL	RV	RS	RM	RX	X	IM	C	G	I	Y	YD	T
1955	6.65	3.64	8.25	3.00	90	89	8.00	26.80	50.01	14.60	7.10	52.91	46.91	6.00
1956	6.49	4.09	8.25	3.00	91	90	10.21	26.23	58.01	16.82	8.10	66.91	59.87	7.04
1957	7.23	4.86	8.25	3.00	102	93	13.13	32.42	64.00	19.70	10.43	74.84	66.99	7.85
1958	9.95	5.62	8.25	3.00	99	94	11.72	36.70	70.97	23.71	14.00	83.70	75.16	8.54
1959	8.98	6.01	8.25	3.00	87	92	11.79	43.37	87.09	25.45	18.17	99.13	88.96	10.17
1960	8.14	6.90	8.25	3.00	83	87	19.76	47.05	88.45	27.02	17.51	105.69	94.68	11.01
1961	8.35	7.73	8.25	3.00	84	86	25.92	46.61	102.76	28.12	16.95	127.14	115.44	11.70
1962	11.72	9.78	8.25	3.00	82	89	29.22	51.80	102.36	29.04	22.01	130.83	117.40	13.43
1963	6.19	8.57	8.25	3.00	83	87	28.80	61.06	116.82	33.04	20.02	137.62	123.72	13.90
1964	11.85	11.77	8.25	3.75	83	88	36.24	56.65	123.47	32.27	25.29	160.62	143.69	16.93
1965	5.13	10.53	8.25	3.75	83	94	41.47	63.55	138.04	36.79	27.79	180.54	160.87	19.67
1966	6.53	12.68	8.25	3.75	85	92	45.95	76.60	149.48	39.17	27.65	185.65	161.34	24.31
1967	8.25	12.85	8.25	3.75	89	104	38.20	63.68	158.55	46.36	26.52	205.95	185.34	20.61
1968	8.04	13.17	8.25	3.75	90	112	38.64	90.98	153.36	58.61	37.65	197.28	175.75	21.53
1969	5.97	13.77	8.25	3.75	93	115	46.29	108.69	164.47	67.08	64.57	233.72	209.63	24.09
1970	6.86	13.86	8.25	3.75	100	100	45.79	89.89	165.07	61.08	40.45	222.50	199.20	23.30
1971	11.02	14.55	9.00	4.50	107	90	33.95	93.01	183.00	62.88	49.77	236.59	211.93	24.66
1972	18.51	17.80	9.00	4.50	107	101	65.68	119.88	193.52	72.55	51.16	263.03	234.12	28.91
1973	18.53	21.18	9.00	4.50	118	101	72.99	136.36	220.00	83.41	51.30	291.34	257.74	33.60
1974	15.62	27.41	9.00	4.50	145	117	117.50	184.63	256.78	100.86	83.44	373.95	334.84	39.11
1975	24.69	37.69	9.00	5.25	158	120	160.73	250.30	280.63	118.85	108.99	418.90	375.58	43.32
1976	18.09	52.91	9.00	5.25	171	134	218.40	339.54	360.70	154.52	150.12	544.20	474.30	69.90

APPENDIX B

OLS ESTIMATES OF THE STRUCTURAL EQUATIONS IN LOG-LINEAR FORM

$$\text{Log CC} = -4.4618 + 1.3301 \text{ Log Y} - 1.1599 \text{ Log Z} \qquad (1.4)$$
$$(0.0625)^* \qquad (0.1401)^*$$
$$\bar{R}^2 = 0.969,\ DW = 1.722,\ \rho = 0.213,\ SE = 0.107$$

$$\text{Log DD} = -3.5143 + 1.3293 \text{ Log Y} + 0.3151 \text{ Log Z} \qquad (2.4)$$
$$(0.0959)^* \qquad (0.1474)^*$$
$$\bar{R}^2 = 0.951,\ DW = 1.592,\ \rho = 0.165,\ SE = 0.103$$

$$\text{Log TD} = -6.1199 + 1.5249 \text{ Log Y} + 0.3095 \text{ Log RS} \qquad (3.4)$$
$$(0.1575)^* \qquad (0.4332)$$
$$\bar{R}^2 = 0.974,\ DW = 1.531,\ \rho = 0.324,\ SE = 0.119$$

$$\text{Log CL} = -1.2259 + 0.2255 \text{ Log IM} + 1.1789 \text{ Log Y} - 1.1384 \text{ Log RV} \qquad (4)$$
$$(0.1409) \qquad (0.1478)^* \qquad (0.6816)$$
$$\bar{R}^2 = 0.980,\ DW = 1.833,\ SE = 0.075$$

$$\text{Log VC} = -0.9884 + 0.5092 \text{ Log VC}_{-1} + 0.3132 \text{ Log D} \qquad (5)$$
$$(0.2263)^* \qquad (0.1107)^*$$
$$\bar{R}^2 = 0.702,\ DW = 2.050,\ h = -0.830,\ SE = 0.237$$

$$\text{Log EL} = -0.0123 + 0.5995 \text{ Log D} \qquad (6)$$
$$(0.1787)^*$$
$$\bar{R}^2 = 0.687,\ DW = 1.392,\ \rho = 0.396,\ SE = 0.295$$

$$\text{Log RS} = -2.3681 + 0.8014 \text{ Log RS}_{-1} + 1.2410 \text{ Log RV} \qquad (8)$$
$$(0.1441)^* \qquad (0.6045)^*$$
$$\bar{R}^2 = 0.860,\ DW = 1.749,\ h = 0.734,\ SE = 0.065$$

$$\text{Log C} = 0.4702 + 0.6957 \text{ Log YD} + 0.1921 \text{ Log C}_{-1} \qquad (13)$$
$$(0.1115)^* \qquad (0.1250)$$
$$\bar{R}^2 = 0.983,\ DW = 2.141,\ h = -0.380,\ SE = 0.034$$

$$\text{Log I} = 0.2515 + 0.9343 \text{ Log CL} - 0.3210 \text{ Dum} \qquad (14)$$
$$(0.0603)^* \qquad (0.1907)$$
$$\bar{R}^2 = 0.926,\ DW = 1.631,\ SE = 0.185$$

$$\text{Log IM} = 0.5715 + 0.1795 \text{ Log Y} + 0.3527 \text{ Log CL} + 0.4462 \text{ Log FR}$$
$$(0.2799) \qquad (0.1926) \qquad (0.0724)^*$$
$$- 0.4173 \text{ Dum} \qquad (15)$$
$$(0.0674)^*$$
$$\bar{R}^2 = 0.987,\ DW = 2.407,\ SE = 0.064$$

$$\text{Log T} = -2.4037 + 1.0301 \text{ Log Y} \qquad (16)$$
$$(0.0300)^*$$
$$\bar{R}^2 = 0.979,\ DW = 2.051,\ SE = 0.067$$

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*Indicates the estimated coefficients are significantly different from zero at the five percent level.

APPENDIX C

DYNAMIC STABILITY

TABLE XVII

THE STRUCTURE MATRIX FOR SIMULATION

	Endogenous Variables																		
	DD	CC	TD	CL	RS	VC	EL	RL	LA	D	M	M2	C	I	IM	T	YD	Y	Z
DD	1.0																	-0.1882	
CC		1.0																-0.3588	
TD			1.0		-4.4219													-0.1293	
CL				1.0											-0.3055			-0.1090	
RS					1.0														
VC						1.0				-0.0101									
EL							1.0			-0.1281									
RL	-0.25		-0.25					1.0											
LA							-1.0	-1.0	1.0										
D	-1.0		-1.0							1.0									
M	-1.0	-1.0									1.0								
M2	-1.0	-1.0	-1.0									1.0							
C													1.0				-0.4496		
I				-0.9762										1.0					
IM				-0.6112											1.0			-0.1797	
T																1.0		-0.1072	
YD																1.0	1.0	-1.0	
Y													-1.0	-1.0	1.0			1.0	
Z																			1.0

TABLE XVII (Continued)

Predetermined Variables										
CONS	RV	RS1	VC1	OD	C1	X	FR	G	DUM	DD/M
-23.3574										33.2471
30.3399										-139.7517
-21.5599										
41.1512	-6.1284									
- 4.5750	0.6516	0.7727								
0.3829			0.4363							
3.7230										
				0.25						
				1.0						
12.4509					0.4167					
1.6653									-10.2596	
- 4.3453							0.7825		-33.1737	
- 0.1733										
						1.0		1.0		
										1.0

X VARIABLE	DD
1.000	-0.271
2.000	1.147
3.000	2.074
4.000	2.681
5.000	3.078
6.000	3.337
7.000	3.507
8.000	3.618
9.000	3.690
10.000	3.738
11.000	3.769
12.000	3.789
13.000	3.803
14.000	3.811
15.000	3.817
16.000	3.821
17.000	3.823
18.000	3.825
19.000	3.826
20.000	3.826
21.000	3.827
22.000	3.827
23.000	3.827
24.000	3.827
25.000	3.828
26.000	3.828
27.000	3.828
28.000	3.828
29.000	3.828
30.000	3.828
31.000	3.828
32.000	3.828
33.000	3.828
34.000	3.828
35.000	3.828
36.000	3.828
37.000	3.828
38.000	3.828
39.000	3.828
40.000	3.828
41.000	3.828
42.000	3.828
43.000	3.828
44.000	3.828
45.000	3.828
46.000	3.828
47.000	3.828
48.000	3.828
49.000	3.828
50.000	3.828

X VARIABLE	CC
1.000	17.475
2.000	20.179
3.000	21.947
4.000	23.103
5.000	23.860
6.000	24.354
7.000	24.678
8.000	24.889
9.000	25.028
10.000	25.118
11.000	25.178
12.000	25.216
13.000	25.242
14.000	25.258
15.000	25.269
16.000	25.276
17.000	25.281
18.000	25.284
19.000	25.286
20.000	25.287
21.000	25.288
22.000	25.288
23.000	25.289
24.000	25.289
25.000	25.289
26.000	25.289
27.000	25.289
28.000	25.289
29.000	25.289
30.000	25.290
31.000	25.290
32.000	25.290
33.000	25.290
34.000	25.290
35.000	25.290
36.000	25.290
37.000	25.290
38.000	25.290
39.000	25.290
40.000	25.290
41.000	25.290
42.000	25.290
43.000	25.290
44.000	25.290
45.000	25.290
46.000	25.290
47.000	25.290
48.000	25.290
49.000	25.290
50.000	25.290

X VARIABLE	TD
1.000	1.693
2.000	3.070
3.000	4.019
4.000	4.676
5.000	5.135
6.000	5.457
7.000	5.684
8.000	5.846
9.000	5.962
10.000	6.046
11.000	6.107
12.000	6.152
13.000	6.185
14.000	6.209
15.000	6.227
16.000	6.240
17.000	6.250
18.000	6.258
19.000	6.264
20.000	6.268
21.000	6.271
22.000	6.274
23.000	6.276
24.000	6.277
25.000	6.278
26.000	6.279
27.000	6.280
28.000	6.280
29.000	6.281
30.000	6.281
31.000	6.281
32.000	6.282
33.000	6.282
34.000	6.282
35.000	6.282
36.000	6.282
37.000	6.282
38.000	6.282
39.000	6.282
40.000	6.282
41.000	6.282
42.000	6.282
43.000	6.282
44.000	6.282
45.000	6.282
46.000	6.282
47.000	6.282
48.000	6.282
49.000	6.282
50.000	6.282

X VARIABLE	CL
1.000	5.906
2.000	7.424
3.000	8.417
4.000	9.067
5.000	9.492
6.000	9.769
7.000	9.951
8.000	10.070
9.000	10.148
10.000	10.199
11.000	10.232
12.000	10.254
13.000	10.268
14.000	10.277
15.000	10.283
16.000	10.287
17.000	10.290
18.000	10.291
19.000	10.293
20.000	10.293
21.000	10.294
22.000	10.294
23.000	10.294
24.000	10.294
25.000	10.295
26.000	10.295
27.000	10.295
28.000	10.295
29.000	10.295
30.000	10.295
31.000	10.295
32.000	10.295
33.000	10.295
34.000	10.295
35.000	10.295
36.000	10.295
37.000	10.295
38.000	10.295
39.000	10.295
40.000	10.295
41.000	10.295
42.000	10.295
43.000	10.295
44.000	10.295
45.000	10.295
46.000	10.295
47.000	10.295
48.000	10.295
49.000	10.295
50.000	10.295

X VARIABLE	RS
1.000	3.118
2.000	3.209
3.000	3.280
4.000	3.334
5.000	3.376
6.000	3.409
7.000	3.434
8.000	3.453
9.000	3.468
10.000	3.480
11.000	3.489
12.000	3.495
13.000	3.501
14.000	3.505
15.000	3.508
16.000	3.511
17.000	3.513
18.000	3.514
19.000	3.515
20.000	3.516
21.000	3.517
22.000	3.517
23.000	3.518
24.000	3.518
25.000	3.518
26.000	3.518
27.000	3.519
28.000	3.519
29.000	3.519
30.000	3.519
31.000	3.519
32.000	3.519
33.000	3.519
34.000	3.519
35.000	3.519
36.000	3.519
37.000	3.519
38.000	3.519
39.000	3.519
40.000	3.519
41.000	3.519
42.000	3.519
43.000	3.519
44.000	3.519
45.000	3.519
46.000	3.519
47.000	3.519
48.000	3.519
49.000	3.519
50.000	3.519

X VARIABLE	VC
1.000	1.263
2.000	1.057
3.000	0.986
4.000	0.968
5.000	0.968
6.000	0.975
7.000	0.981
8.000	0.987
9.000	0.991
10.000	0.995
11.000	0.997
12.000	0.999
13.000	1.000
14.000	1.001
15.000	1.001
16.000	1.002
17.000	1.002
18.000	1.002
19.000	1.003
20.000	1.003
21.000	1.003
22.000	1.003
23.000	1.003
24.000	1.003
25.000	1.003
26.000	1.003
27.000	1.003
28.000	1.003
29.000	1.003
30.000	1.003
31.000	1.003
32.000	1.003
33.000	1.003
34.000	1.003
35.000	1.003
36.000	1.003
37.000	1.003
38.000	1.003
39.000	1.003
40.000	1.003
41.000	1.003
42.000	1.003
43.000	1.003
44.000	1.003
45.000	1.003
46.000	1.003
47.000	1.003
48.000	1.003
49.000	1.003
50.000	1.003

X VARIABLE	EL
1.000	4.925
2.000	5.283
3.000	5.523
4.000	5.685
5.000	5.795
6.000	5.869
7.000	5.920
8.000	5.955
9.000	5.979
10.000	5.996
11.000	6.008
12.000	6.016
13.000	6.022
14.000	6.026
15.000	6.029
16.000	6.031
17.000	6.033
18.000	6.034
19.000	6.035
20.000	6.036
21.000	6.036
22.000	6.037
23.000	6.037
24.000	6.037
25.000	6.037
26.000	6.037
27.000	6.037
28.000	6.038
29.000	6.038
30.000	6.038
31.000	6.038
32.000	6.038
33.000	6.038
34.000	6.038
35.000	6.038
36.000	6.038
37.000	6.038
38.000	6.038
39.000	6.038
40.000	6.038
41.000	6.038
42.000	6.038
43.000	6.038
44.000	6.038
45.000	6.038
46.000	6.038
47.000	6.038
48.000	6.038
49.000	6.038
50.000	6.038

X VARIABLE	RL
1.000	2.345
2.000	3.044
3.000	3.513
4.000	3.829
5.000	4.043
6.000	4.188
7.000	4.288
8.000	4.356
9.000	4.403
10.000	4.436
11.000	4.459
12.000	4.475
13.000	4.487
14.000	4.495
15.000	4.501
16.000	4.505
17.000	4.508
18.000	4.511
19.000	4.512
20.000	4.514
21.000	4.515
22.000	4.515
23.000	4.516
24.000	4.516
25.000	4.516
26.000	4.517
27.000	4.517
28.000	4.517
29.000	4.517
30.000	4.517
31.000	4.517
32.000	4.517
33.000	4.517
34.000	4.517
35.000	4.517
36.000	4.517
37.000	4.517
38.000	4.517
39.000	4.517
40.000	4.517
41.000	4.517
42.000	4.517
43.000	4.517
44.000	4.517
45.000	4.517
46.000	4.517
47.000	4.517
48.000	4.517
49.000	4.517
50.000	4.517

X VARIABLE	LA
1.000	7.270
2.000	8.327
3.000	9.037
4.000	9.514
5.000	9.838
6.000	10.058
7.000	10.208
8.000	10.311
9.000	10.382
10.000	10.432
11.000	10.467
12.000	10.491
13.000	10.509
14.000	10.521
15.000	10.530
16.000	10.537
17.000	10.541
18.000	10.545
19.000	10.548
20.000	10.549
21.000	10.551
22.000	10.552
23.000	10.553
24.000	10.553
25.000	10.554
26.000	10.554
27.000	10.554
28.000	10.555
29.000	10.555
30.000	10.555
31.000	10.555
32.000	10.555
33.000	10.555
34.000	10.555
35.000	10.555
36.000	10.555
37.000	10.555
38.000	10.555
39.000	10.555
40.000	10.555
41.000	10.555
42.000	10.555
43.000	10.555
44.000	10.555
45.000	10.555
46.000	10.555
47.000	10.555
48.000	10.555
49.000	10.555
50.000	10.555

X VARIABLE	D
1.000	9.382
2.000	12.177
3.000	14.053
4.000	15.317
5.000	16.172
6.000	16.754
7.000	17.151
8.000	17.424
9.000	17.613
10.000	17.744
11.000	17.836
12.000	17.901
13.000	17.947
14.000	17.980
15.000	18.004
16.000	18.021
17.000	18.033
18.000	18.043
19.000	18.049
20.000	18.055
21.000	18.058
22.000	18.061
23.000	18.063
24.000	18.065
25.000	18.066
26.000	18.067
27.000	18.068
28.000	18.068
29.000	18.069
30.000	18.069
31.000	18.069
32.000	18.069
33.000	18.069
34.000	18.070
35.000	18.070
36.000	18.070
37.000	18.070
38.000	18.070
39.000	18.070
40.000	18.070
41.000	18.070
42.000	18.070
43.000	18.070
44.000	18.070
45.000	18.070
46.000	18.070
47.000	18.070
48.000	18.070
49.000	18.070
50.000	18.070

X VARIABLE	M
1.000	17.204
2.000	21.326
3.000	24.021
4.000	25.784
5.000	26.937
6.000	27.691
7.000	28.185
8.000	28.507
9.000	28.718
10.000	28.856
11.000	28.947
12.000	29.006
13.000	29.044
14.000	29.070
15.000	29.086
16.000	29.097
17.000	29.104
18.000	29.109
19.000	29.112
20.000	29.114
21.000	29.115
22.000	29.116
23.000	29.116
24.000	29.117
25.000	29.117
26.000	29.117
27.000	29.117
28.000	29.117
29.000	29.117
30.000	29.117
31.000	29.117
32.000	29.117
33.000	29.117
34.000	29.117
35.000	29.117
36.000	29.117
37.000	29.117
38.000	29.117
39.000	29.117
40.000	29.117
41.000	29.117
42.000	29.117
43.000	29.117
44.000	29.117
45.000	29.117
46.000	29.117
47.000	29.117
48.000	29.117
49.000	29.117
50.000	29.117

X VARIABLE	M2
1.000	18.897
2.000	24.396
3.000	28.040
4.000	30.460
5.000	32.072
6.000	33.148
7.000	33.869
8.000	34.354
9.000	34.681
10.000	34.901
11.000	35.054
12.000	35.157
13.000	35.229
14.000	35.278
15.000	35.313
16.000	35.337
17.000	35.354
18.000	35.366
19.000	35.375
20.000	35.382
21.000	35.386
22.000	35.390
23.000	35.392
24.000	35.394
25.000	35.395
26.000	35.396
27.000	35.397
28.000	35.398
29.000	35.398
30.000	35.398
31.000	35.399
32.000	35.399
33.000	35.399
34.000	35.399
35.000	35.399
36.000	35.399
37.000	35.399
38.000	35.399
39.000	35.399
40.000	35.399
41.000	35.399
42.000	35.399
43.000	35.399
44.000	35.399
45.000	35.399
46.000	35.399
47.000	35.399
48.000	35.399
49.000	35.399
50.000	35.399

X VARIABLE	C
1.000	62.753
2.000	71.087
3.000	76.538
4.000	80.103
5.000	82.435
6.000	83.960
7.000	84.957
8.000	85.610
9.000	86.036
10.000	86.315
11.000	86.498
12.000	86.617
13.000	86.695
14.000	86.746
15.000	86.780
16.000	86.802
17.000	86.816
18.000	86.825
19.000	86.831
20.000	86.835
21.000	86.838
22.000	86.840
23.000	86.841
24.000	86.841
25.000	86.842
26.000	86.842
27.000	86.842
28.000	86.843
29.000	86.843
30.000	86.843
31.000	86.843
32.000	86.843
33.000	86.843
34.000	86.843
35.000	86.843
36.000	86.843
37.000	86.843
38.000	86.843
39.000	86.843
40.000	86.843
41.000	86.843
42.000	86.843
43.000	86.843
44.000	86.843
45.000	86.843
46.000	86.843
47.000	86.843
48.000	86.843
49.000	86.843
50.000	86.843

X VARIABLE	I
1.000	7.430
2.000	8.913
3.000	9.882
4.000	10.516
5.000	10.931
6.000	11.202
7.000	11.380
8.000	11.496
9.000	11.572
10.000	11.621
11.000	11.654
12.000	11.675
13.000	11.689
14.000	11.698
15.000	11.704
16.000	11.708
17.000	11.710
18.000	11.712
19.000	11.713
20.000	11.714
21.000	11.714
22.000	11.714
23.000	11.715
24.000	11.715
25.000	11.715
26.000	11.715
27.000	11.715
28.000	11.715
29.000	11.715
30.000	11.715
31.000	11.715
32.000	11.715
33.000	11.715
34.000	11.715
35.000	11.715
36.000	11.715
37.000	11.715
38.000	11.715
39.000	11.715
40.000	11.715
41.000	11.715
42.000	11.715
43.000	11.715
44.000	11.715
45.000	11.715
46.000	11.715
47.000	11.715
48.000	11.715
49.000	11.715
50.000	11.715

X VARIABLE	IM
1.000	24.008
2.000	26.290
3.000	27.783
4.000	28.759
5.000	29.397
6.000	29.815
7.000	30.088
8.000	30.266
9.000	30.383
10.000	30.460
11.000	30.510
12.000	30.542
13.000	30.564
14.000	30.578
15.000	30.587
16.000	30.593
17.000	30.597
18.000	30.599
19.000	30.601
20.000	30.602
21.000	30.603
22.000	30.603
23.000	30.604
24.000	30.604
25.000	30.604
26.000	30.604
27.000	30.604
28.000	30.604
29.000	30.604
30.000	30.604
31.000	30.604
32.000	30.604
33.000	30.604
34.000	30.604
35.000	30.604
36.000	30.604
37.000	30.604
38.000	30.604
39.000	30.604
40.000	30.604
41.000	30.604
42.000	30.604
43.000	30.604
44.000	30.604
45.000	30.604
46.000	30.604
47.000	30.604
48.000	30.604
49.000	30.604
50.000	30.604

X VARIABLE	T
1.000	7.674
2.000	8.482
3.000	9.010
4.000	9.356
5.000	9.582
6.000	9.739
7.000	9.826
8.000	9.889
9.000	9.931
10.000	9.958
11.000	9.976
12.000	9.987
13.000	9.995
14.000	10.000
15.000	10.003
16.000	10.005
17.000	10.006
18.000	10.007
19.000	10.008
20.000	10.008
21.000	10.008
22.000	10.009
23.000	10.009
24.000	10.009
25.000	10.009
26.000	10.009
27.000	10.009
28.000	10.009
29.000	10.009
30.000	10.009
31.000	10.009
32.000	10.009
33.000	10.009
34.000	10.009
35.000	10.009
36.000	10.009
37.000	10.009
38.000	10.009
39.000	10.009
40.000	10.009
41.000	10.009
42.000	10.009
43.000	10.009
44.000	10.009
45.000	10.009
46.000	10.009
47.000	10.009
48.000	10.009
49.000	10.009
50.000	10.009

X VARIABLE	YD
1.000	65.531
2.000	72.258
3.000	76.657
4.000	79.535
5.000	81.417
6.000	82.648
7.000	83.453
8.000	83.979
9.000	84.324
10.000	84.549
11.000	84.696
12.000	84.793
13.000	84.856
14.000	84.897
15.000	84.924
16.000	84.941
17.000	84.953
18.000	84.960
19.000	84.965
20.000	84.969
21.000	84.971
22.000	84.972
23.000	84.973
24.000	84.974
25.000	84.974
26.000	84.974
27.000	84.974
28.000	84.975
29.000	84.975
30.000	84.975
31.000	84.975
32.000	84.975
33.000	84.975
34.000	84.975
35.000	84.975
36.000	84.975
37.000	84.975
38.000	84.975
39.000	84.975
40.000	84.975
41.000	84.975
42.000	84.975
43.000	84.975
44.000	84.975
45.000	84.975
46.000	84.975
47.000	84.975
48.000	84.975
49.000	84.975
50.000	84.975

X VARIABLE	Y
1.000	73.235
2.000	80.740
3.000	85.667
4.000	88.890
5.000	90.998
6.000	92.377
7.000	93.279
8.000	93.869
9.000	94.254
10.000	94.507
11.000	94.672
12.000	94.780
13.000	94.850
14.000	94.896
15.000	94.927
16.000	94.946
17.000	94.959
18.000	94.968
19.000	94.973
20.000	94.977
21.000	94.979
22.000	94.981
23.000	94.982
24.000	94.982
25.000	94.983
26.000	94.983
27.000	94.983
28.000	94.983
29.000	94.983
30.000	94.984
31.000	94.984
32.000	94.984
33.000	94.984
34.000	94.984
35.000	94.984
36.000	94.984
37.000	94.984
38.000	94.984
39.000	94.984
40.000	94.984
41.000	94.984
42.000	94.984
43.000	94.984
44.000	94.984
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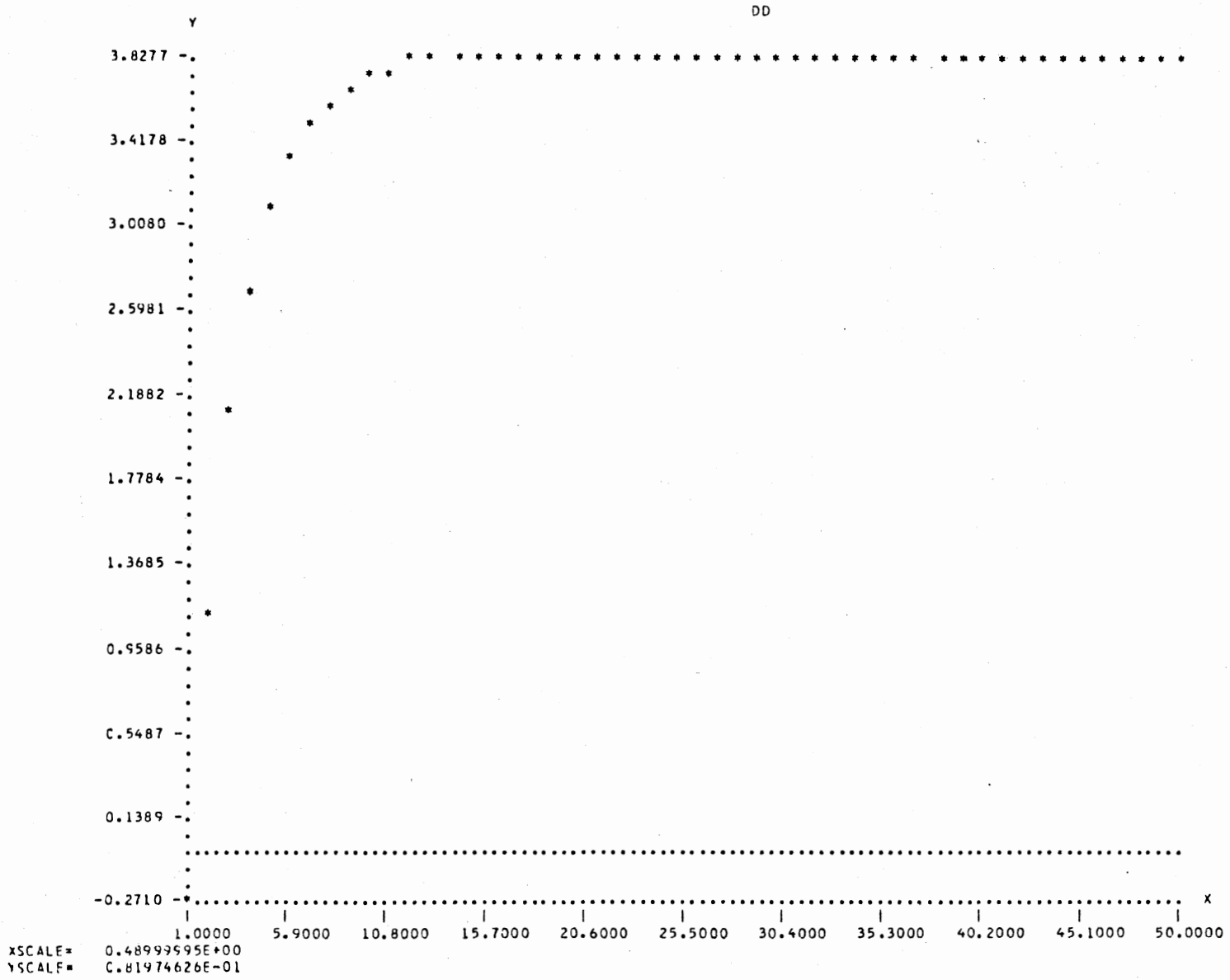
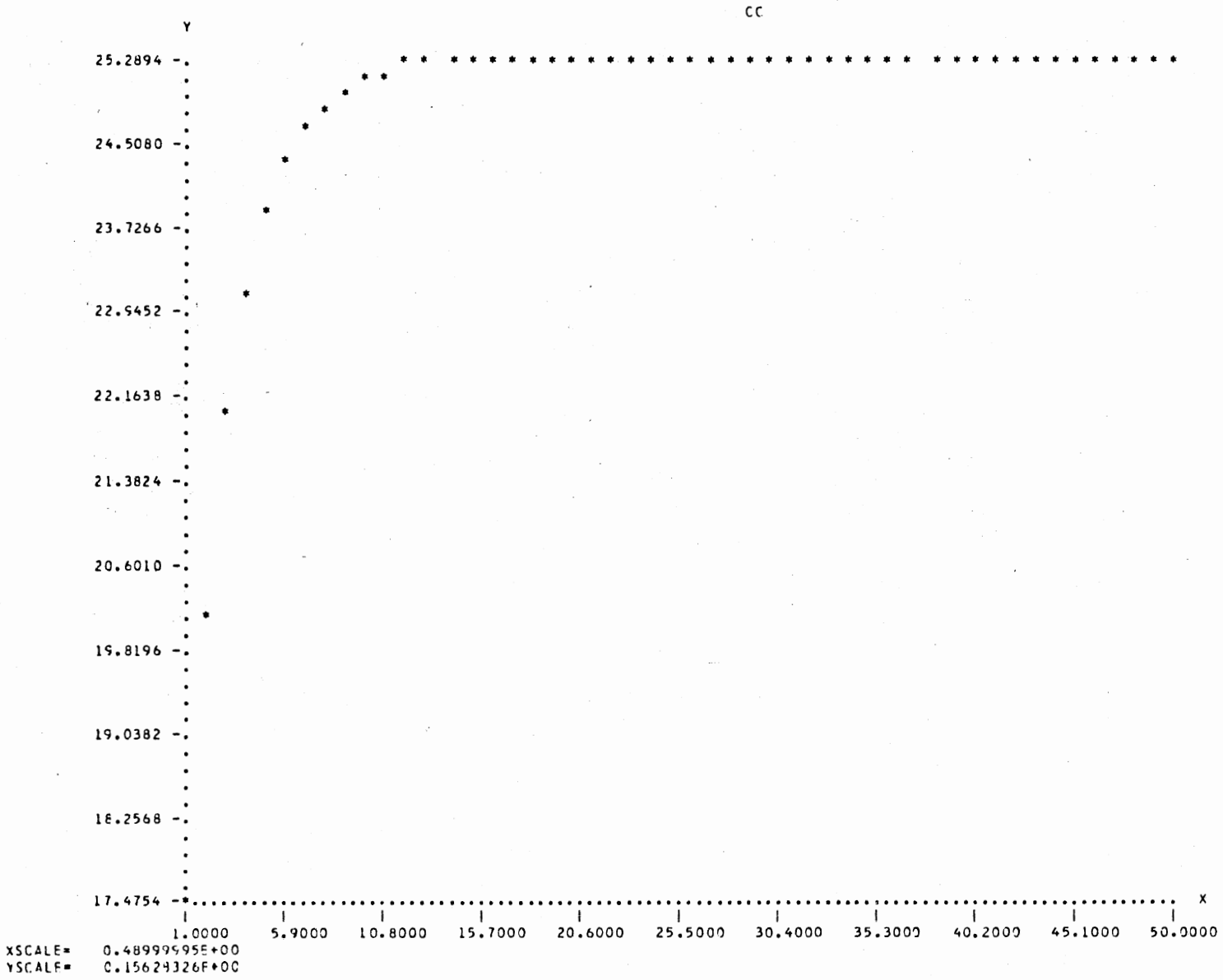
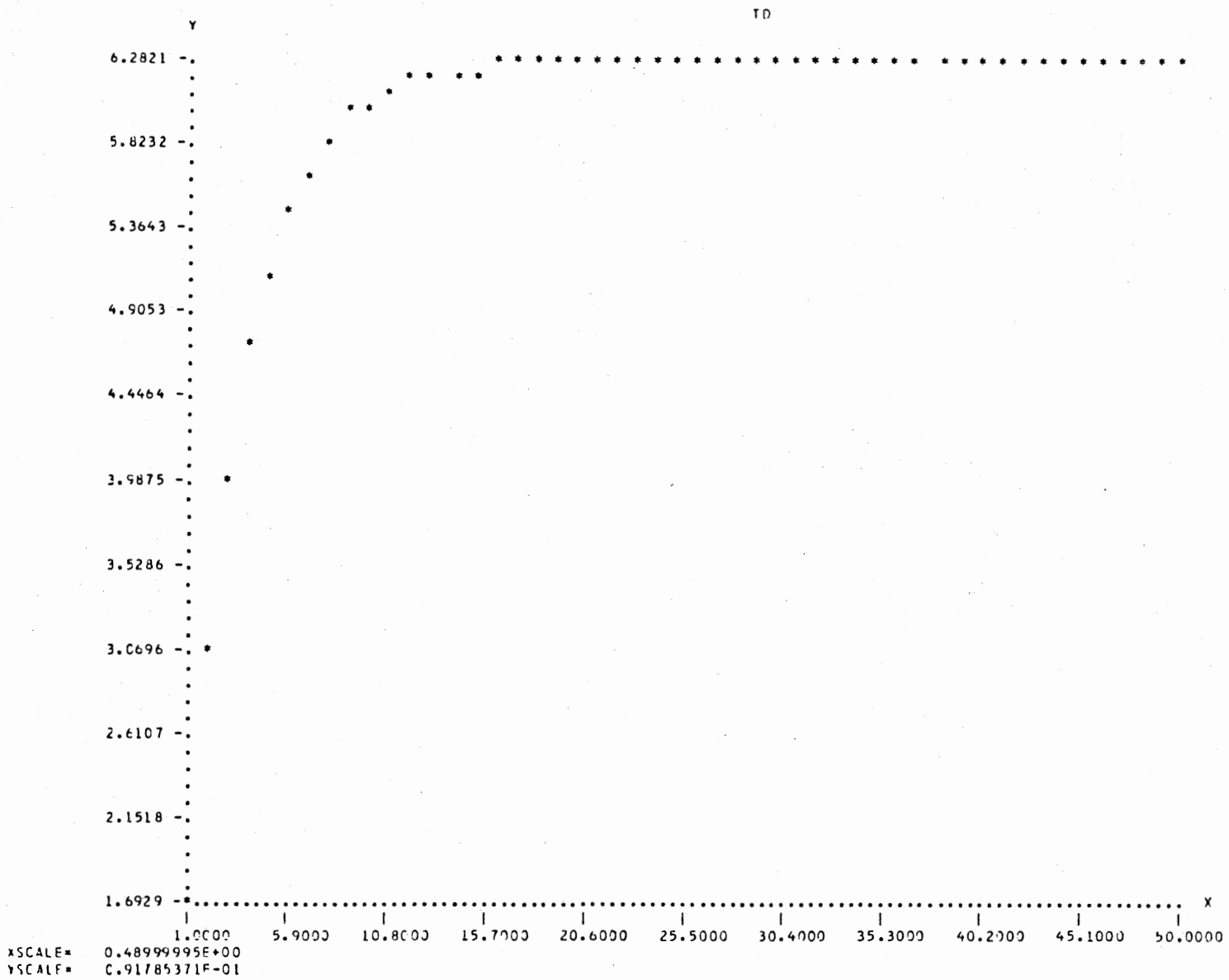
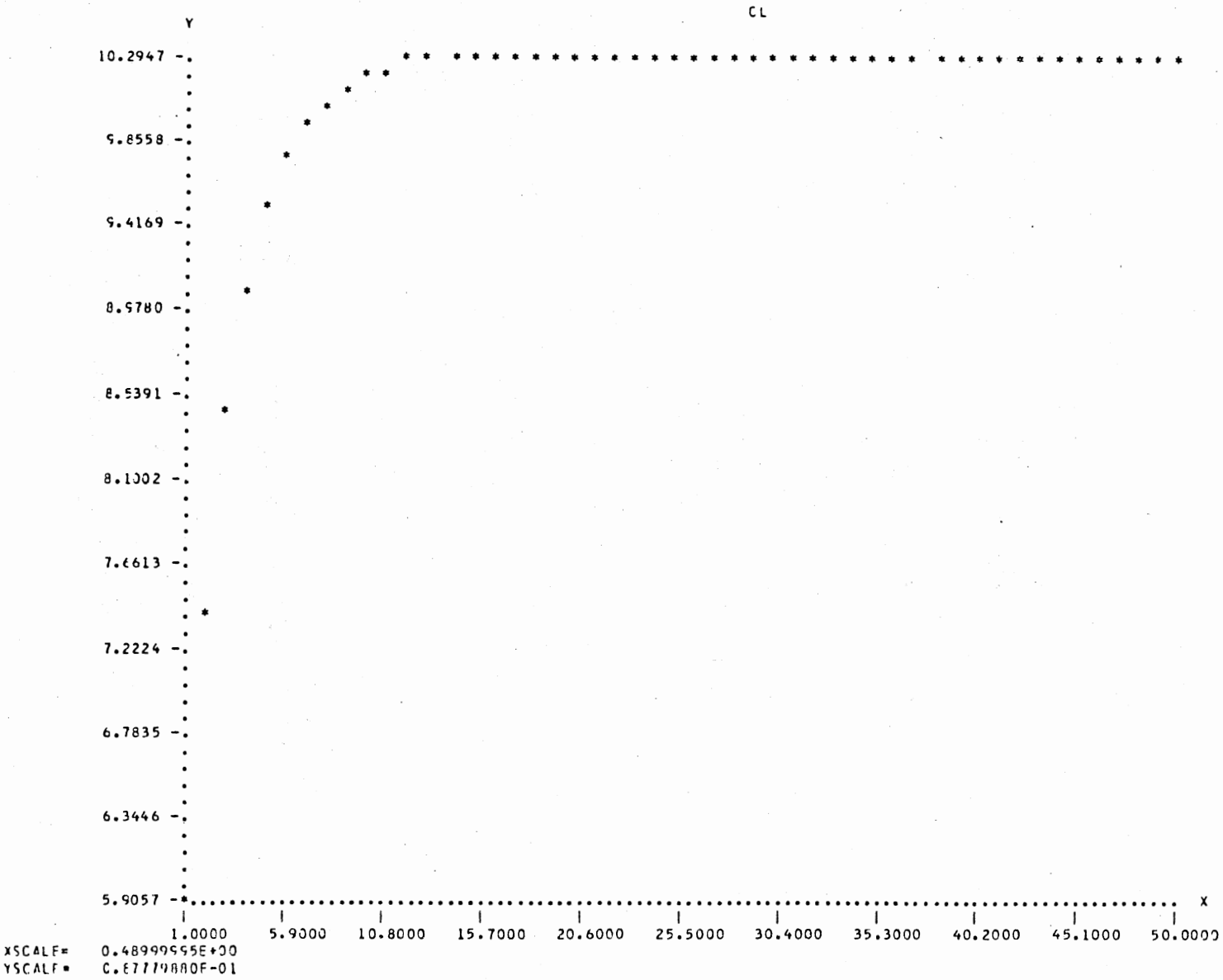
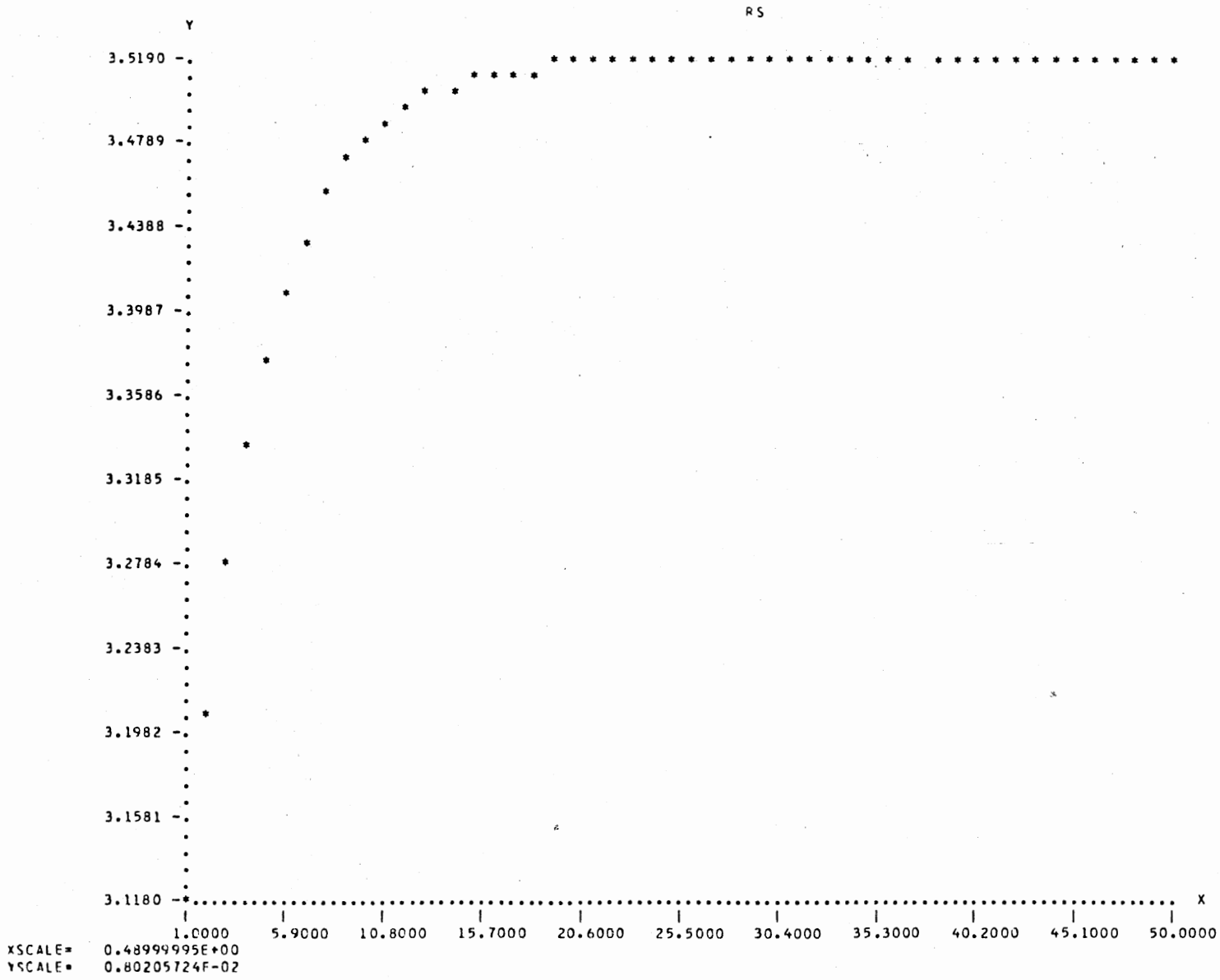
48.000	94.984
49.000	94.984
50.000	94.984

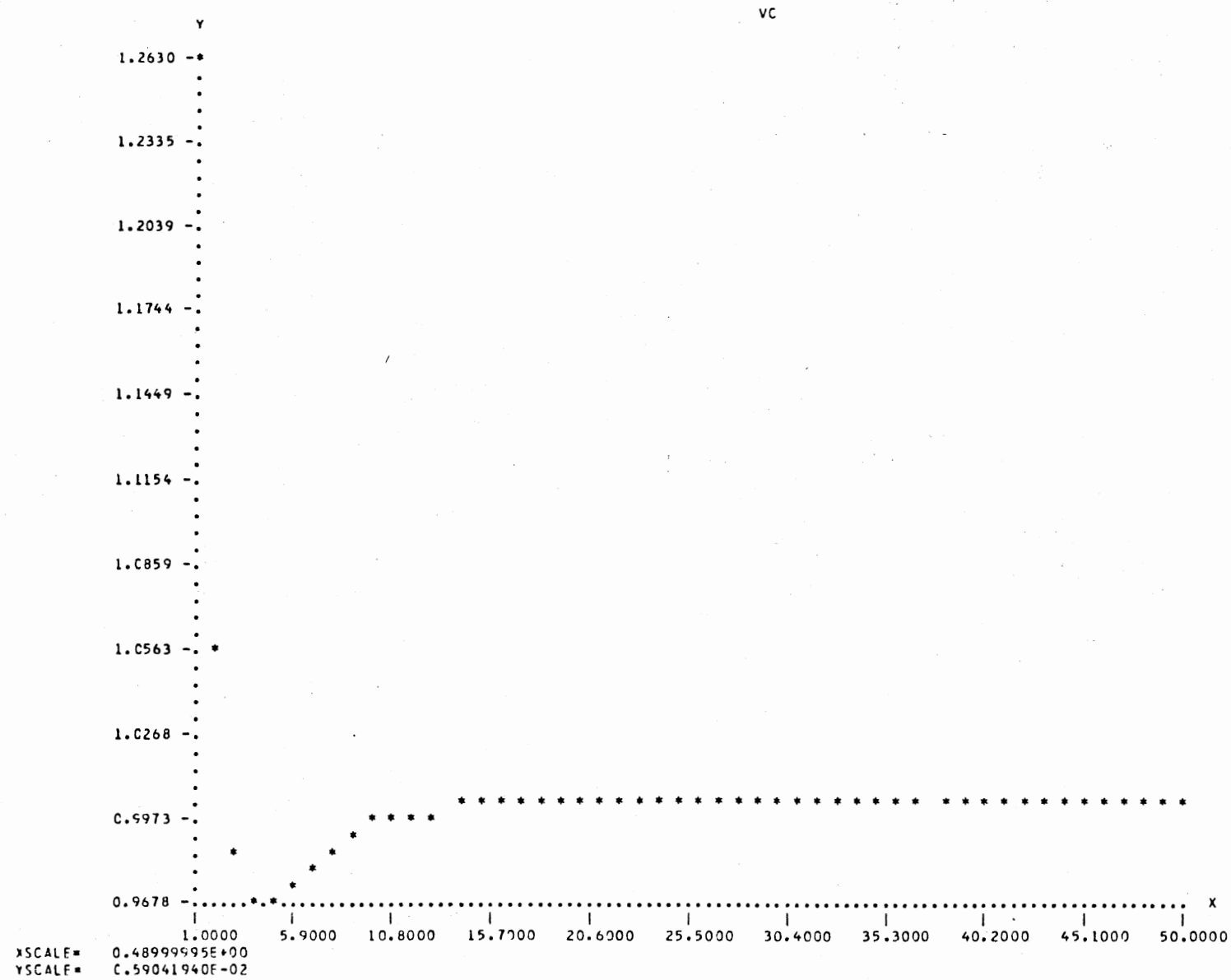

DD
Y
3.8277
3.4178
3.0080
2.5981
2.1882
1.7784
1.3685
0.9586
0.5487
0.1389
-0.2710
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.81974626E-01

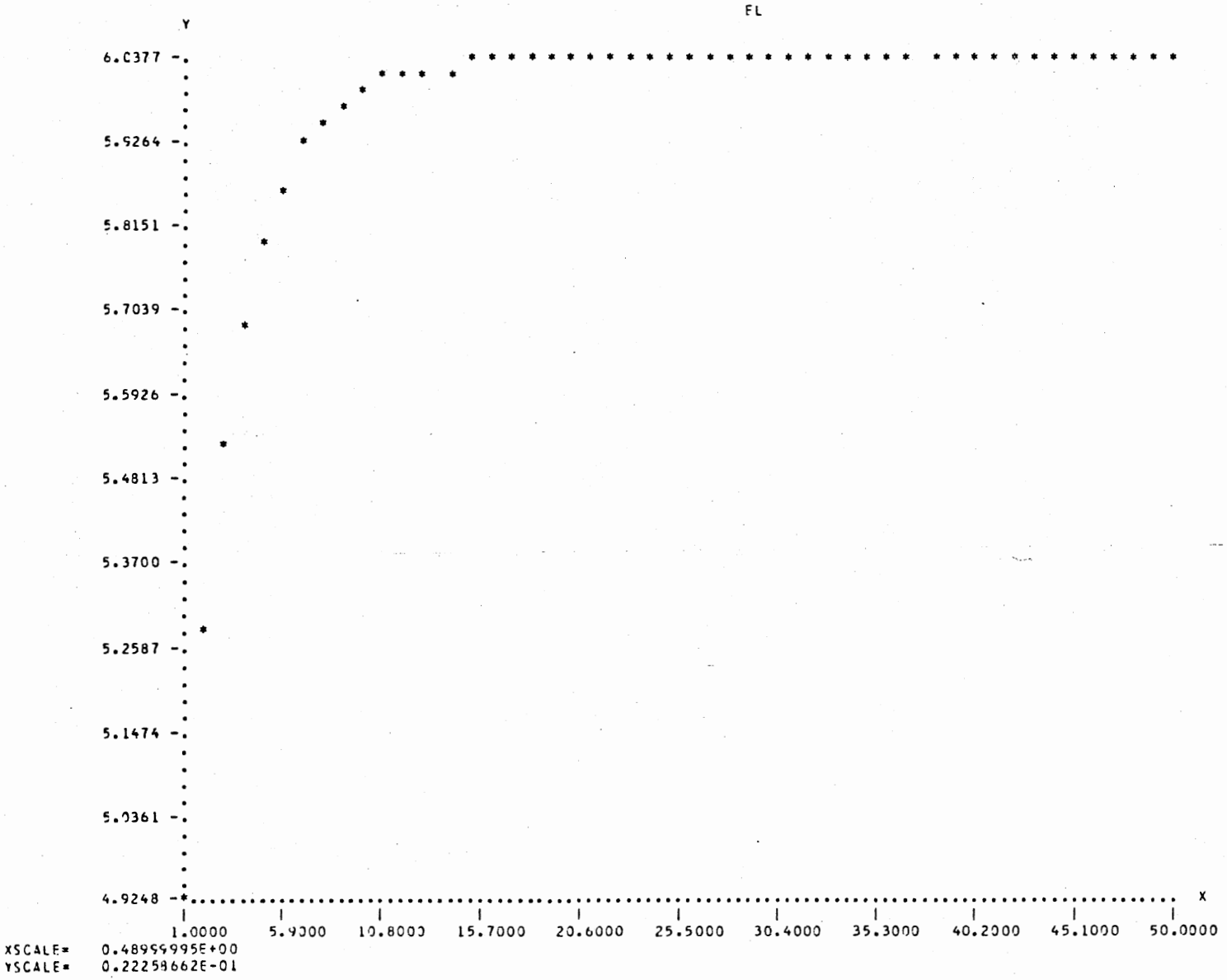

CC
Y
25.2894
24.5080
23.7266
22.9452
22.1638
21.3824
20.6010
19.8196
19.0382
18.2568
17.4754
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.15629326E+00

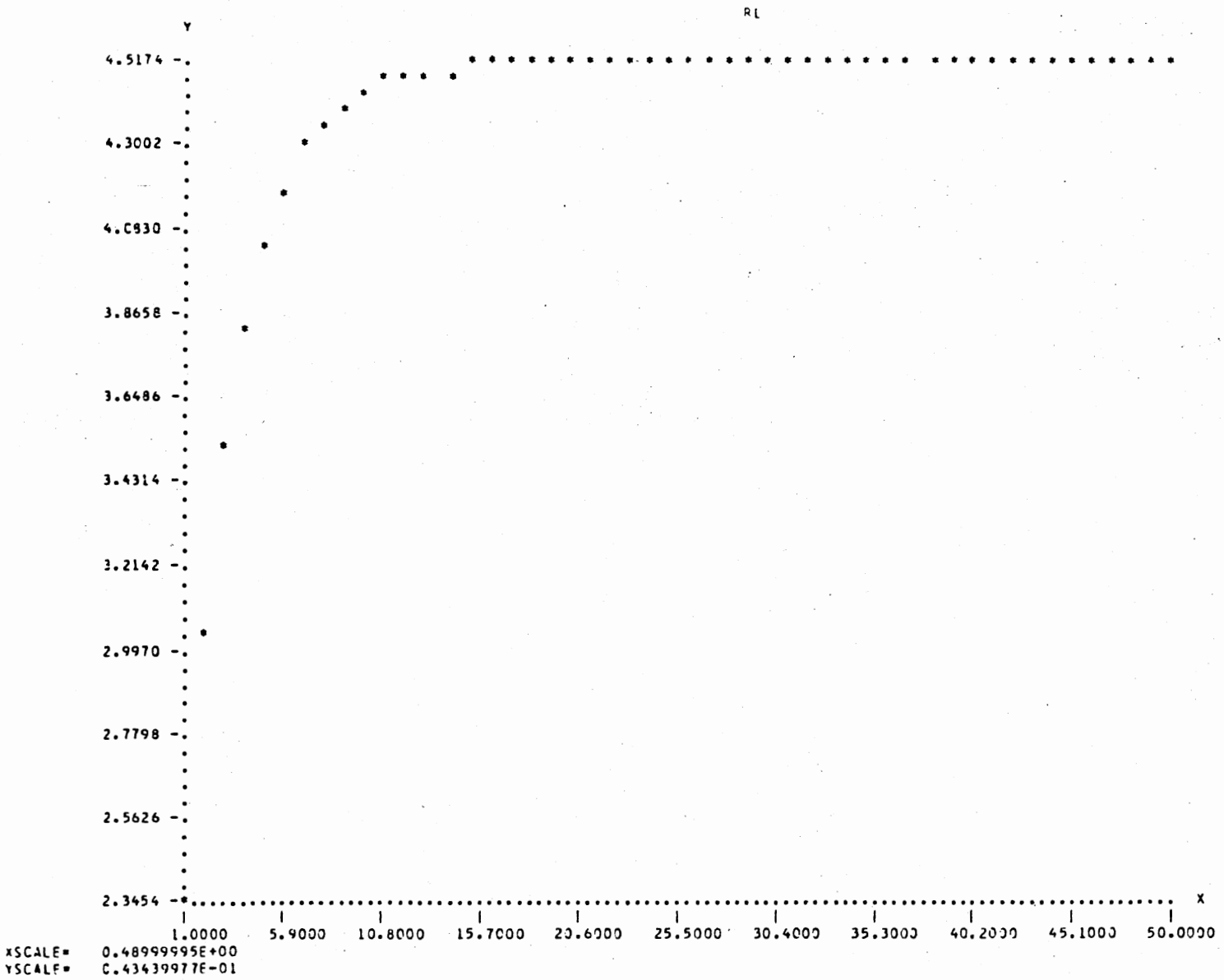

TD
Y
6.2821
5.8232
5.3643
4.9053
4.4464
3.9875
3.5286
3.0696
2.6107
2.1518
1.6929
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.91785371E-01

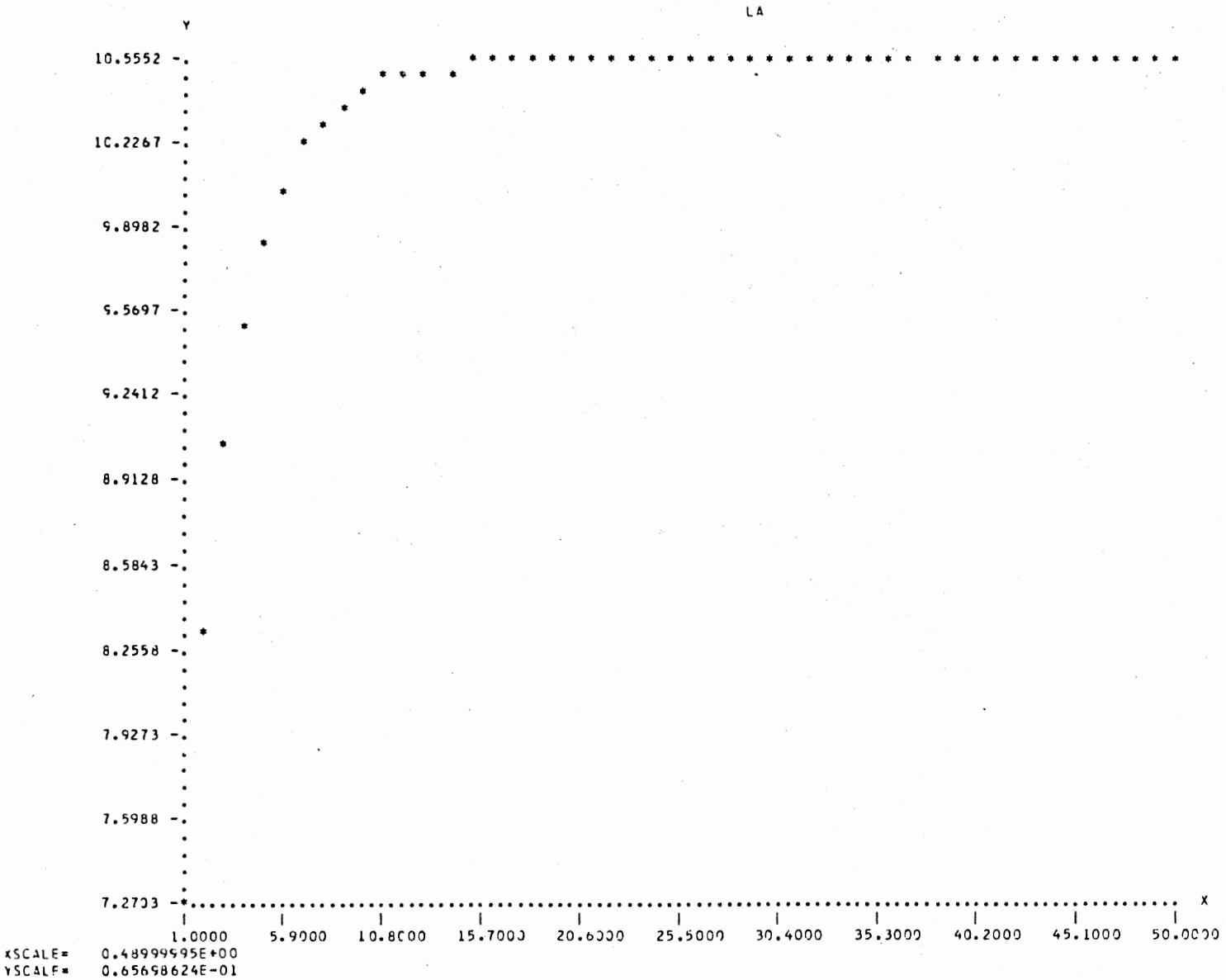

CL
Y
10.2947
9.8558
9.4169
8.9780
8.5391
8.1002
7.6613
7.2224
6.7835
6.3446
5.9057
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.87779880E-01

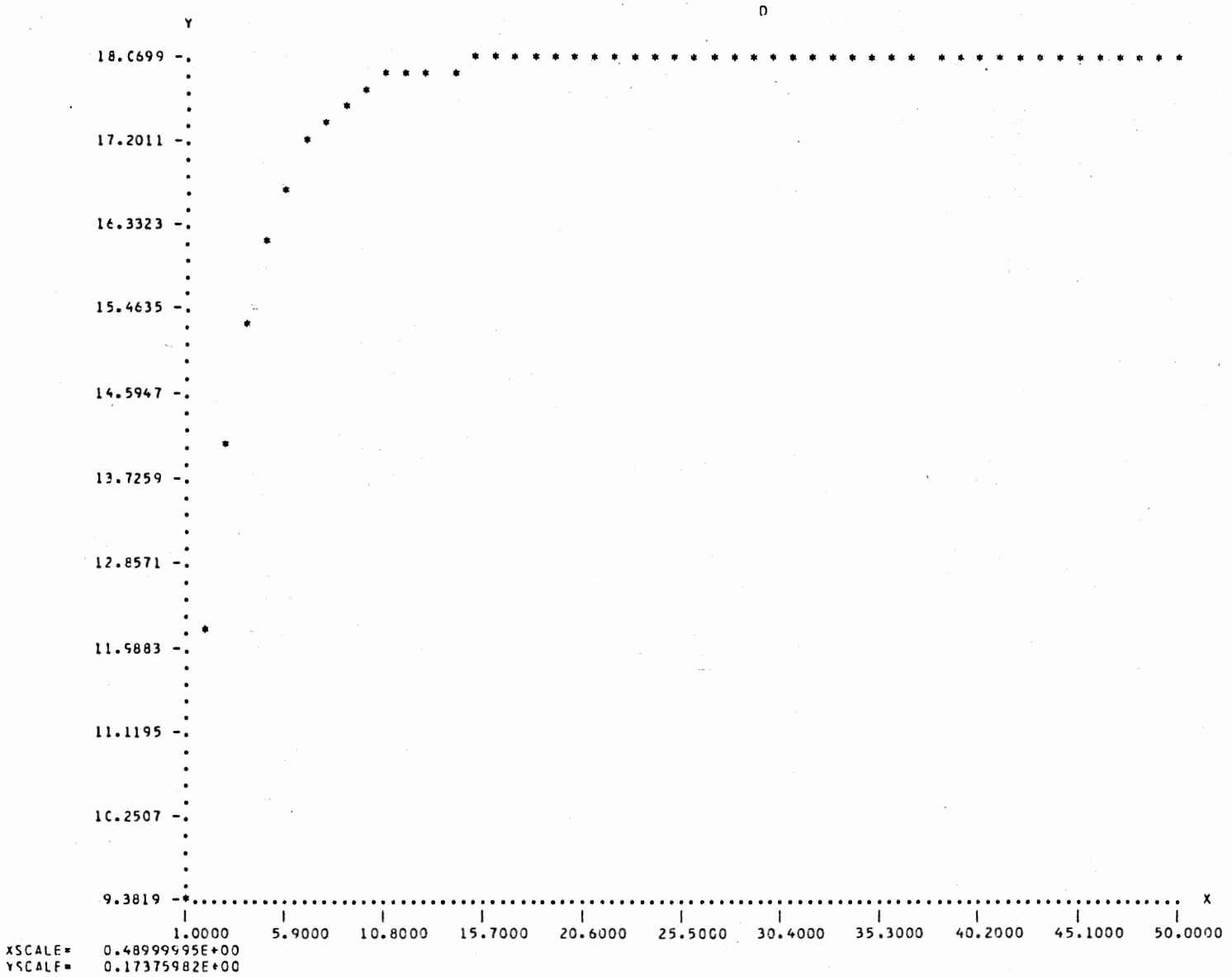

RS
Y
3.5190
3.4789
3.4388
3.3987
3.3586
3.3185
3.2784
3.2383
3.1982
3.1581
3.1180
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.80205724E-02

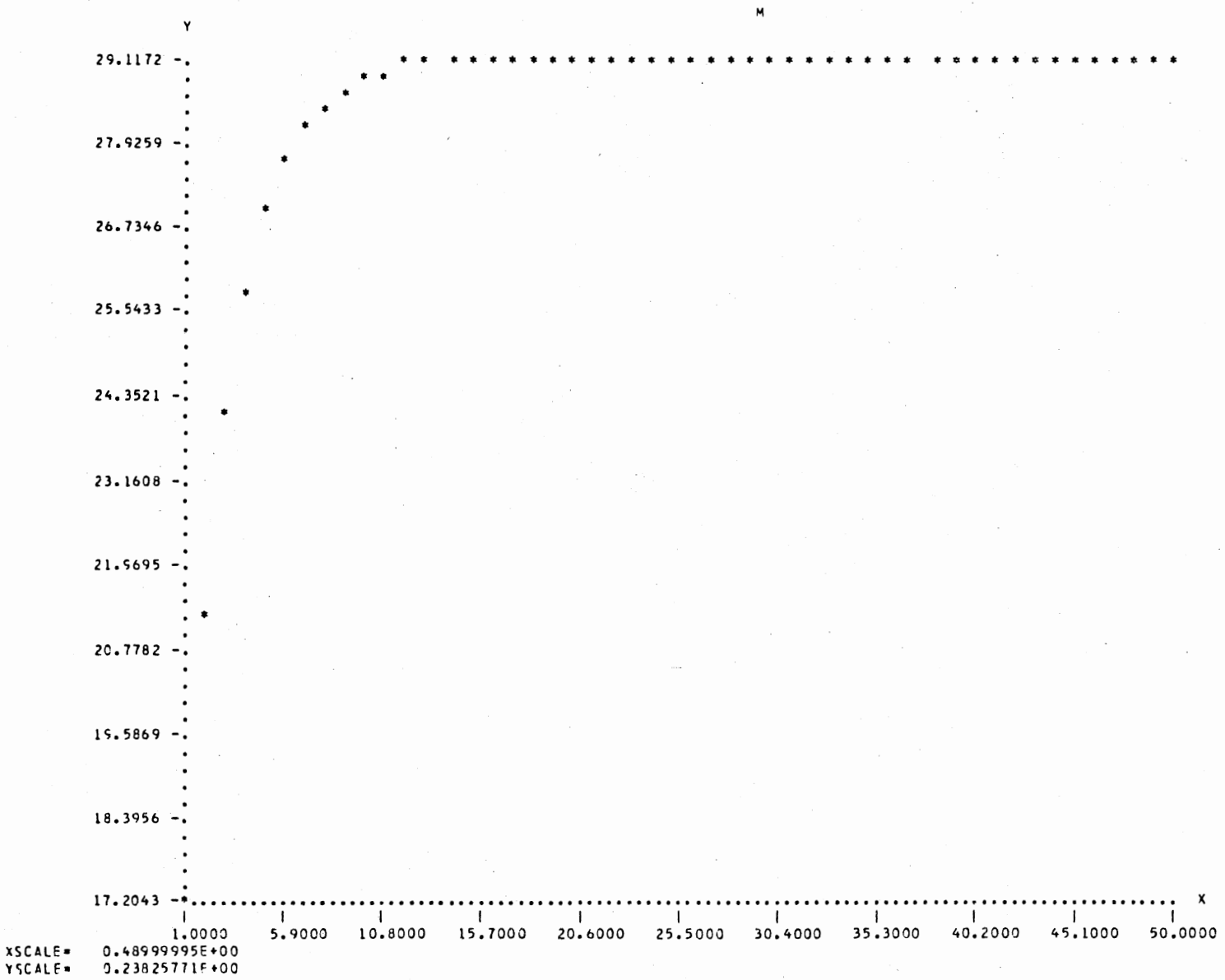

VC
Y
1.2630
1.2335
1.2039
1.1744
1.1449
1.1154
1.0859
1.0563
1.0268
0.9973
0.9678
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.59041940E-02

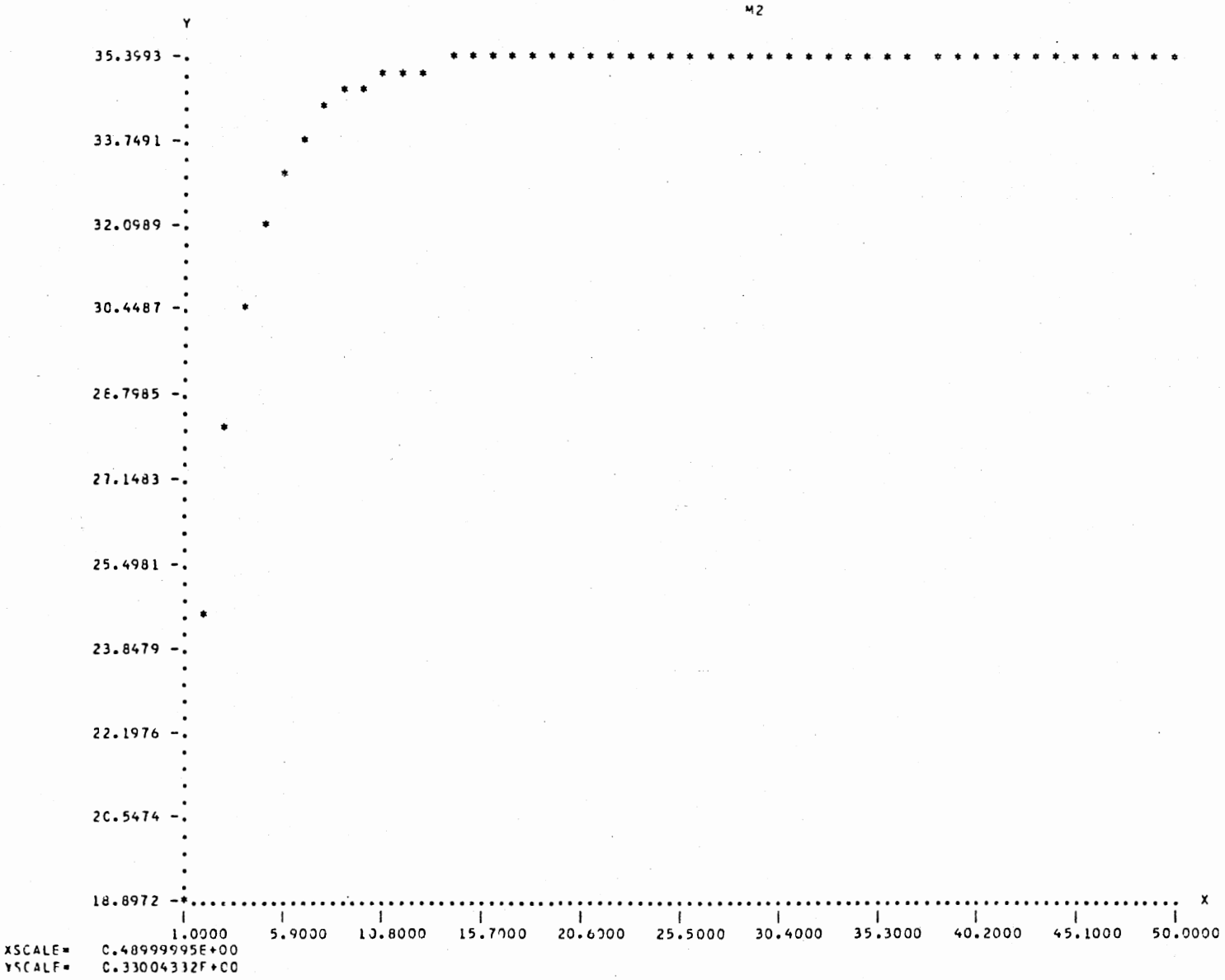

FL
Y
6.0377
5.9264
5.8151
5.7039
5.5926
5.4813
5.3700
5.2587
5.1474
5.0361
4.9248
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.22259662E-01

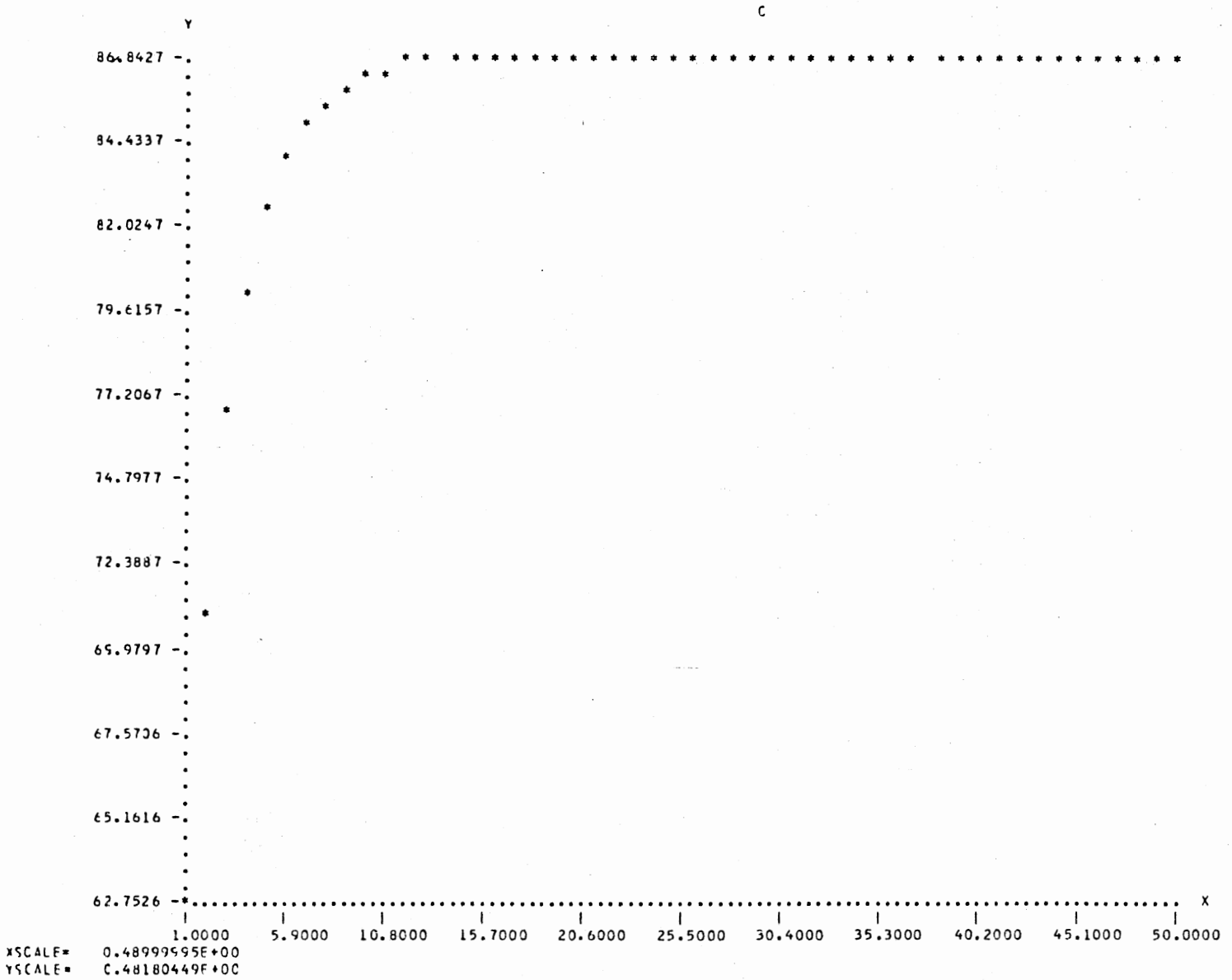

RL
Y
4.5174
4.3002
4.0830
3.8658
3.6486
3.4314
3.2142
2.9970
2.7798
2.5626
2.3454
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
xSCALE= 0.48999995E+00
YSCALE= 0.43439977E-01

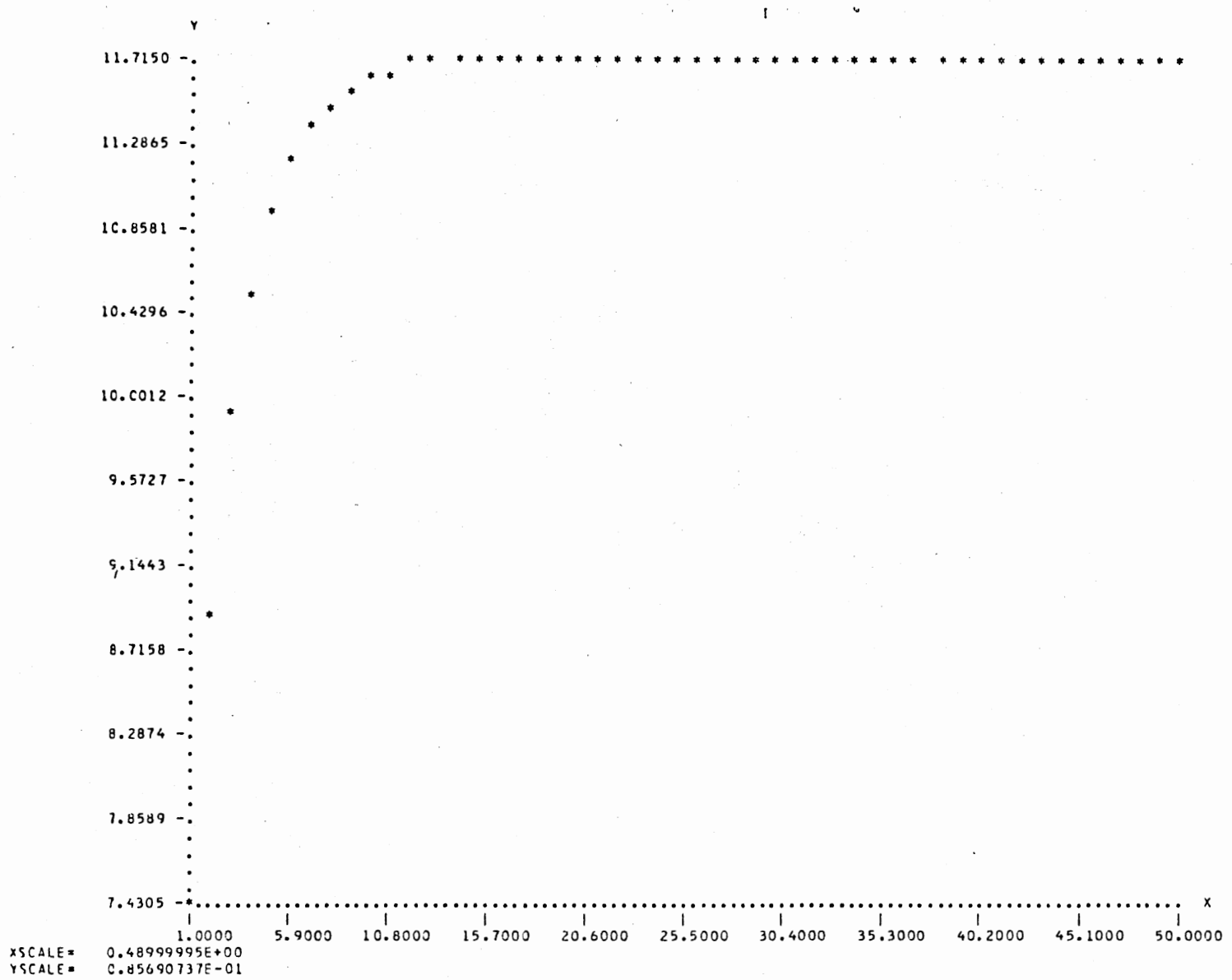

LA
Y
10.5552
10.2267
9.8982
9.5697
9.2412
8.9128
8.5843
8.2558
7.9273
7.5988
7.2703
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.65698624E-01

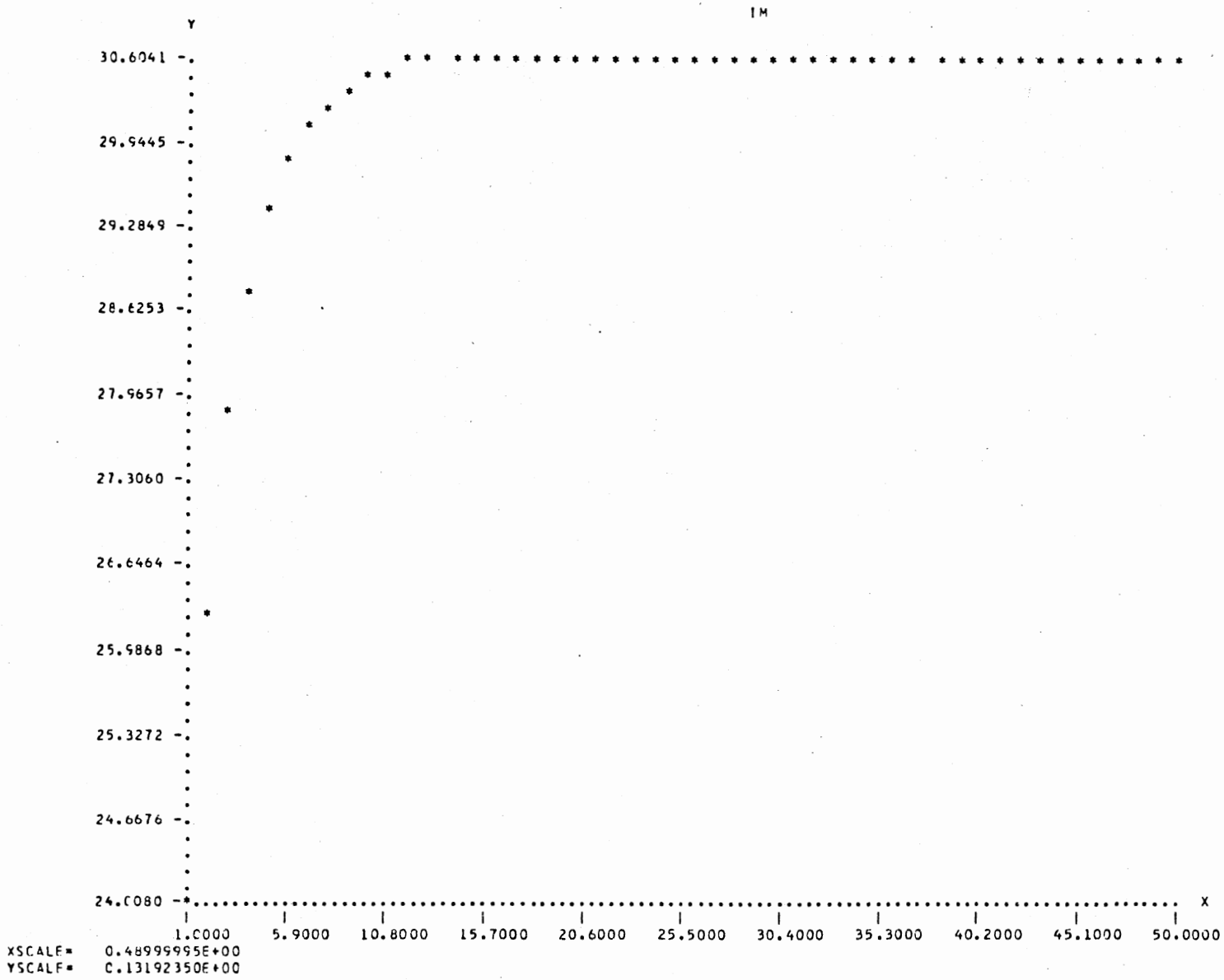

D
Y
18.0699
17.2011
16.3323
15.4635
14.5947
13.7259
12.8571
11.9883
11.1195
10.2507
9.3819
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.17375982E+00

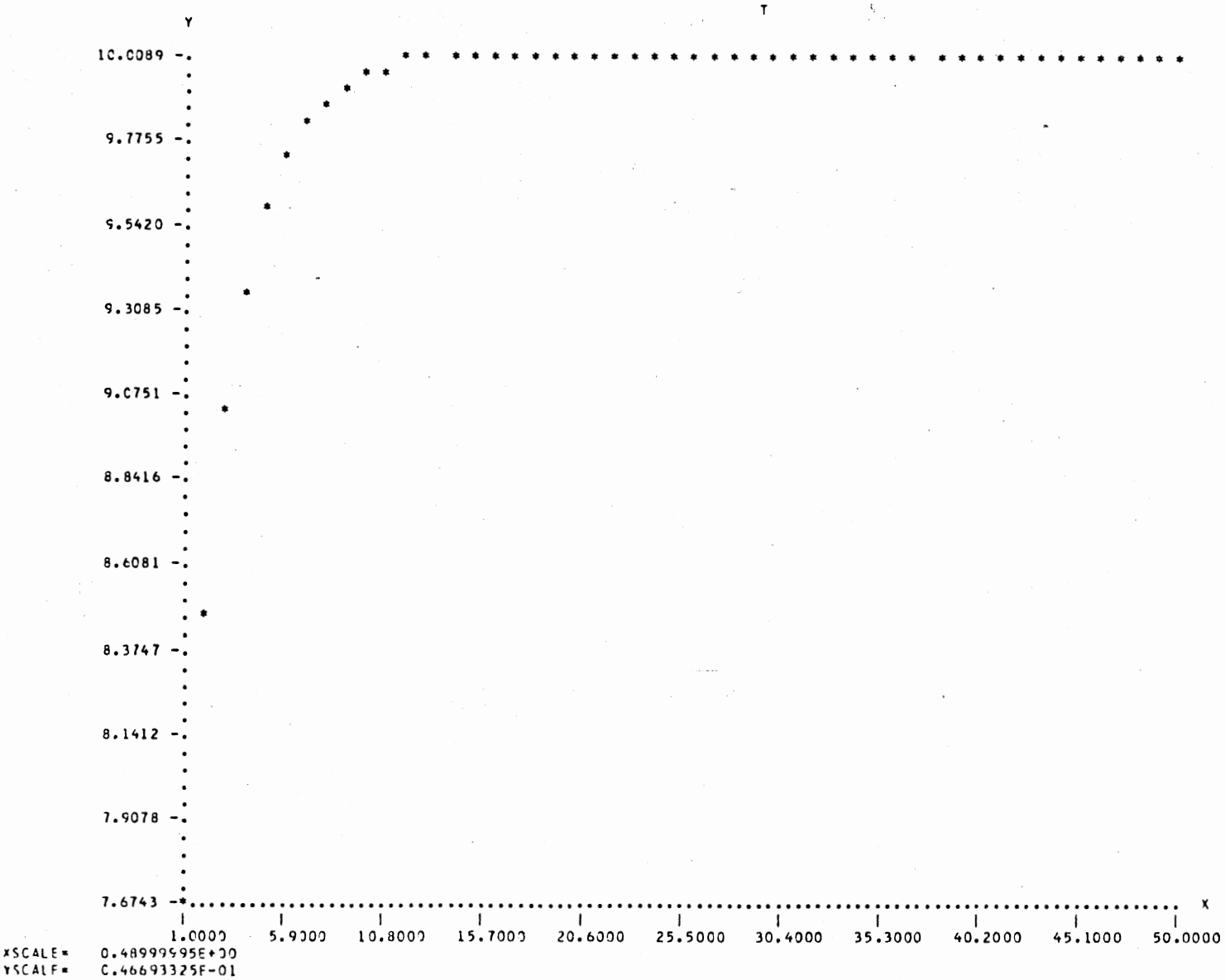

M
Y
29.1172
27.9259
26.7346
25.5433
24.3521
23.1608
21.9695
20.7782
19.5869
18.3956
17.2043
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.23825771E+00

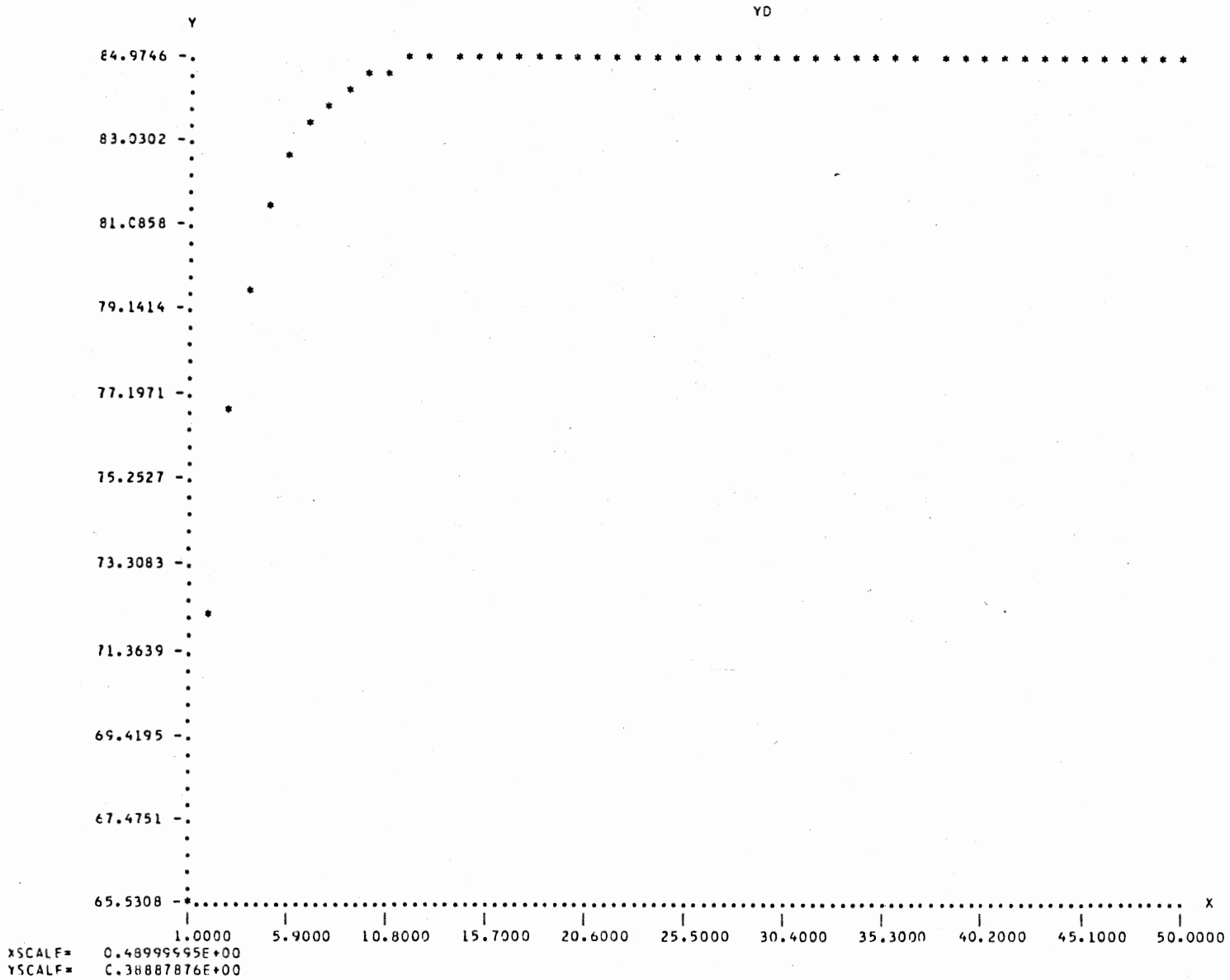

M2
Y
35.3993
33.7491
32.0989
30.4487
28.7985
27.1483
25.4981
23.8479
22.1976
20.5474
18.8972
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.33004332E+00

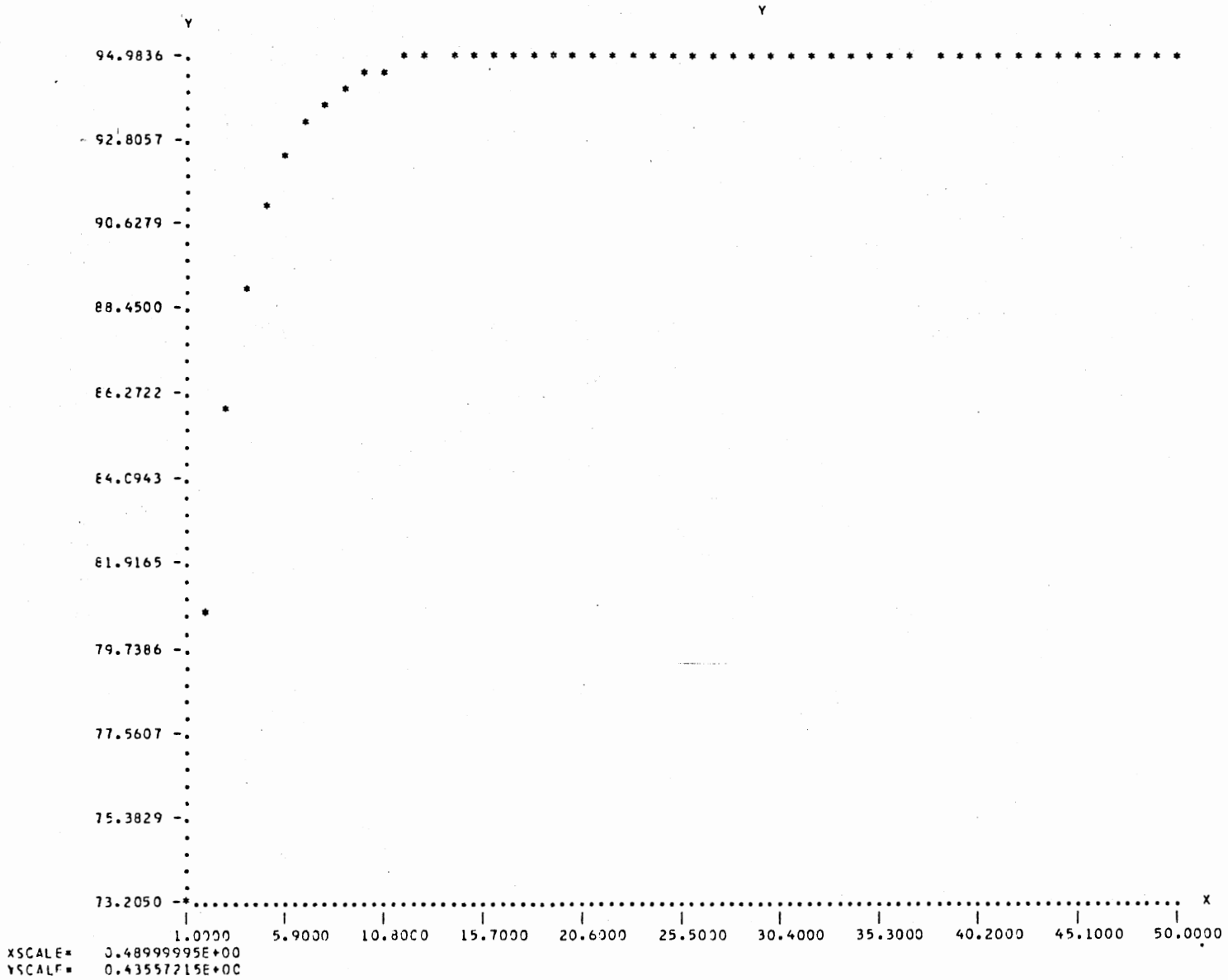

C
Y
86.8427
84.4337
82.0247
79.6157
77.2067
74.7977
72.3887
69.9797
67.5706
65.1616
62.7526
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.48180449E+00


Y
11.7150
11.2865
10.8581
10.4296
10.0012
9.5727
9.1443
8.7158
8.2874
7.8589
7.4305
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.85690737E-01


IM
Y
30.6041
29.9445
29.2849
28.6253
27.9657
27.3060
26.6464
25.9868
25.3272
24.6676
24.0080
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.13192350E+00


T
Y
10.0089
9.7755
9.5420
9.3085
9.0751
8.8416
8.6081
8.3747
8.1412
7.9078
7.6743
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.46693325E-01


YD
Y
84.9746
83.0302
81.0858
79.1414
77.1971
75.2527
73.3083
71.3639
69.4195
67.4751
65.5308
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= C.38887876E+00


Y
94.9836
92.8057
90.6279
88.4500
86.2722
84.0943
81.9165
79.7386
77.5607
75.3829
73.2050
X
1.0000
5.9000
10.8000
15.7000
20.6000
25.5000
30.4000
35.3000
40.2000
45.1000
50.0000
XSCALE= 0.48999995E+00
YSCALE= 0.43557215E+00

APPENDIX D

EX POST SIMULATION

	VARIABLE CD OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	5.680	-0.271	5.951	104.77
2.	7.490	4.316	3.174	42.38
3.	9.170	6.280	2.890	31.52
4.	8.970	6.792	2.178	24.28
5.	10.460	10.566	-0.106	1.02
6.	11.950	13.802	-1.852	15.49
7.	14.430	16.832	-2.402	16.65
8.	16.450	19.643	-3.193	19.41
9.	16.730	20.662	-3.932	22.91
10.	20.770	24.502	-3.732	17.97
11.	25.700	27.291	-1.591	6.19
12.	23.720	24.788	-1.068	4.50
13.	24.430	22.760	1.670	6.84
14.	24.930	27.903	-2.973	11.93
15.	23.030	27.512	-4.482	19.46
16.	24.990	26.176	-1.186	4.75
17.	33.550	33.468	0.082	0.24
18.	41.770	40.553	1.217	2.91
19.	54.730	55.871	-1.141	2.08
20.	79.480	68.261	11.219	14.12

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

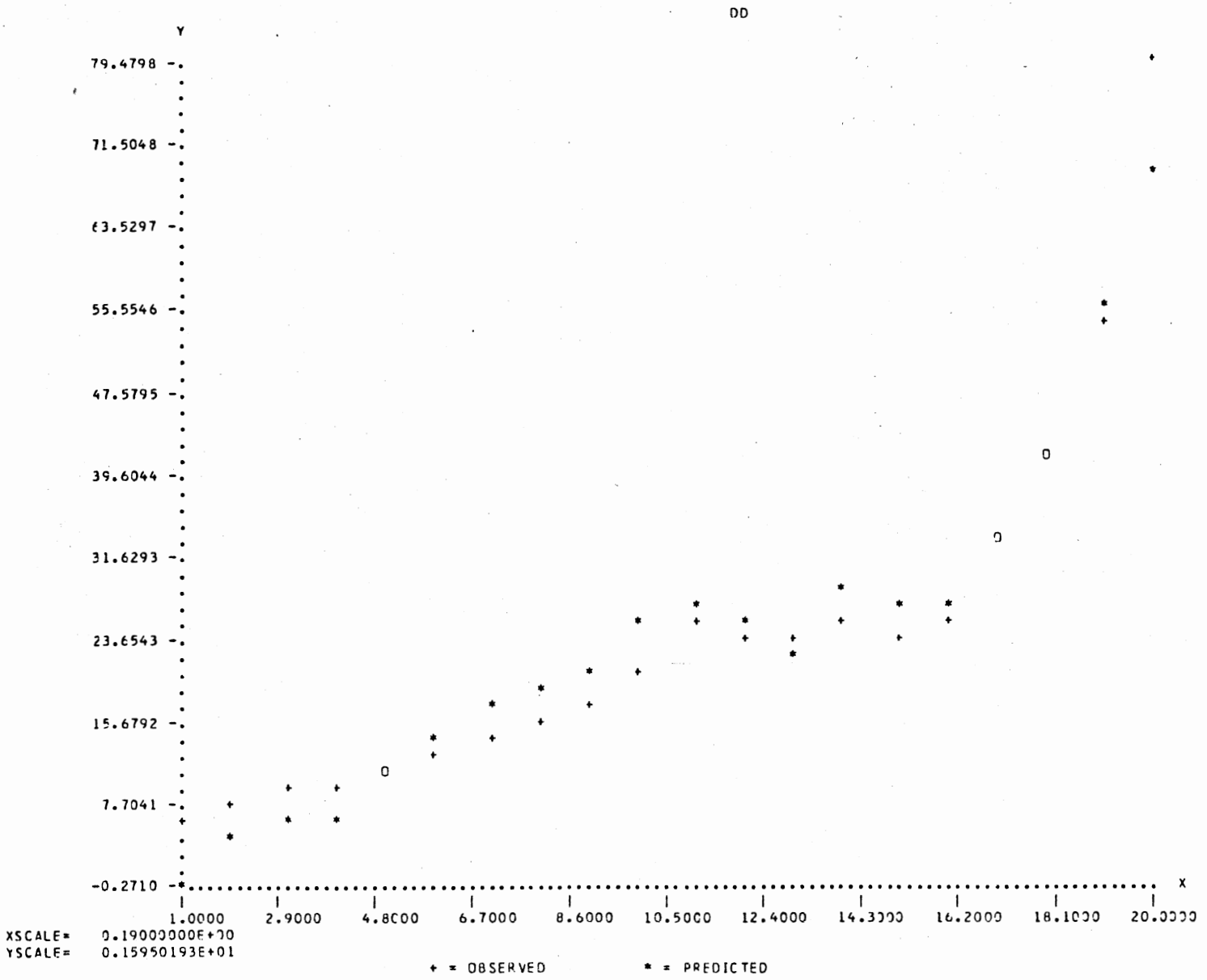
MEAN-ABSOLUTE-ERROR = 2.7969 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 18.4704 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.8247 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 6.5114 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3263 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)


DD
Y
79.4798
71.5048
63.5297
55.5546
47.5795
39.6044
31.6293
23.6543
15.6792
7.7041
-0.2710
X
1.0000
2.9000
4.8000
6.7000
8.6000
10.5000
12.4000
14.3000
16.2000
18.1000
20.0000
XSCALE= 0.19000000E+00
YSCALE= 0.15950193E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE CC OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	14.560	17.475	-2.915	20.02
2.	14.710	14.032	0.678	4.61
3.	15.160	9.651	5.509	36.34
4.	15.270	12.659	2.611	17.10
5.	15.630	13.760	1.870	11.96
6.	16.970	17.897	-0.927	5.46
7.	19.040	19.612	-0.572	3.00
8.	20.400	20.908	-0.508	2.49
9.	23.030	28.754	-5.724	24.86
10.	26.350	32.202	-5.852	22.21
11.	30.330	33.457	-3.127	10.31
12.	51.520	57.124	-5.604	10.88
13.	63.550	61.383	2.167	3.41
14.	71.290	75.251	-3.961	5.56
15.	82.430	82.632	-0.202	0.24
16.	83.010	78.053	4.957	5.97
17.	81.470	79.767	1.703	2.09
18.	97.480	91.244	6.236	6.40
19.	115.490	116.384	-0.894	0.77
20.	139.030	131.880	7.150	5.14

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

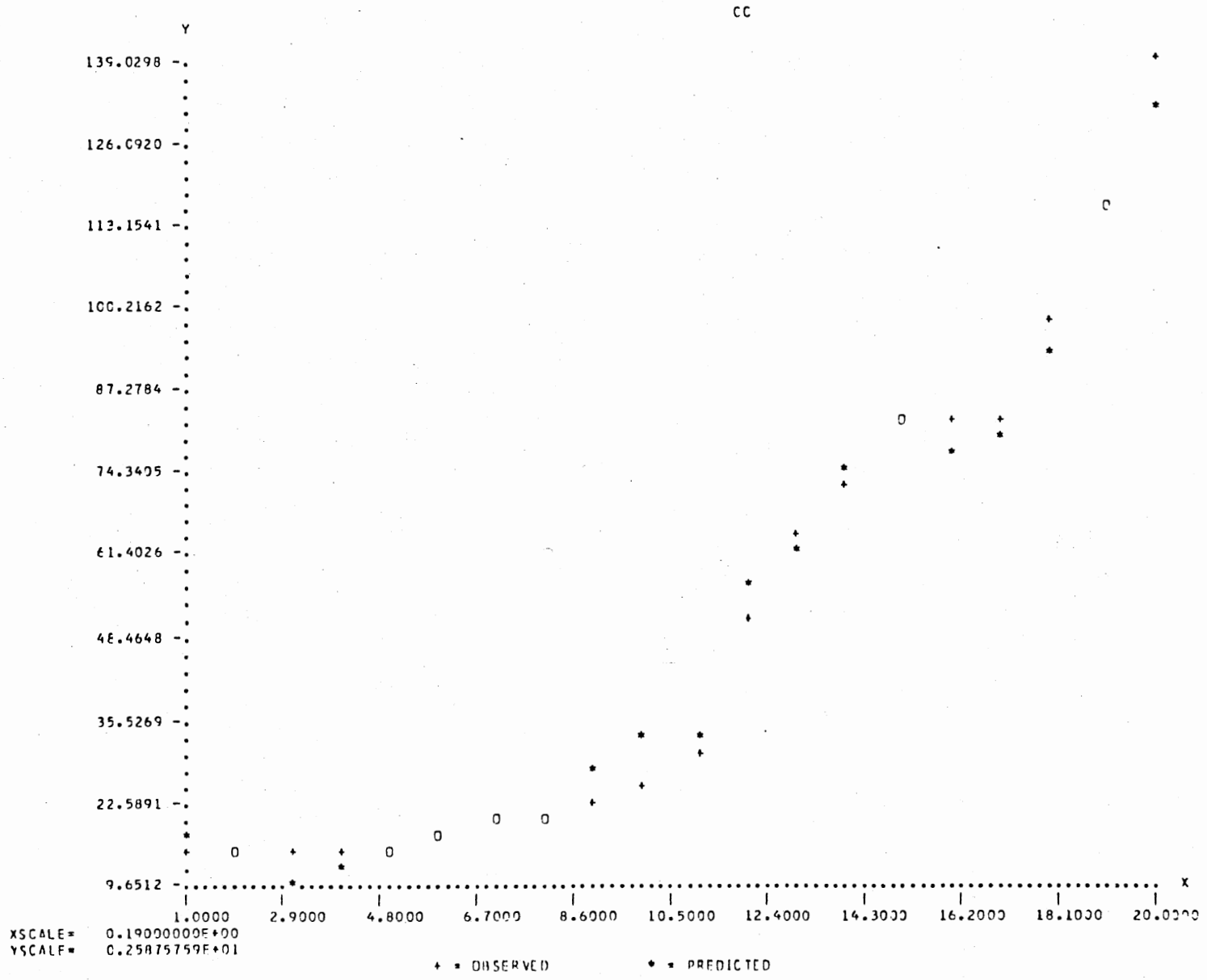
MEAN-ABSOLUTE-ERROR = 3.1584 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 9.9417 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.8631 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 3.0453 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3354 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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YSCALE= 0.25875759E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE TO OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	2.710	1.693	1.017	37.53
2.	3.500	3.877	-0.377	10.76
3.	3.640	4.624	-0.984	27.03
4.	4.700	5.445	-0.745	15.85
5.	4.870	7.539	-2.669	54.79
6.	6.680	9.677	-2.997	44.86
7.	9.570	11.413	-1.843	19.26
8.	11.180	12.973	-1.793	16.04
9.	13.810	14.356	-0.546	3.95
10.	16.990	16.657	0.333	1.96
11.	19.790	18.156	1.634	8.26
12.	18.840	19.665	-0.825	4.38
13.	20.840	19.208	1.632	7.83
14.	22.620	23.217	-0.597	2.64
15.	23.670	23.877	-0.207	0.87
16.	27.110	24.902	2.208	8.15
17.	31.450	30.219	1.231	3.91
18.	36.810	36.155	0.655	1.78
19.	46.530	47.224	-0.694	1.49
20.	59.240	55.597	3.643	6.15

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

MEAN-ABSOLUTE-ERROR = 1.3314 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 13.8746 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.3633 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 4.5962 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.4659 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
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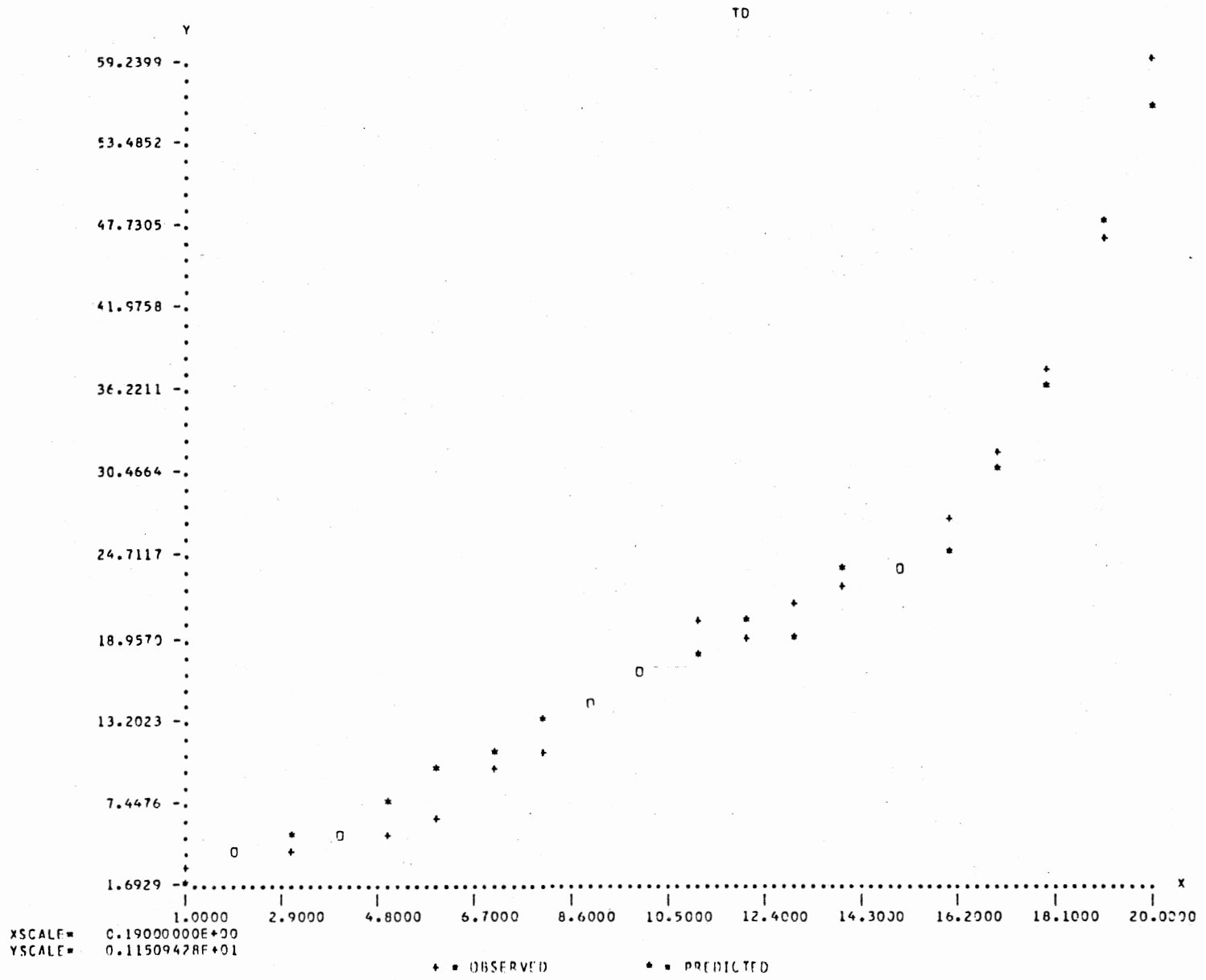
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YSCALE= 0.11509428E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE CL OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	8.260	5.906	2.354	28.50
2.	10.040	9.292	0.748	7.45
3.	10.150	12.035	-1.885	18.57
4.	12.350	13.416	-1.066	8.63
5.	15.840	16.786	-0.946	5.97
6.	18.060	19.718	-1.658	9.18
7.	20.290	21.937	-1.647	8.12
8.	24.870	23.920	0.950	3.82
9.	27.660	27.260	0.400	1.45
10.	31.240	31.042	0.198	0.63
11.	36.410	34.678	1.732	4.76
12.	35.970	30.352	5.618	15.62
13.	37.310	42.228	-4.918	13.18
14.	42.370	46.349	-3.979	9.39
15.	42.720	45.388	-2.668	6.25
16.	43.900	36.762	7.138	16.26
17.	46.990	51.743	-4.753	10.12
18.	58.140	57.893	0.247	0.43
19.	78.930	80.123	-1.193	1.51
20.	114.250	107.696	6.554	5.74

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

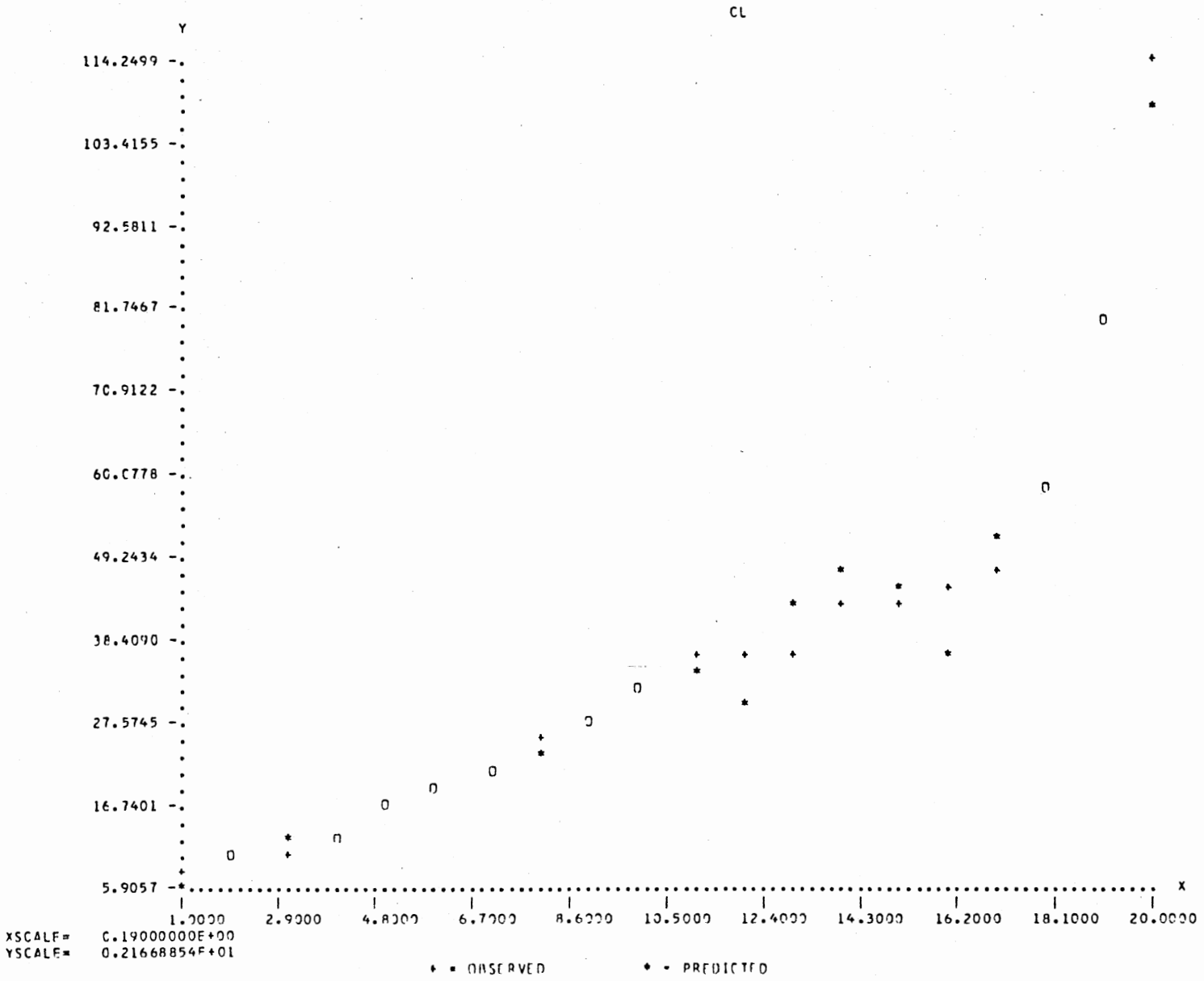
MEAN-ABSOLUTE-ERROR = 2.5325 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 8.7779 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.7381 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 2.4798 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3826 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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XSCALE= 0.19000000E+00
YSCALE= 0.21668854E+01
* = OBSERVED
+ = PREDICTED

	VARIABLE RS OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	3.000	3.118	-0.118	3.93
2.	3.000	3.209	-0.209	6.97
3.	3.000	3.280	-0.280	9.32
4.	3.000	3.334	-0.334	11.13
5.	3.000	3.376	-0.376	12.53
6.	3.000	3.409	-0.409	13.62
7.	3.000	3.434	-0.434	14.45
8.	3.000	3.453	-0.453	15.10
9.	3.750	3.468	0.282	7.52
10.	3.750	3.480	0.270	7.21
11.	3.750	3.489	0.261	6.97
12.	3.750	3.495	0.255	6.79
13.	3.750	3.501	0.249	6.64
14.	3.750	3.505	0.245	6.53
15.	3.750	3.508	0.242	6.45
16.	4.500	3.999	0.501	11.13
17.	4.500	4.379	0.121	2.70
18.	4.500	4.672	-0.172	3.82
19.	4.500	4.898	-0.398	8.85
20.	5.250	5.074	0.176	3.36

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

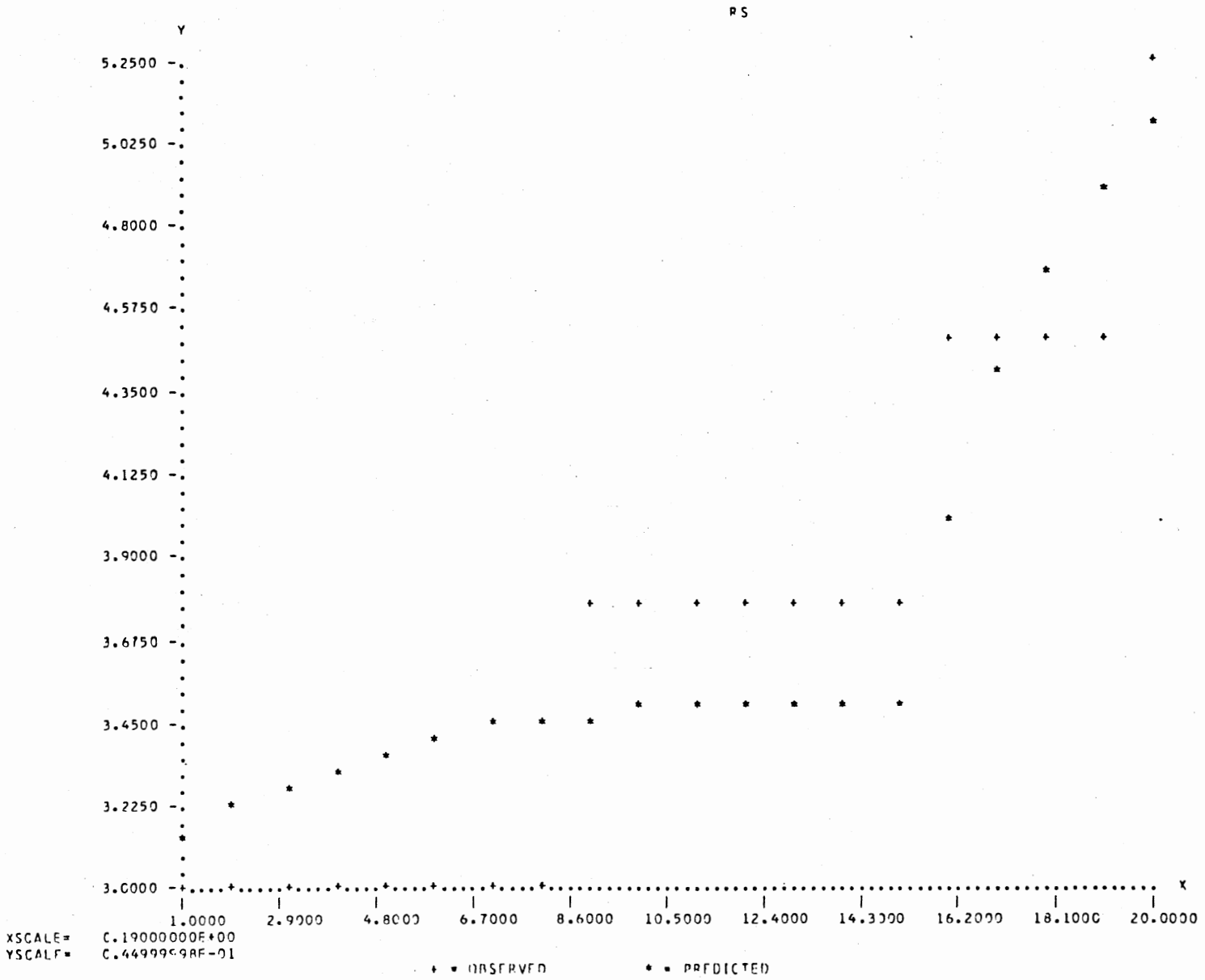
MEAN-ABSOLUTE-ERROR = 0.2893 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 8.2520 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.0689 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 2.0134 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.5639 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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YSCALE= C.44999998E-01
+ = OBSERVED
* = PREDICTED

	VARIABLE VC OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	2.220	1.263	0.957	43.11
2.	0.920	1.102	-0.182	9999.99
3.	1.170	1.071	0.099	8.43
4.	0.710	1.079	-0.369	9999.99
5.	0.770	1.160	-0.390	9999.99
6.	1.000	1.250	-0.250	25.02
7.	1.190	1.366	-0.176	14.80
8.	1.360	1.375	-0.015	1.12
9.	1.270	1.503	-0.233	18.31
10.	1.140	1.498	-0.358	31.43
11.	1.570	1.548	0.022	1.39
12.	1.500	1.596	-0.096	6.43
13.	1.770	1.578	0.192	10.83
14.	1.860	1.664	0.196	10.56
15.	1.990	1.716	0.274	13.77
16.	1.590	1.709	-0.119	7.50
17.	1.910	1.835	0.075	3.95
18.	2.070	2.020	0.050	2.41
19.	2.480	2.390	0.090	3.61
20.	2.890	2.798	0.092	3.17

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

MEAN-ABSOLUTE-ERROR = 0.2118 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 12.1087 (IBID., PP 316-317)
DF (17.)

ROOT-MEAN-SQUARE ERROR = 0.0656 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 4.0161 (IBID., PP 316-317)
DF (17.)

INEQUALITY COEFFICIENT = 0.6224 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
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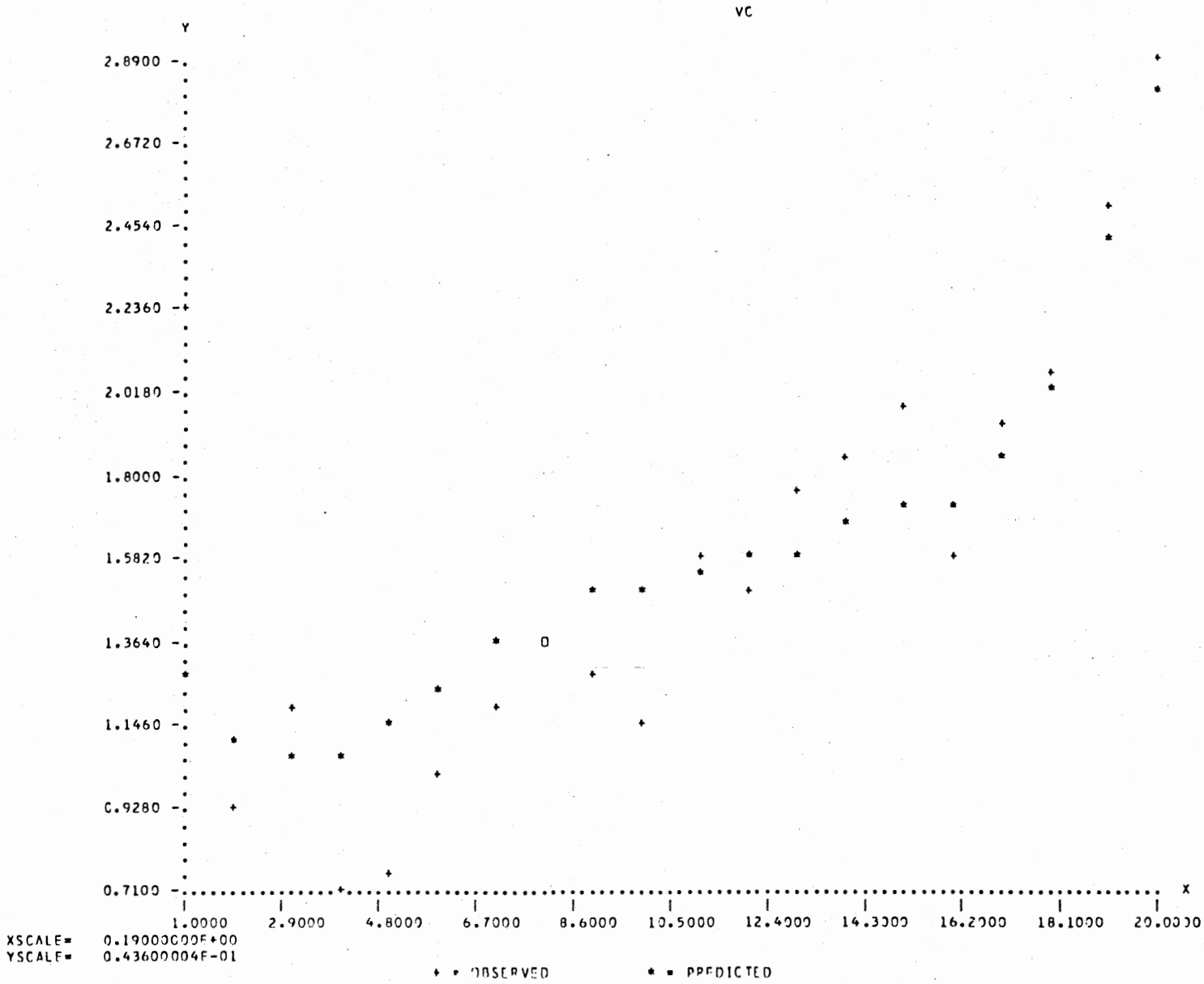
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YSCALE= 0.43600004E-01
+ = OBSERVED
* = PREDICTED

	VARIABLE EL OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	6.490	4.925	1.565	24.12
2.	7.230	5.855	1.375	19.02
3.	9.950	6.356	3.594	36.12
4.	8.980	6.619	2.361	26.29
5.	8.140	7.613	0.527	6.48
6.	8.350	8.304	0.046	0.56
7.	11.720	9.274	2.446	20.87
8.	6.190	8.750	-2.560	41.36
9.	11.850	10.313	1.537	12.97
10.	5.130	9.555	-4.425	86.26
11.	6.530	10.212	-3.682	56.39
12.	8.250	10.547	-2.297	27.84
13.	8.040	10.050	-2.010	24.99
14.	5.970	11.234	-5.264	88.17
15.	6.860	11.426	-4.566	66.55
16.	11.020	11.049	-0.029	0.26
17.	18.510	12.677	5.833	31.51
18.	18.530	14.336	4.194	22.63
19.	15.620	18.005	-2.385	15.27
20.	24.690	21.130	3.560	14.42

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

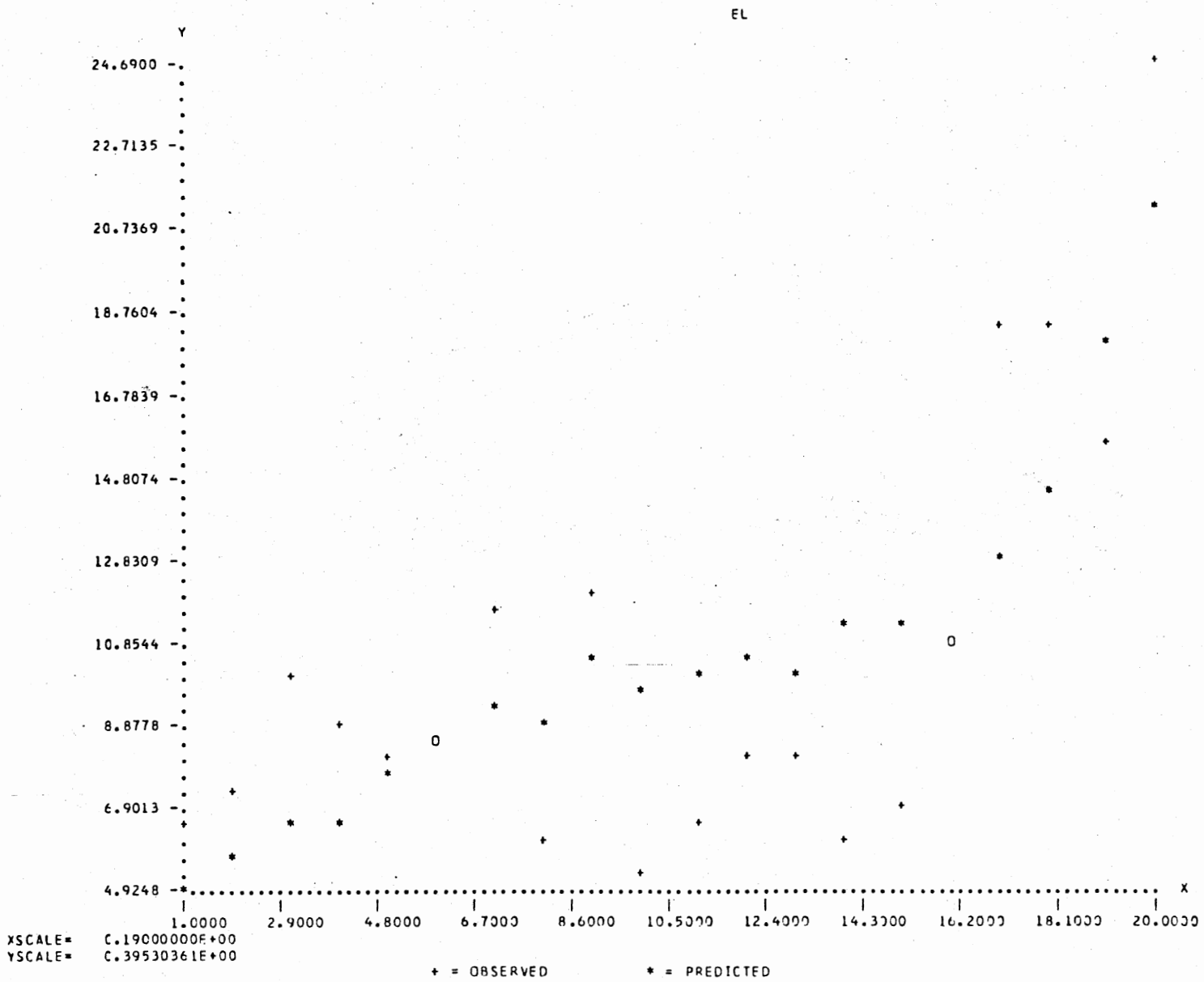
MEAN-ABSOLUTE-ERROR = 2.7128 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 31.1044 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.7053 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 8.8693 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.6865 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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+ = OBSERVED
* = PREDICTED

	VARIABLE RL OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	4.090	2.345	1.745	42.65
2.	4.860	4.161	0.699	14.39
3.	5.620	5.138	0.482	8.57
4.	6.010	5.652	0.358	5.96
5.	6.900	7.591	-0.691	10.02
6.	7.730	8.940	-1.210	15.65
7.	9.780	10.834	-1.054	10.77
8.	8.570	9.812	-1.242	14.49
9.	11.770	12.862	-1.092	9.28
10.	10.530	11.382	-0.852	8.09
11.	12.680	12.664	0.016	0.12
12.	12.850	13.318	-0.468	3.64
13.	13.170	12.347	0.823	6.25
14.	13.770	14.658	-0.888	6.45
15.	13.860	15.032	-1.172	8.46
16.	14.550	14.297	0.253	1.74
17.	17.800	17.474	0.326	1.83
18.	21.180	20.712	0.468	2.21
19.	27.410	27.874	-0.464	1.69
20.	37.690	33.972	3.718	9.86

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

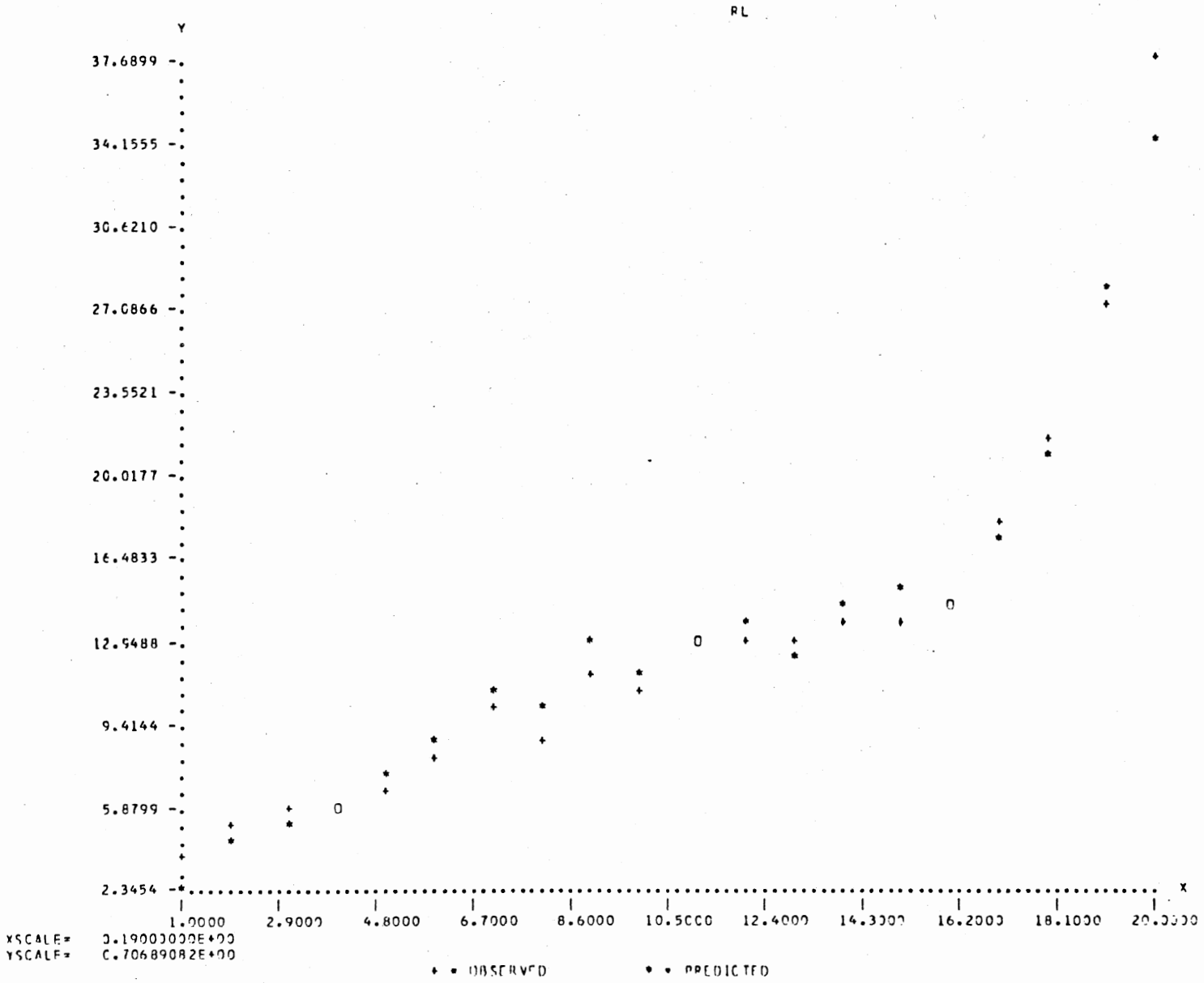
MEAN-ABSOLUTE-ERROR = 0.9010 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 9.1063 (IBIC., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.2641 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 2.8438 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3502 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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XSCALE= 0.19000000E+00
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* = OBSERVED
O = PREDICTED

	VARIABLE LA OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	10.580	7.270	3.310	31.28
2.	12.090	10.015	2.075	17.16
3.	15.570	11.495	4.075	26.18
4.	14.990	12.271	2.719	18.14
5.	15.040	15.204	-0.164	1.09
6.	16.080	17.243	-1.163	7.23
7.	21.500	20.108	1.392	6.47
8.	14.760	18.562	-3.802	25.76
9.	23.620	23.176	0.444	1.88
10.	15.660	20.937	-5.277	33.70
11.	19.210	22.876	-3.666	19.09
12.	21.100	23.865	-2.765	13.11
13.	21.210	22.397	-1.187	5.59
14.	19.740	25.891	-6.151	31.16
15.	20.720	26.458	-5.738	27.69
16.	25.570	25.346	0.224	0.88
17.	36.310	30.151	6.159	16.96
18.	39.710	35.048	4.662	11.74
19.	43.030	45.879	-2.849	6.62
20.	62.380	55.102	7.278	11.67

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

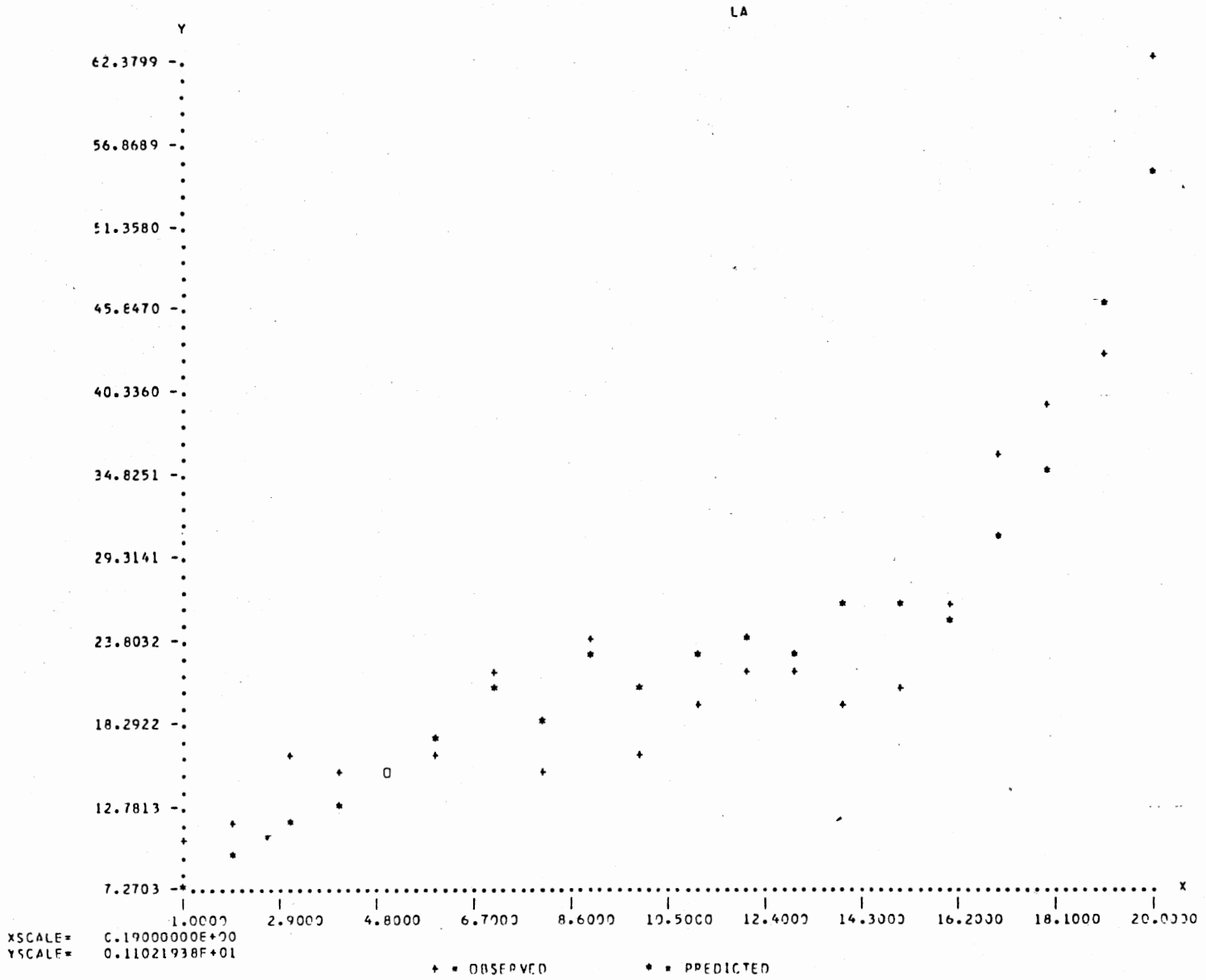
MEAN-ABSOLUTE-ERROR = 3.2551 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 15.6701 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.8648 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 4.2121 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.4486 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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XSCALE= 0.19000000E+00
YSCALE= 0.11021938E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE D OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	16.350	9.382	6.968	42.62
2.	19.440	16.642	2.798	14.39
3.	22.460	20.554	1.906	8.49
4.	24.040	22.607	1.433	5.96
5.	27.590	30.365	-2.775	10.06
6.	30.910	35.758	-4.848	15.68
7.	39.090	43.335	-4.245	10.86
8.	34.260	39.246	-4.986	14.55
9.	47.070	51.448	-4.378	9.30
10.	42.130	45.528	-3.398	8.07
11.	50.700	50.657	0.043	0.09
12.	51.380	53.272	-1.892	3.68
13.	52.690	49.388	3.302	6.27
14.	55.060	58.630	-3.570	6.48
15.	55.440	60.129	-4.689	8.46
16.	58.210	57.188	1.022	1.76
17.	71.210	69.897	1.313	1.84
18.	84.720	82.848	1.872	2.21
19.	109.660	111.495	-1.835	1.67
20.	150.750	135.888	14.862	9.86

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

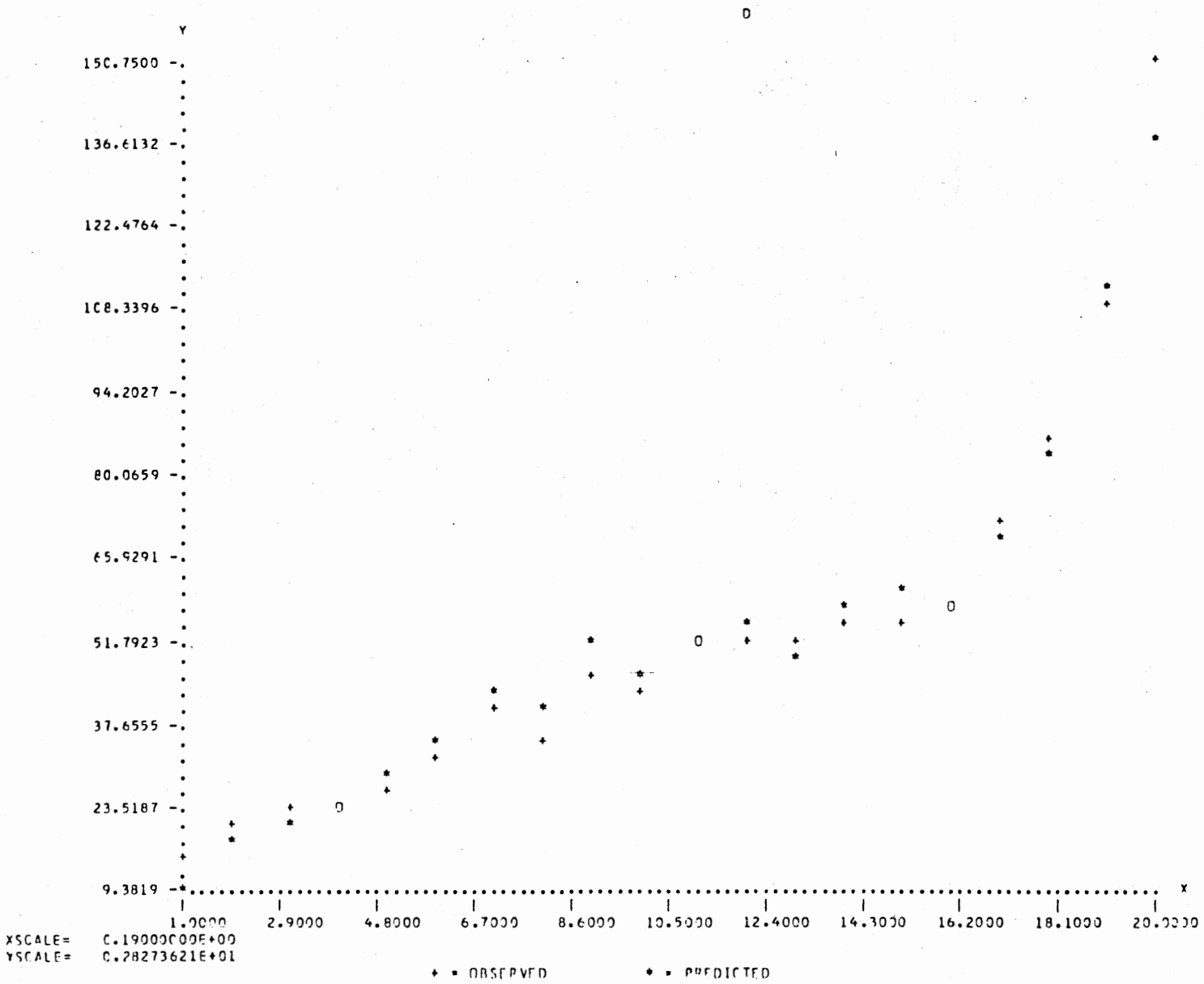
MEAN-ABSOLUTE-ERROR = 3.6068 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 9.1149 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.0567 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 2.8449 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3501 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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YSCALE= 0.28273621E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE M OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	20.240	17.204	3.036	15.00
2.	22.200	18.347	3.853	17.36
3.	24.330	15.931	8.399	34.52
4.	24.240	19.451	4.789	19.76
5.	26.090	24.326	1.764	6.76
6.	28.920	31.698	-2.778	9.61
7.	33.470	36.444	-2.974	8.88
8.	36.850	40.551	-3.701	10.04
9.	39.760	49.316	-9.556	24.04
10.	47.120	56.703	-9.583	20.34
11.	56.030	60.748	-4.718	8.42
12.	75.240	81.912	-6.672	8.87
13.	87.980	84.142	3.838	4.36
14.	96.220	103.154	-6.934	7.21
15.	105.460	110.144	-4.684	4.44
16.	108.000	104.229	3.771	3.49
17.	115.020	113.235	1.785	1.55
18.	139.250	131.797	7.453	5.35
19.	170.220	172.255	-2.035	1.20
20.	218.510	200.142	18.368	8.41

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

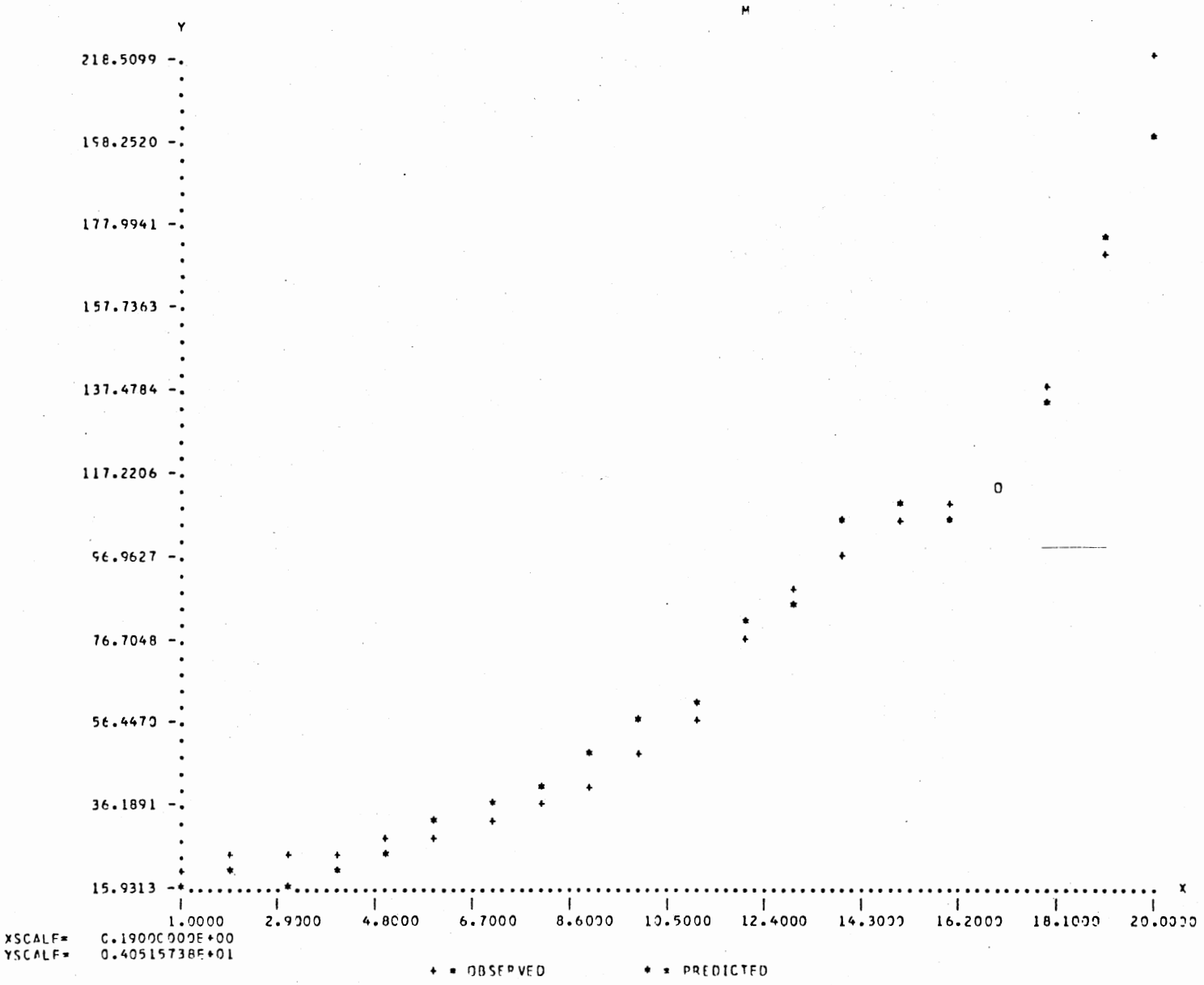
MEAN-ABSOLUTE-ERROR = 5.5346 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 10.9799 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.5001 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 3.0712 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3451 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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+ = OBSERVED
* = PREDICTED

	VARIABLE M2			
	OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	22.950	18.897	4.053	17.66
2.	25.700	22.224	3.476	13.53
3.	27.970	20.555	7.415	26.51
4.	28.940	24.895	4.045	13.98
5.	30.560	31.865	-0.905	2.92
6.	35.600	41.375	-5.775	16.22
7.	43.040	47.857	-4.817	11.19
8.	48.030	53.525	-5.495	11.44
9.	53.570	63.672	-10.102	18.86
10.	64.110	73.360	-9.250	14.43
11.	75.820	78.904	-3.084	4.07
12.	94.080	101.576	-7.496	7.97
13.	108.820	103.351	5.469	5.03
14.	118.840	126.372	-7.532	6.34
15.	129.130	134.021	-4.891	3.79
16.	135.110	129.131	5.979	4.43
17.	146.470	143.454	3.016	2.06
18.	176.060	167.952	8.108	4.61
19.	216.750	219.478	-2.728	1.26
20.	277.750	255.738	22.012	7.93

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

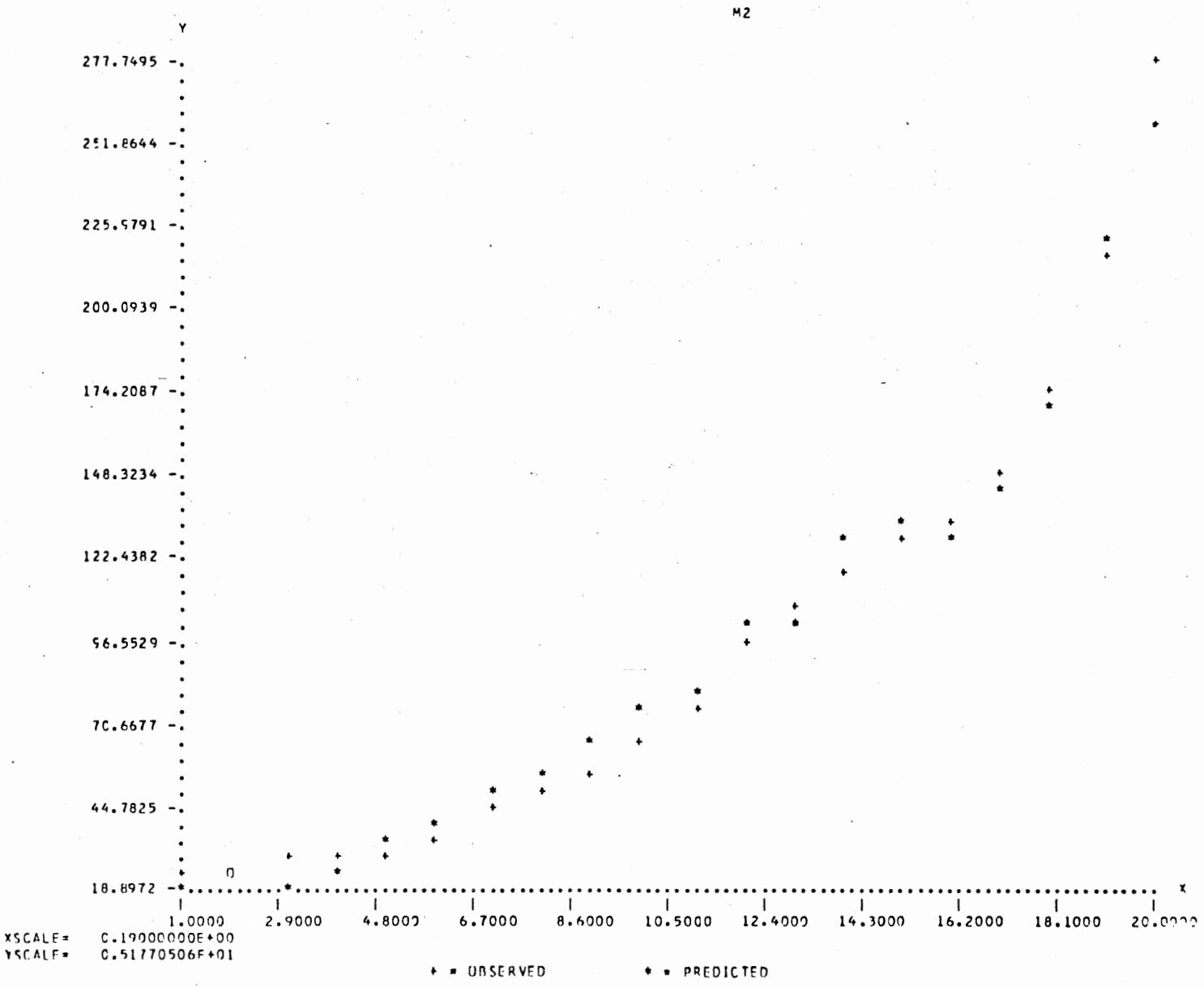
MEAN-ABSOLUTE-ERROR = 6.2824 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 9.7097 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.6984 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 2.6238 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3106 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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YSCALE= 0.51770506E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE C OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	58.010	62.753	-4.743	8.18
2.	64.000	73.590	-9.590	14.99
3.	70.970	79.460	-8.490	11.96
4.	87.090	83.707	3.383	3.88
5.	88.450	91.399	-2.949	3.33
6.	102.760	100.796	1.964	1.91
7.	102.360	109.757	-7.397	7.23
8.	116.820	118.068	-1.248	1.07
9.	123.470	125.619	-2.149	1.74
10.	138.040	135.749	2.291	1.66
11.	149.480	144.502	4.978	3.33
12.	158.550	152.737	5.813	3.67
13.	153.360	154.680	-1.320	0.86
14.	164.470	167.878	-3.408	2.07
15.	165.070	175.380	-10.310	6.25
16.	183.000	174.948	8.052	4.40
17.	193.520	186.065	7.455	3.85
18.	220.000	205.101	14.899	6.77
19.	256.780	244.285	12.495	4.87
20.	280.630	284.203	-3.573	1.27

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

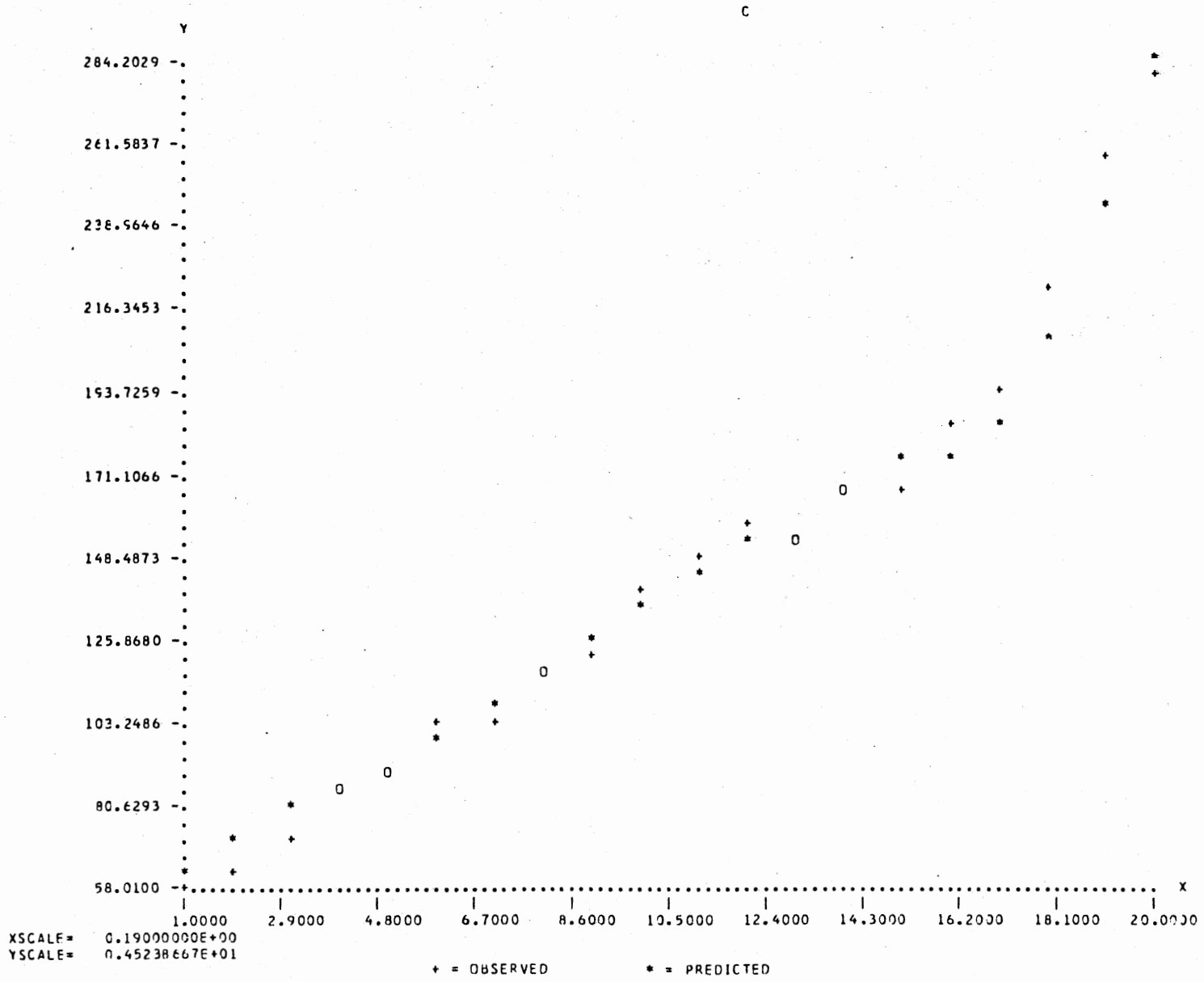
MEAN-ABSOLUTE-ERROR = 5.8254 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 4.6644 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.5542 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 1.3205 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3217 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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+ = OBSERVED
* = PREDICTED

	VARIABLE I			
	OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	8.100	7.430	0.670	8.27
2.	10.430	10.737	-0.307	2.94
3.	14.000	13.414	0.586	4.18
4.	18.170	14.762	3.408	18.76
5.	17.510	18.052	-0.542	3.09
6.	16.950	20.914	-3.964	23.39
7.	22.010	23.080	-1.070	4.86
8.	20.020	25.016	-4.996	24.96
9.	25.290	28.276	-2.986	11.81
10.	27.790	31.969	-4.179	15.04
11.	27.650	35.518	-7.868	28.46
12.	26.520	21.036	5.484	20.68
13.	37.650	42.888	-5.238	13.91
14.	64.570	46.911	17.659	27.35
15.	40.450	45.973	-5.523	13.65
16.	49.770	37.552	12.218	24.55
17.	51.160	52.177	-1.017	1.99
18.	51.300	58.180	-6.880	13.41
19.	83.440	79.882	3.558	4.26
20.	108.990	106.798	2.192	2.01

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

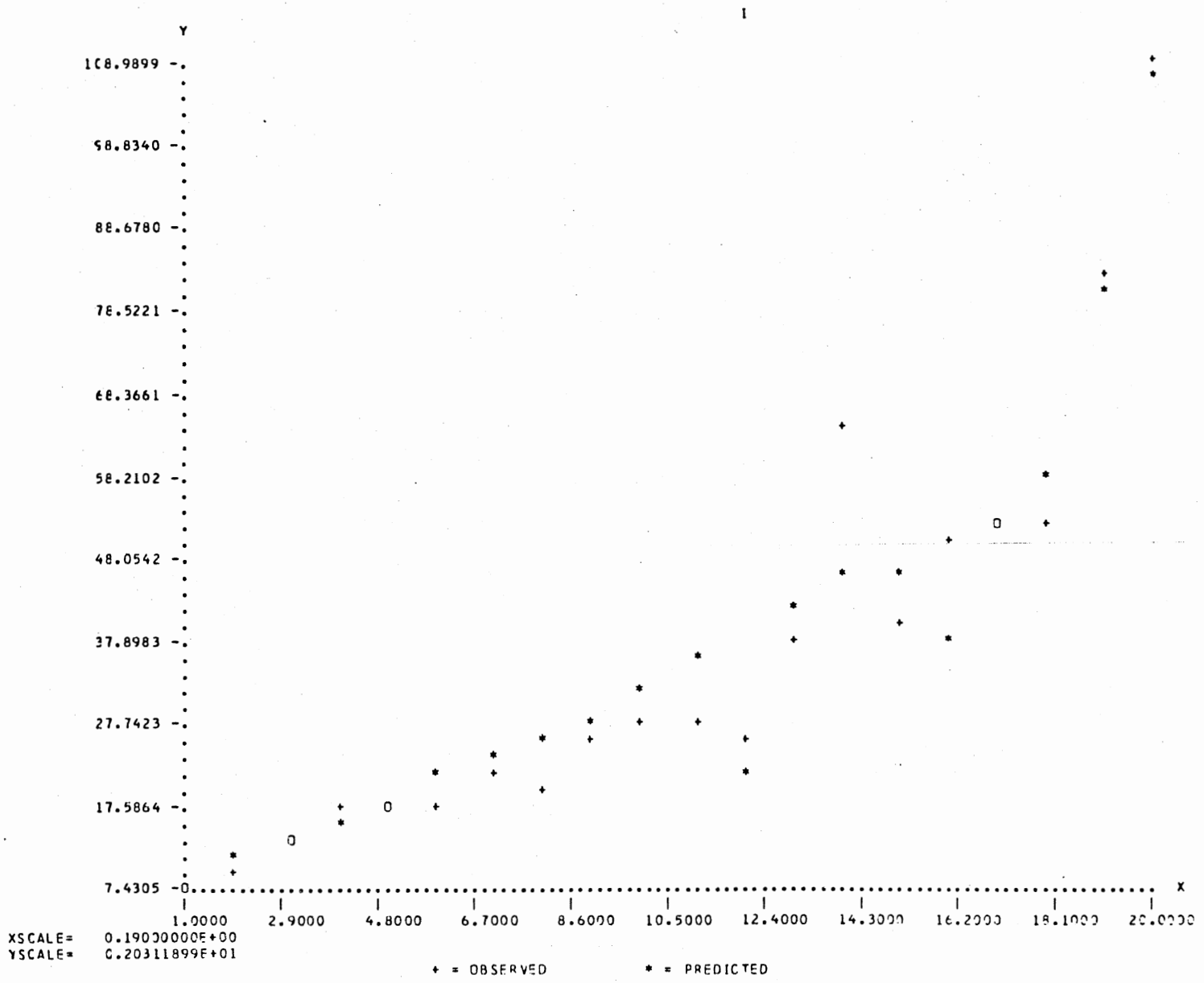
MEAN-ABSOLUTE-ERROR = 4.5173 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 13.3784 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.3765 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 3.6017 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.4620 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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XSCALE= 0.19000000E+00
YSCALE= 0.20311899E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE IM OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	26.230	24.008	2.222	8.47
2.	32.420	30.180	2.240	6.91
3.	36.700	37.956	-1.256	3.42
4.	43.370	40.873	2.497	5.76
5.	47.050	46.641	0.409	0.87
6.	46.610	50.736	-4.126	8.85
7.	51.800	53.513	-1.713	3.31
8.	61.060	55.937	5.123	8.39
9.	56.650	63.236	-6.586	11.63
10.	63.550	69.410	-5.860	9.22
11.	76.600	77.283	-0.683	0.89
12.	63.680	59.045	4.635	7.28
13.	90.980	99.240	-8.260	9.08
14.	108.690	101.718	6.972	6.41
15.	89.890	96.793	-6.903	7.68
16.	93.010	86.766	6.244	6.71
17.	119.880	125.762	-5.882	4.91
18.	136.360	133.089	3.271	2.40
19.	184.630	178.078	6.552	3.55
20.	250.300	247.362	2.938	1.17

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

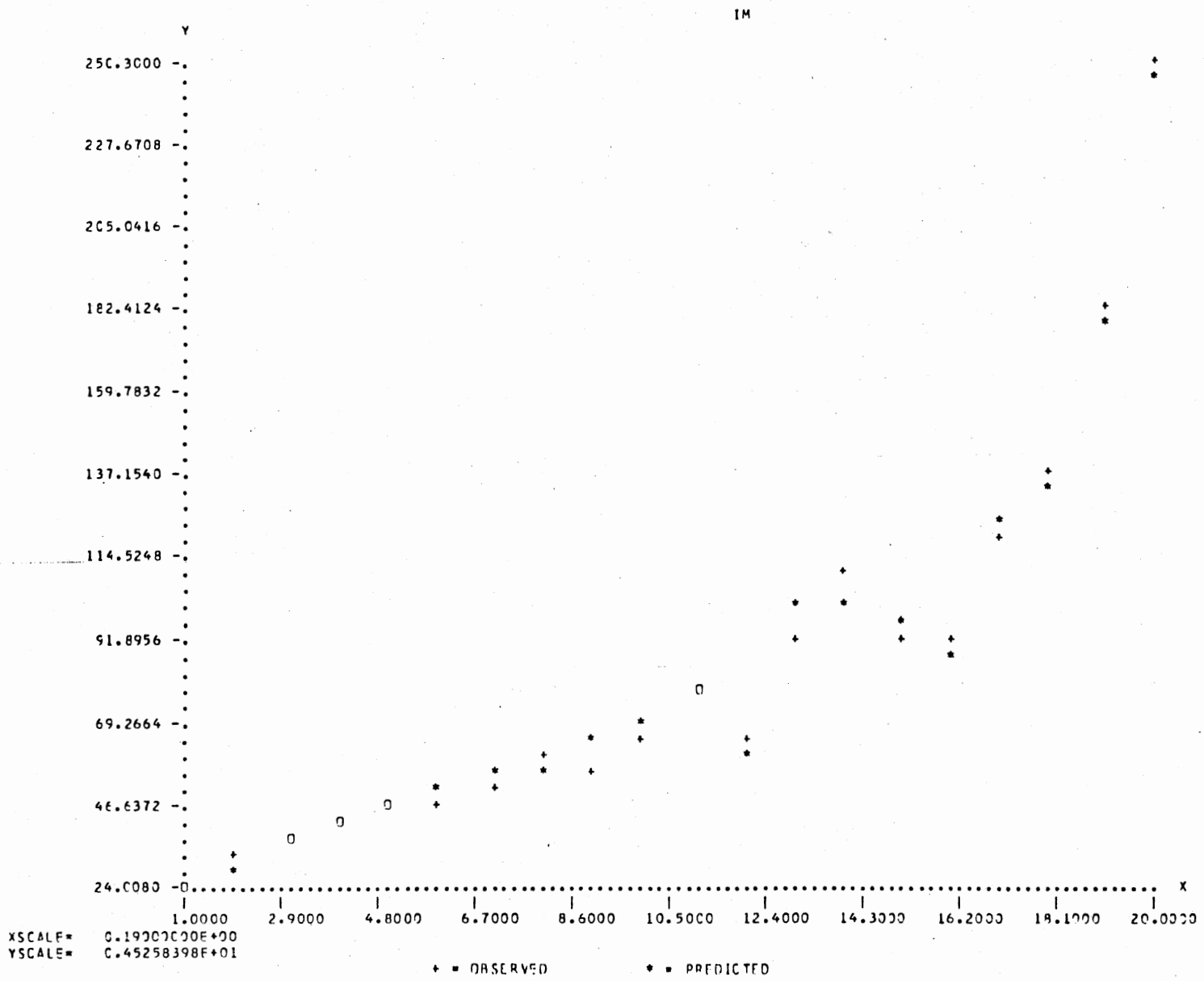
MEAN-ABSOLUTE-ERROR = 4.2185 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 5.8452 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.0772 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 1.4749 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.2591 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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+ = OBSERVED
* = PREDICTED

	VARIABLE T OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	7.040	7.674	-0.634	9.01
2.	7.850	9.151	-1.301	16.57
3.	8.540	9.512	-0.972	11.38
4.	10.170	9.993	0.177	1.74
5.	11.010	11.575	-0.565	5.13
6.	11.700	13.228	-1.528	13.06
7.	13.430	14.576	-1.146	8.53
8.	13.900	15.798	-1.898	13.66
9.	16.930	16.890	0.040	0.24
10.	19.670	18.755	0.915	4.65
11.	24.310	19.965	4.345	17.87
12.	20.610	21.190	-0.580	2.82
13.	21.530	20.793	0.737	3.42
14.	24.090	24.101	-0.011	0.05
15.	23.300	24.636	-1.336	5.73
16.	24.660	23.686	0.974	3.95
17.	28.910	26.703	2.207	7.63
18.	33.600	30.549	3.051	9.08
19.	39.110	38.896	0.214	0.55
20.	43.320	45.196	-1.876	4.33

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

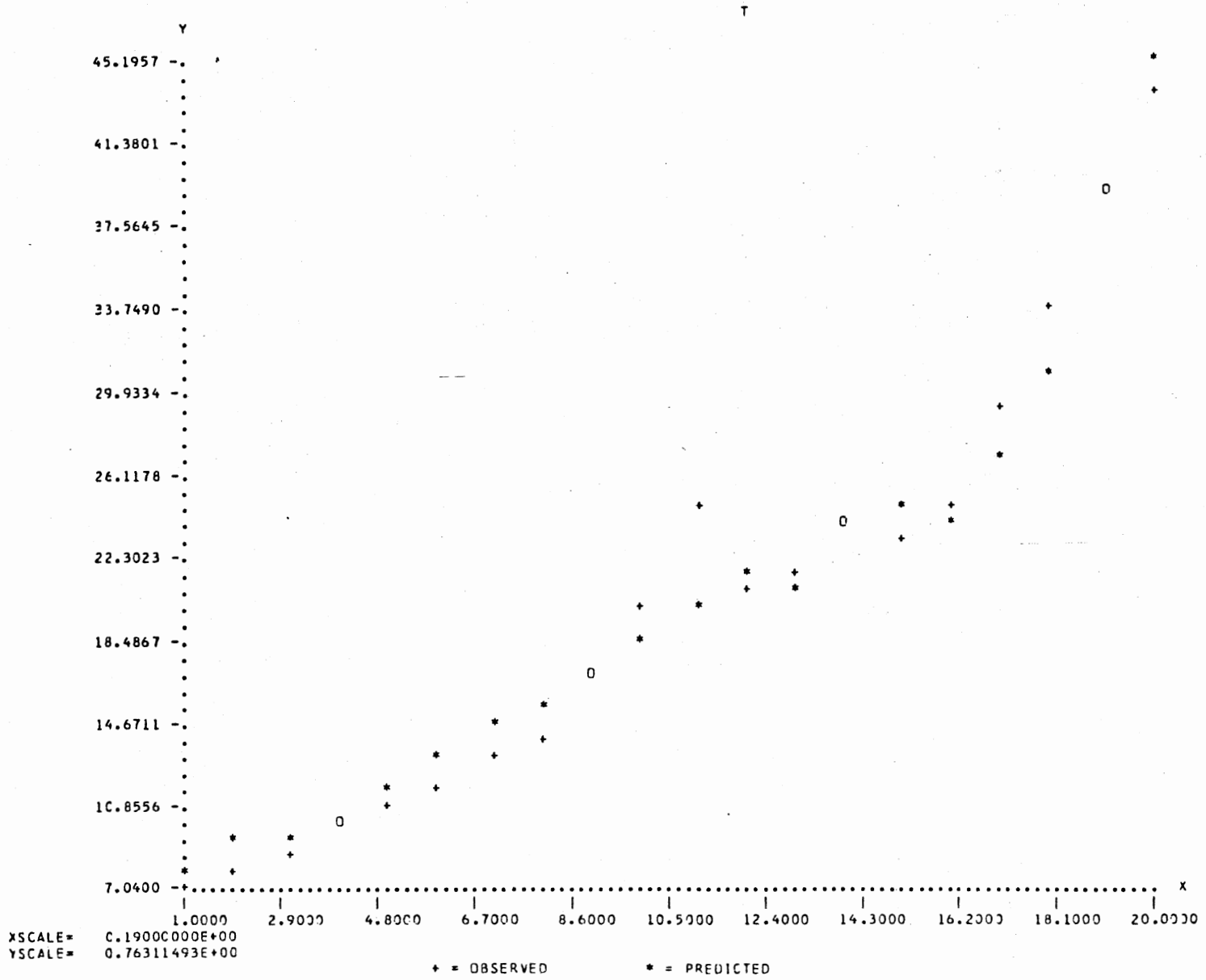
MEAN-ABSOLUTE-ERROR = 1.2254 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 6.9703 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 0.3596 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 1.9452 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.3714 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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+ = OBSERVED
* = PREDICTED

	VARIABLE YD OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	59.870	65.531	-5.661	9.46
2.	66.990	77.826	-10.836	16.18
3.	75.160	80.836	-5.676	7.55
4.	88.960	84.842	4.118	4.63
5.	94.680	98.015	-3.335	3.52
6.	115.440	111.786	3.654	3.17
7.	117.400	123.008	-5.608	4.78
8.	123.720	133.189	-9.469	7.65
9.	143.690	142.280	1.410	0.98
10.	160.870	157.814	3.056	1.90
11.	161.340	167.892	-6.552	4.06
12.	185.340	178.098	7.242	3.91
13.	175.750	174.785	0.965	0.55
14.	209.630	202.340	7.290	3.48
15.	199.200	206.795	-7.595	3.81
16.	211.930	198.879	13.051	6.16
17.	234.120	224.008	10.112	4.32
18.	257.740	256.043	1.697	0.66
19.	334.840	325.553	9.287	2.77
20.	375.580	378.023	-2.443	0.65

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

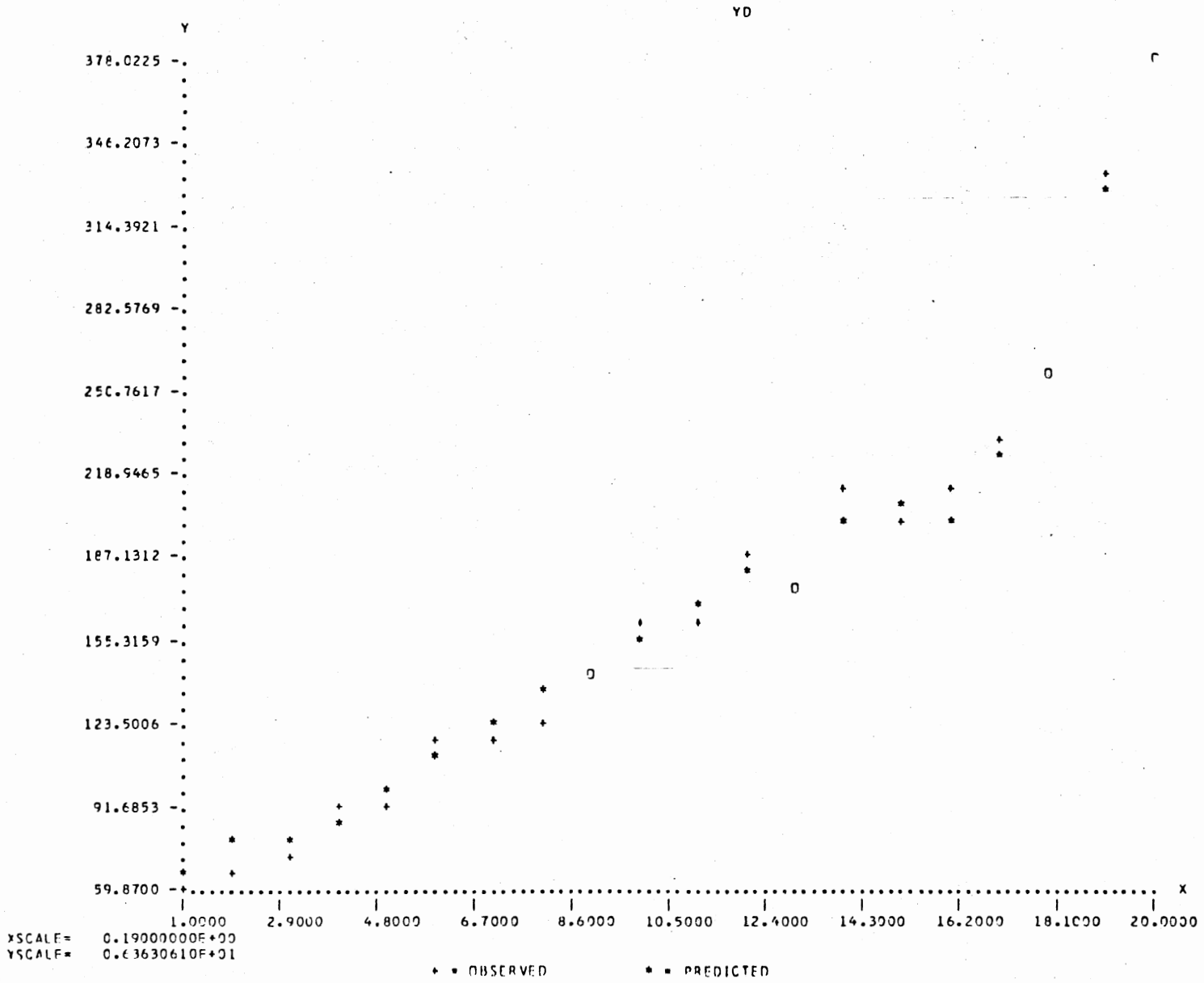
MEAN-ABSOLUTE-ERROR = 5.9529 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 4.5089 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.5251 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 1.2862 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.2723 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)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XSCALE= 0.19000000E+00
YSCALE= 0.63630610E+01
+ = OBSERVED
* = PREDICTED

	VARIABLE Y OBSERVED VALUE	FORECASTED VALUE	RESIDUAL	ABSOLUTE PERCENTAGE ERROR
1.	66.910	73.205	-6.295	9.41
2.	74.840	86.977	-12.137	16.22
3.	83.700	90.348	-6.648	7.94
4.	99.130	94.835	4.295	4.33
5.	105.690	109.590	-3.900	3.69
6.	127.140	125.014	2.126	1.67
7.	130.830	137.584	-6.754	5.16
8.	137.620	148.987	-11.367	8.26
9.	160.620	159.170	1.450	0.90
10.	180.540	176.569	3.971	2.20
11.	185.650	187.856	-2.206	1.19
12.	205.950	199.288	6.662	3.23
13.	197.280	195.578	1.702	0.86
14.	233.720	226.441	7.279	3.11
15.	222.500	231.431	-8.931	4.01
16.	236.590	222.564	14.026	5.93
17.	263.030	250.710	12.320	4.68
18.	291.340	286.592	4.748	1.63
19.	373.950	364.449	9.501	2.54
20.	418.900	423.219	-4.319	1.03

TEST CRITERIA FOR EVALUATING MULTI-EQUATION SIMULATION MODELS.

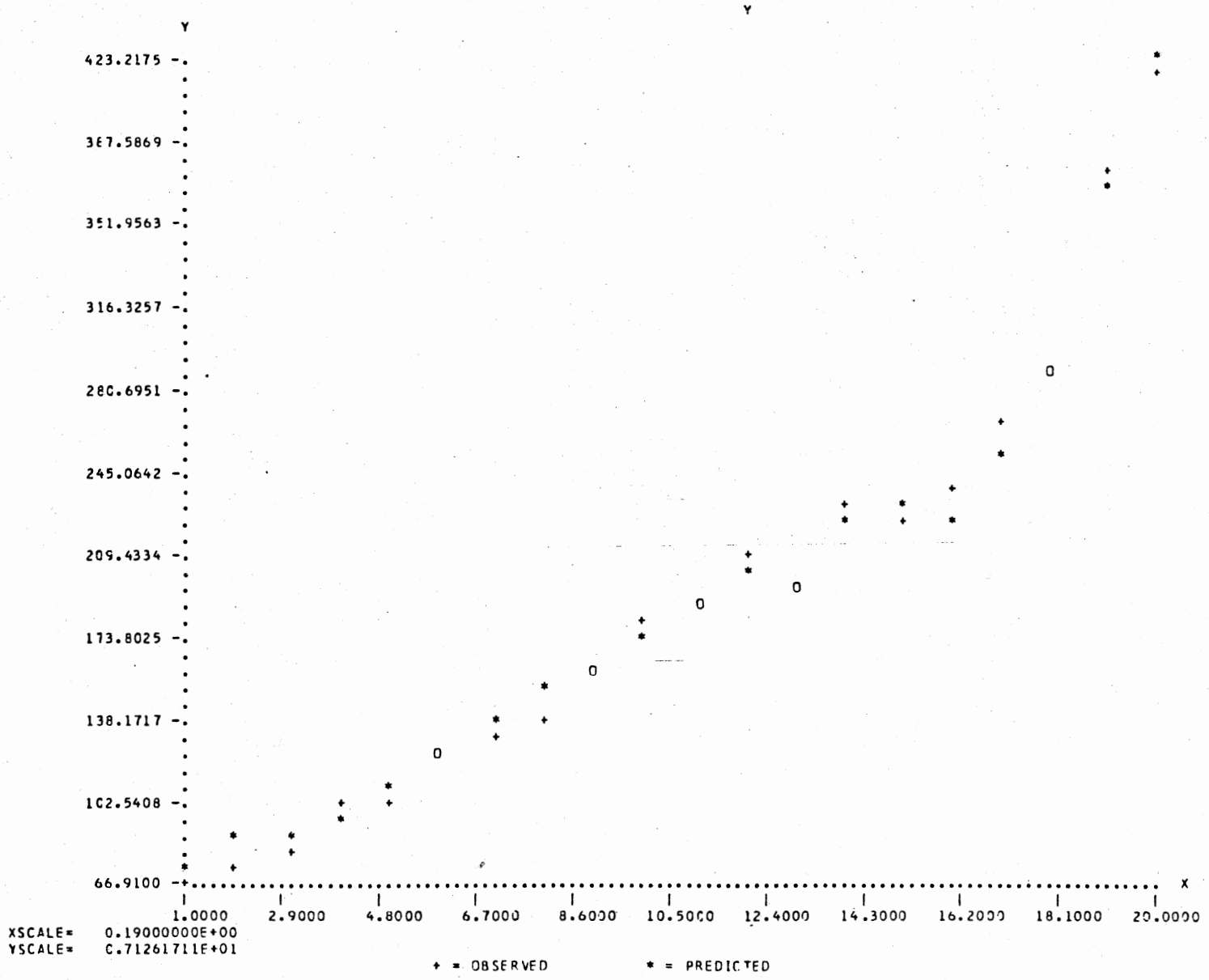
MEAN-ABSOLUTE-ERROR = 6.5318 (SEE PINDYCK & RUBINFELD,(1976),"ECONOMETRIC MODELS AND ECONOMIC FORECASTS", PP 316-317)
DF (20.)

MEAN-ABSOLUTE-PERCENT ERROR = 4.4007 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE ERROR = 1.6784 (IBID., PP 316-317)
DF (20.)

ROOT-MEAN-SQUARE PERCENT ERROR = 1.2806 (IBID., PP 316-317)
DF (20.)

INEQUALITY COEFFICIENT = 0.2559 (SEE THEIL,(1965),"ECONOMIC FORECASTS AND POLICY", PP 32-38)
DF (19.)


Y
423.2175
387.5869
351.9563
316.3257
280.6951
245.0642
209.4334
173.8025
138.1717
102.5408
66.9100
X
1.0000
2.9000
4.8000
6.7000
8.6000
10.5000
12.4000
14.3000
16.2000
18.1000
20.0000
XSCALE= 0.19000000E+00
YSCALE= 0.71261711E+01
+ = OBSERVED
* = PREDICTED

VITA[2]

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