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8. INTERNATIONAL STUDIES

Introduction

Several projects in the international area have matured during the past year. The largest in terms of the amount of new information collected and analyzed is the study of "Price Competitiveness in World Trade," by Irving B. Kravis and Robert E. Lipsey, which will soon go to press. This study serves a dual purpose, providing both a contribution toward improved methods of international price collection and comparison and an analysis of relative price levels and trends in the international trade of the United States and its leading competitors. Further work that makes use of the data collected and other price series is reported on below by Kravis and Lipsey under the heading "The Role of Prices in International Trade."

Another study now in press is Michael Michaely's "The Responsiveness of Demand Policies to the Balance of Payments: Postwar Patterns." Michaely's objective is to examine the behavior of monetary and fiscal policy variables in the United States and other leading countries and to try to determine, by systematic statistical investigation, to what extent the direction of movement in these variables has been consistent with changes in the international payments positions of these countries. The analysis is pursued both on a comparative basis and in detail for each of nine countries.

A monograph on "Measuring International Capital Movements," by Walther P. Michael, undertaken much earlier as part of a project on the structure of world trade and payments,¹ has been sent to the Board. It is a unique attempt to construct detailed matrices of different types of capital movements by drawing on data from both capital-exporting and capital-importing countries.

Among the work completed, mention should also be made of the conference volume on *The Technology Factor in International Trade*,

edited by Raymond Vernon, which was recently published. The proceedings of the Conference on the International Mobility and Movement of Capital, held in January 1970 under the chairmanship of Fritz Machlup, are being edited for publication.

The major new research endeavor recently undertaken as part of the international studies program concerns exchange controls and liberalization in developing countries. This project, for which financing is being provided by the Agency for International Development, is under the joint direction of Jagdish Bhagwati and Anne Krueger, and will entail the participation of a number of other leading scholars having first-hand knowledge of the problems to be studied. Plans for the study are given below in the report by Bhagwati and Krueger. Further support to another major project has been received from the National Science Foundation in the form of a second grant for the Robert Lipsey and Merle Yahr Weiss study of the relation between U.S. manufacturing abroad and U.S. exports. This is one of several international projects originally undertaken with the support of a grant by the Ford Foundation. Others in this group are the Michaely study and the conference on technology and trade, mentioned above, the Furth-Mikesell study reported on below, and my own volume published in 1968 on *Imports of Manufactures from Less Developed Countries*. Research in this last area is being carried on by Seiji Naya, who is continuing his work on the striking growth in the foreign trade of Korea.

The project on determinants of rates of intracountry diffusion of new technological processes, in which the National Bureau is cooperating with several European research institutes, is now well under way and beginning to yield questionnaire returns with the data needed for analysis. Alfred H. Conrad gives a detailed report below on the statistical design for the study of the basic oxygen process, for which the National Bureau has particular re-

¹ See Herbert B. Woolley, *Measuring Transactions Between World Areas*, New York, NBER, 1966.

sponsibility as its part in this cooperative research venture.

Among the international studies on which separate reports follow is that by George Garvy on money and banking systems in the Soviet Union and Eastern Europe.

Hal B. Lary

The Relation of U.S. Manufacturing Abroad to U.S. Exports

This study of interrelationships between manufacturing abroad by affiliates of U.S. companies and the export trade of the United States has been devoted mainly to data collection during the past year. The Office of Business Economics has completed its re-editing of data from several years of voluntary returns relating to trade between U.S. companies and their foreign affiliates. The only government data we are still waiting for are those of the Office of Foreign Direct Investments, covering the location and size of all foreign affiliates of U.S. companies and the exports of a large sample of U.S. parent companies. Both of these sets of data, after they are combined with information supplied by the National Bureau, are to be processed by the Bureau of the Census in such a way as to insure the confidentiality of the government records.

Of the data to be provided by the National Bureau, those on exports of the United States and its main competitors, by detailed commodity class and destination, have now been collected and processed. For many of the main countries in which U.S. direct investment is located, the affiliates of U.S. firms have been classified by industry and main product group. We expect to complete this aspect of the work soon. Data have also been collected on the sales, assets, and other characteristics of the parent companies. Of particular interest for this study is the information on the distribution, by SIC group, of parent companies' employment in the United States. The company identifications have been matched with those

used by government agencies in order to permit the assembly of a single unified file.

A description of the plans for the study, the data to be used, and the relationships to be measured was read at the 1969 Annual Meeting of the American Statistical Association. The paper, entitled "The Relation of U.S. Manufacturing Abroad to U.S. Exports: A Framework for Analysis," was published in the 1969 *Proceedings of the Business and Economics Section*, American Statistical Association.

The study has been financed by grants from the Ford Foundation and the National Science Foundation. Marianne Lloris and Susan Tebbets have been the research assistants responsible for most of the data collection and computer processing.

Robert E. Lipsey
Merle Yahr Weiss

The Role of Prices in International Trade

The new indexes of international price competitiveness compiled in our study, "Price Competitiveness in World Trade," that is now being readied for publication, offer opportunities to test the role of price levels and price changes in determining the level and direction of trade. Chapter 6 of that study includes some experiments along that line, but these did not take into account any of the factors other than prices that we might expect to influence trade flows. The present study is an attempt to exploit the data and the methods developed in the earlier study.

The first aspect of this work is an examination of the asymmetry between increases and decreases in U.S. price competitiveness during the period covered by the indexes, 1953 to 1964, for which we found that decreases in U.S. price competitiveness produced much stronger effects on trade than increases. One hypothesis we are testing is that the elasticity of substitution is sensitive to the initial share of each exporter in the market for a product. Pre-

liminary results suggest that this is indeed the case.

A second question we are investigating is whether the price level difference between two countries influences subsequent shifts in trade. If it does, the implication would be that the response to price changes is slow, and that this year's changes in trade shares may be a response to price changes in past periods. If the price level difference is not a significant factor, the implication would be that the adjustment is fairly rapid and that the trade pattern of each period already reflects recent price levels.

A further step in the analysis, for which the data collection is now complete, will involve a disaggregation of the trade data by major markets. In this way we will eliminate the influence of each country's domestic market on the results and take account of the possibility that substitution elasticities differ significantly among markets.

In addition to these analyses, which will be conducted using price data from the price competitiveness study, we plan to construct wholesale price indexes for the main trading countries on the same principles used for the international price indexes; that is, with a common weighting system based on international trade weights. These indexes will then be used to interpolate and extend our international price indexes and also, by themselves, to study changes in trade. We will make use of these wholesale price data despite their serious deficiencies, which we discussed in the Price Competitiveness volume, because our own international price indexes are not available beyond 1964 and there is no immediate prospect of any official program to bring them up to date. For the near future, therefore, current analyses will have to rely on wholesale prices and other less suitable series.

We have now collected all the basic price data needed for the calculation of these indexes, to cover the period 1953 through 1968 for the United States, the United Kingdom, Germany, and Japan. We have also assembled trade data for the period since 1964 in addition to that collected earlier. Christine Mortensen

and Eva Wyler have been assisting us with the price collection and data processing.

The first results of this project, based entirely on the international price indexes, were presented in a paper at the Conference on Research in Income and Wealth in May 1970.

Irving B. Kravis
Robert E. Lipsey

The Diffusion of New Technologies

During the second full year of the New Technology Project, the European group drafted and distributed questionnaires on special presses in paper-making (Industriens Utredningsinstitut, Stockholm), shuttleless looms in textiles (National Institute for Economic and Social Research, London), numerically controlled machine tools (Institut für Wirtschaftsforschung, Munich), and continuous- or strand-casting in steel manufacture (Osterreichisches Institut für Wirtschaftsforschung, Vienna). At the National Bureau, in addition to the reworking of some of the questionnaire materials to fit American practices more closely, and their subsequent distribution among American firms, a second, company-level questionnaire was prepared for the basic oxygen process in steel. Secondly, in the face of the reluctance of many European firms to reveal capacity figures and the refusal of American manufacturers to report capacities after 1960, Wharton School capacity series were prepared here from steel output data for each of the participating countries. In addition, financial data were gathered by us at the European Economic Community and the High Authority of the European Iron and Steel Community to supplement the limited availability of balance sheets and income statements by European steelmakers. Finally, work has gone forward on the two-stage statistical design for the steel study, based upon a partial-adjustment investment function of the Koyck-Nerlove type (and similar to John Lintner's dividend model).

The second-stage questionnaire in steel asks for information on (1) the technological en-

vironment at the plant level, (2) managerial patterns, or style, and (3) research and development activity by the companies. Following the emphasis in the NBER design upon the technological background to the cost advantages of the innovation, the new inquiry concentrates on scrap balance, hot metal capacity, and operating improvements in existing furnaces. Management style is approached in terms of educational backgrounds, patterns of executive compensation, and turnover rates in the executive group. The research and development questions include specific chronologies as well as information on expenditures and personnel.

The Wharton capacity-utilization indexes were prepared from national data on steel production and investment. In addition to the obvious test of comparison with the period for which independent series are available for the United States from the American Iron and Steel Institute, the European series were sent to the participating institutes to be checked against unpublished indicators (or even more informally within the industry); the results have been generally reassuring on the usefulness of this crucial set of estimates for the "acceleration-principle" part of the diffusion model.

The empirical model starts from a comparison between the desired or optimal level of diffusion at time t , and the actual level. Let Y_t stand for the actual level of diffusion at time t , measured as the relative share of the new-technique capacity in the total capacity of the industry. Y_t^* , similarly, is the desired or optimal level of diffusion at time t . We can then write

$$(1) \quad Y_t - Y_{t-1} = \alpha(Y_t^* - Y_{t-1})$$

where α is the partial adjustment coefficient, measuring the degree to which the actual rate of diffusion, $Y_t - Y_{t-1}$, approaches the desired (or "desirable") rate of diffusion.¹ The desired

¹ In this *deterministic* form, the adjustment function does not include a random disturbance term, u_t , say. In the stochastic estimating form of the equation, such a term should of course be included.

rate is defined by

$$(2) \quad Y_t^* = a + b_1 X_{1t-1} + b_2 X_{2t-1} + \dots + b_k X_{kt-1}$$

where X_1, X_2 , etc., are the profitability, output growth, capacity utilization, and other (national level, i.e., average or aggregate) market and technical variables mentioned earlier.

Combining (1) and (2), we have

$$(3) \quad Y_t = \alpha a + \alpha b_1 X_{1t-1} + \alpha b_2 X_{2t-1} + \dots + \alpha b_k X_{kt-1} + (1-\alpha)Y_{t-1}$$

which relates the actual level of diffusion to the postulated economic determinants. The stochastic form of equation 3 (equation 3.1) includes the addition of a random disturbance term, u_t . By applying ordinary least squares to (3.1) we can, in theory, get direct estimates of the parameters, α, a, b_1, b_2 , etc. Returning to equation 2, the estimated \hat{a} and \hat{b}_i should enable us to define the optimal diffusion level \hat{Y}_t^* . (The limits of inference, in addition to the problem of the adequacy of the sample, require that the equation be fitted to the full set of international observations. An alternative procedure is to derive the parameters, b_i , extraneously from engineering estimates.)

We now have two ways of specifying the dependent variable in the second stage. If the managerial variables can be operationally defined over time, then the expression $\hat{Y}_t^* - Y_t = (Y_t - Y_{t-1}) - (\hat{Y}_t^* - Y_{t-1})$ may be regressed upon time series of the management-style variables. But management style as we have discussed it is likely to be a long-run stable characteristic of firms within a country, perhaps even without regard to industry or sector, so that \hat{a} , the adjustment or response *coefficient*, would itself provide a more plausible second-stage dependent *variable*. The analysis of covariance analogue to the pooled regression procedure suggested for (3.1) will deliver a set of \hat{a} 's as country constants, but a simpler, though crude, procedure is also available. Given the estimates \hat{b}_i , we can use the raw data on Y_t and X_{it} in equation 3, country by coun-

try, to estimate the individual national δ 's.

Up to this point, we have dealt with the profit-maximizing aspect of the decision to adopt a new technique. By introducing the adjustment factor, which is obviously intended here to be something more than a random error term, we are able to go beyond the maximizing decision to consider questions of innovating style. The technique suggested earlier was to relate the optimal-actual difference, or the adjustment coefficient itself, to a set of variables specified to approximate both financial behavior and the availability of funds, as well as management style and attitudes toward innovative behavior.

The explanation of observed diffusion patterns, then, is broken into two parts. The first part is derived from an orthodox profit-maximization model, applied to a specific kind of investment decision: the adoption of a new process. The second part of the theory is an attempt to relate the observed rates of response to the technological opportunity, on the one hand, with variations in management motivation and style, on the other. Because the innovating spirit is a value-loaded concept, we are attempting to go beyond stated attitudes, which may express desirable images as much as actual behavior, and consider such evidence of motivation as can be found in varying policies toward liquidity, research budget practice, and the executive structure of the firm.

In view of the severity of our specification and data problems, how are we proceeding to implement the empirical model of diffusion?

First, in order to generate a series of Y^* for each country for the given industry, it is necessary to have estimates of the \hat{b}_i for those variables which enter the cost-saving relationship. Cost differences between the new processes and existing techniques will be a function of the scale of operations, the relative prices of primary inputs, and the other technical economic variables observed in the first-stage questionnaires. The problem is how we can most effectively incorporate the cost-advantage variable into the diffusion model.

Two approaches have been considered. The

first would be to derive a measure of cost-advantage directly, which (let us call it the γ variable) then becomes one of the arguments on the right-hand side of equation 2, which, in turn, determines the desired rate of diffusion. But, in order to predict the γ values—since that is how the cost advantage enters the investment decision—we must have estimates of the elasticities of total cost with respect to the technical conditions mentioned in the paragraph above. As was suggested earlier, it may be most convenient to estimate these elasticities directly from best-practice engineering data. We have engineering cost comparisons under varying conditions for steelmaking. Again, recall that the purpose of these elasticities is to make possible a set of γ estimates which are indicative of the technical conditions *specific to each country*. Ideally, and where there are sufficient time series, we should generate a series of such observations on γ . I have discussed previously the simultaneity problem involved at this stage of the analysis, where the conditions themselves may change in anticipation of or in response to the adoption of the new technique. The problem is equally grave at the next step, the estimation of the \hat{b} coefficients in equation 3.1 for subsequent use in (2).

The second approach would be to enter the cost-advantage variables directly into equation 2. However, while it is possible to estimate the cost-saving elasticities extraneously in order to use the cost-advantage in (2), it is not obvious how we could identify any direct relationships between the cost-determining variables and the desired diffusion rate. In general, the estimation of the \hat{b} coefficients, either directly or in terms of the γ variables, depends upon the significance we are able to attach to the α estimates in equation 3.1.

In addition to the cost-advantage variables, the first-stage analysis must take account of product specifications (the proportion of special steels, essentially) which directly condition the appropriateness of the new technique. Another conditioning variable is the presence of a sufficient supply of hot metal for the basic oxygen converter. Preliminary investigation

suggests that the necessity to construct new blast furnace capacity, which would in any event not be required in order to introduce an electric steelmaking furnace, would be an almost entirely dominant negative influence in the decision with respect to the basic oxygen process.

The final group of first-stage variables in the model is drawn from the theory underlying the acceleration principle, rather than from marginal theories of the capital decision. If the productive capacity is increasing in an industry, the possibility of increasing the share of a new technology in the total is obviously greater than when adoption of the new technique involves a decision to retire (replace) existing active capacity. Similarly, if the stock of capital is of relatively early vintage—in calendar terms, not simply technologically—so that a large proportion of the stock is approaching the age of physical retirement and has been written off, then the new capital decision is a choice between techniques, essentially, and not a decision to replace active capacity. The variables measuring the rate of growth of output in the given industry within each country and, where it is available, a measure of the vintage of the capital stock, are entered directly into equation 3. In addition, the capacity-utilization series mentioned earlier are part of the set of acceleration variables.

These variables seem to me to be sufficient to generate the “desired” diffusion rates, Y^* . In those cases especially where a complete time series is not possible because of gaps in the basic data, we will try to redesign the first stage to provide an optimal “prediction” of new technique proportions at a pair of dates, *e.g.*, two and seven years from the data of first commercial application.

Since the optimal rate is a manufactured measure, rather than an observed datum, it can in no way be tested for statistical significance. (I omit discussion of the obvious Bayesian argument with regard to the decision-making significance of the Y^* measure, beyond observing that the Bayesian approach may be more relevant than classical significance for a theory

derived from the investment decision.) There is still the possibility of testing a single-stage model in the general form of equation 3. In that event, of course, the managerial variables must be added to equation 3.1, in which case we shall quickly run into problems of statistical degrees of freedom and the more serious interdependence difficulties already discussed with respect to the \hat{b} estimates. It may be possible to avoid this by careful grouping and the use of binary dummy variables or other nonparametric techniques; but in the grouping case, I would be anxious about heteroscedasticity, and in the use of dummies, I would regret the inevitable loss of richness.

The first-stage national data series are in hand now. The second-stage company-level responses are beginning to come in. The group's timetable is now aimed toward a final editorial meeting in June 1971.

During the past year, the project staff at the National Bureau has included, for varying lengths of time, Guy Herregat, concentrating on the steel questionnaires; Mansing Lee and Neville Beharie on the textile, paper, and machine-tool questionnaires; Pamela Mash on the capacity utilization series and textile trade statistics; and Jae Won Lee on statistical problems.

Alfred H. Conrad

Exchange Control, Liberalization, and Economic Development

This study is concerned with the exchange control systems applied in most of the developing countries, the effects of these controls upon economic growth, and ways in which liberalization of restrictionist regimes can be accomplished. Quantitative controls in the developing countries affect virtually every aspect of economic activity: production levels are frequently determined by the availability of imports; the implicit protection afforded to import-competing producers leads to high-cost import substitution and, frequently, to domestic monopoly

positions; and export growth is inhibited by overvaluation of the exchange rate. Liberalization is not easily achieved, however, and little is known about how it can be successfully carried out.

In the course of the project, the experience of a number of developing countries with exchange control and liberalization efforts will be carefully and systematically examined. Each of the country studies will be undertaken by an economist already familiar with that country, and coordination of the individual research projects will be sought through a basic "analytic framework" prepared by us in consultation with the other participants and through periodic meetings of the group. On the basis of the individual studies, which will be carried on over the next year and a half, the project directors will prepare an over-all synthesis with the aim of providing better answers than are now available concerning the effects of controls and the most promising means of liberalization. It is anticipated that the systematic and parallel investigation of a number of cases will provide, among other things, new insights into the costs of exchange control systems, in terms of the effects on the growth rates of developing countries and the viability of their economic development.

Countries whose experience will be subjected to detailed examination will probably include Brazil, Chile, Colombia, Egypt, Ghana, India, Israel, Pakistan, Philippine Islands, South Korea, Turkey, and several others yet to be determined. The initial meeting of economists participating in the project was held at the National Bureau on May 28 and 29.

Jagdish N. Bhagwati
Anne O. Krueger

The Pattern of Exports and Import-Substitution in an Outward-Looking Economy: Korea

In continuation of a study of Korea's trade pattern, my research during the past year has been

primarily concerned with the extent to which the country's tariff structure affords protection to value added by production, as distinguished from the gross value of production, of its industries. In measuring this "effective rate of protection," 158 manufacturing sectors have been selected from 299 interindustry sectors for the year 1966. Nominal tariffs and special customs duties are combined as tariff measures (with both import-weighted and output-weighted tariffs employed for different computations).

One result of the various computations made is that the pattern of effective rates across industries, measured under the assumption of fixed input coefficients, closely reflects that obtained when substitution between inputs is allowed. In testing for possible distortion of effective rates when measured with fixed input coefficients, I have computed proportionate changes in the price of value-added inputs based on the CES production function and an assumed value of 0.5 for the elasticity of substitution between value-added and intermediate inputs. Under the fixed coefficients assumption, both the average rate and the coefficient of variation are found to be more than 50 per cent larger than under the substitution assumption. Yet the pattern given by these two sets of estimates is virtually identical (the correlation between them being .9919).

Since the above finding is based on assumptions with respect to the production function and the elasticity of substitution, two more sets of effective rates have been computed as an additional test. These are based on 1963 and 1966 input coefficients but use the same 1965 tariffs. A close similarity in the pattern of effective rates is again disclosed, despite the use of different input coefficients.

My work on the export performance and trade structure of Korea is now being extended to other Asian countries. This work, which employs Lary's value-added-per-employee as a proxy for capital intensity, is being financed by a grant from the Southeast Asia Development Advisory Group.

Seiji Naya

Foreign Holdings of Liquid Dollar Assets

The purpose of the study is to analyze the behavior of foreign holdings of liquid dollar assets over the period 1957-69 in order to improve our understanding of the international functions of the dollar and of the position of the United States as an international financial center.

The study focuses on the different types of liquid dollar holders, i.e., foreign official agencies, foreign commercial banks, foreign branches of U.S. banks, and other foreigners. The published breakdown by types of holders of direct foreign dollar claims on the United States ("American dollars") is unsatisfactory for the purpose of the study because the data do not reflect the impact of the Eurodollar market on both the size and the distribution of total liquid dollar assets held by foreigners. Similarly, the published Eurodollar statistics of the Bank for International Settlements need to be modified for the purpose of the study in order to eliminate double counting. The integration of American dollar and Eurodollar statistics presents many conceptual and statistical difficulties but is essential for estimating and analyzing the behavior of foreign holdings of liquid dollar assets.

On the basis of our estimates, the changes in foreign-held dollar assets will be compared with the corresponding changes in foreign-owned dollar liabilities, again including liabilities both to U.S. residents and to other foreigners, so as to arrive at estimates of foreign "net" dollar holdings by type of holder. We also plan to analyze the foreign demand for liquid dollar assets by category of holder, in terms of the major determinants of foreign demand which have been dealt with in the literature on international short-term capital movements. These determinants include: (a) interest rates or interest rate differentials; (b) trade flows or total transactions involving dollars; (c) exchange rate expectations; (d) various measures of foreign confidence in U.S. dollars; (e) portfolio balance prescriptions; and (f) institutional factors.

We believe the previous analyses of these determinants of foreign dollar balances have been inadequate because of their failure to disaggregate balances by type and by category of holder.

A complete analysis of the foreign demand for liquid dollar assets would require the formulation and testing of a comprehensive econometric model, which would include among the variables all liquid assets that serve as a substitute for liquid dollar assets and those transactions governing the supply of liquid dollar assets. Our purpose is the more modest one of providing the conceptual and statistical basis for such an analysis. However, we do plan to undertake a preliminary study of variations in categories of foreign liquid dollar assets in relation to the determinants noted above. This study will provide the basis for a critical review of several models that have been formulated (and tested) in the literature relating foreign dollar balances to central bank asset preferences, the transactions demand for dollar balances, and balanced portfolio hypotheses.

Our initial work has consisted of bringing up to date the data contained in an earlier draft of this study prepared by Herbert Furth, and subjecting the data to some tentative statistical tests. Readjustment of the "net" value of the Eurodollar market has resulted in a figure considerably lower than that used by the Bank for International Settlements but still large enough to influence decisively the aggregate amount of foreign dollar holdings. The data confirm our suspicion that, on balance, only foreign official agencies are holders of sizable net liquid dollar assets, while foreign commercial banks tend to maintain a zero net position, and other foreigners are on balance substantial net dollar debtors. The data also show how closely the rise in foreign net dollar holdings is associated with the increase in the net value of the Eurodollar market, and how the participation of foreign official agencies in that market has caused, on occasion, the paradox of a U.S. payments surplus on "official reserve transactions" account at a time of record deficits on the "liquidity" account. Similarly, disaggregation

between dollar assets held by foreign banks and by foreign branches of U.S. banks, together with further disaggregation by regions, brings to light the differences in the behavior of foreign banks in Western Europe (where banks have been substituting Eurodollars for American dollar holdings) and in the rest of the world (where banks have continued to expand working balances in American dollars in line with the growth in international commerce).

J. Herbert Furth
Raymond F. Mikesell

Credit, Banking, and Financial Flows in Eastern Europe

The main objective of my project is to analyze the functioning of the banking and credit systems in the socialist countries of Eastern Europe and their relation to central planning. Because money and credit are largely elementary rather than dynamic elements of the socialist economies, and fiscal rather than monetary policy is relied upon to achieve macroeconomic equilibrium, a full evaluation of the contribution of monetary policy to economic stability and growth will not be attempted.

The monograph will cover all the socialist countries of Europe with the exception of Albania. The Soviet system was introduced in the other countries of Eastern Europe about thirty years after the Bolshevik Revolution, in the course of which the old Russian monetary and banking system had been liquidated and, after a series of experiments, replaced by the present system. The smaller countries of Eastern Europe did not start *de novo*, they merely copied an existing system. Thus, the main part of the project will deal with what I have called the "standard system" developed in the Soviet Union after the credit reform of 1930-32. In carrying out this project the role of money and credit in a centrally directed economy will be explored, as well as the structure and functioning of the banking system, which I have called the "monobank."

Part I of the monograph will provide a general historical introduction. It will first trace some elements of the standard system to the deep involvement of the Czarist State Bank in creating the Russian banking system and in using it to achieve specific goals of government policy. A second chapter will show that some of the ideas embodied in the standard system were, in fact, developed by several academic and financial economists of prerevolutionary Russia. In another chapter the sources of Lenin's views that the banking system should be used as a means for the socialist transformation of the Russian economy will be traced. As it happened, partly because of the Civil War, the money and banking system collapsed, and the blueprint proved inapplicable. The nationalization and liquidation of the prerevolutionary banking system will be the subject of the final chapter of the historical part.

The "standard system" emerged in the Soviet Union in the early 1930's, and has undergone little change since then. Since all the elements of the socialist monetary and credit system adopted by the countries of Eastern Europe in the late 1940's derive from the Soviet prototype, the latter will be examined in some detail in Part II. Successive chapters will describe the monetary system structured to serve a centrally directed economy, the role of credit in such an economy, the structure and functioning of the banking system, the various instruments and processes of "socialist credit," and finally, the nature of financial flows and the financial planning designed to project and to control these flows.

The proposed plan for Part II will permit an analytical treatment of the "standard case," while the institutional and policy differences which emerged in the other countries will be reserved for Part III. In the smaller countries, the Soviet credit system was introduced against the background of a financial structure which, in most cases, was much more developed than in Russia at the time of the Revolution, and more of the traditional elements of their respective banking structures were carried into the standard system. Other differences in the

smaller countries compared with the Soviet system relate to the greater relative importance of the financing of foreign trade and the provision of credit to households and to the non-socialized sector of the economy. Soon after its adoption, the Russian system began to be modified to fit the particular needs of each of the smaller countries embarked upon a program of economic reforms. Credit became one of the main instruments for channeling funds into investment and for achieving a more decentralized and flexible system of production and distribution responding to demands by ultimate consumers. Part III, then, will be a comparative study of the credit systems of the smaller socialist countries. It will show significant differences in policies and techniques among these countries, as well as the way in which the standard system had been adapted and in some cases developed beyond the Soviet example. A separate chapter will deal with foreign monetary relations and operations, including the role of the International Bank for

Economic Cooperation and the "transferable ruble."

Yugoslavia, which originally had also slavishly copied the Russian system, has gradually evolved a system which is geared to a competitive socialist market economy. It pioneered some of the ideas embodied in the economic reforms now being undertaken by its neighbors. Because banking and credit in Yugoslavia can no longer be adequately described as just a variant of the Soviet prototype, a separate chapter on Yugoslavia will conclude Part III.

Part IV will discuss the role of credit in the economic reforms in Eastern Europe. A significant part of these reforms concerns the use of financial incentives and the rechanneling of financial flows through the use of credit in preference to the financing of investment by nonreturnable grants. Developments up to the end of 1969 will be covered.

George Garvy

9. ECONOMETRICS AND MEASUREMENT METHODS

Analysis of Long-Run Dependence in Time Series: The R/S Technique

This study is concerned with testing out and improving R/S analysis,¹ a new and extremely promising statistical technique that can be used either to test for the presence of very long-run nonperiodic statistical dependence, or to define and estimate the intensity of such dependence. Very long-run nonperiodic dependence manifests itself by the presence of "cycles," clear cut but of variable periodicity, superimposed upon a variety of "variable trends," "slow cycles," and "long swings"; where the slowest swing period is roughly of the order of magnitude of the total available record. Such behavior is well-known to be characteristic of many economic records.

¹ R/S symbolizes cumulative range divided by the standard deviation.

Since the sources of the R/S analysis are not readily accessible,² the basic definitions must be repeated. Let $X(t)$ be a stationary random

function with $\sum_{\hat{t}=1}^t X(u)$ denoted by $X^*(t)$. For

every value of d (called the lag) one defines

$$R(t, d) = \max_{0 \leq u \leq d} \{ X^*(t+u) - X^*(t) - (u/d)[X^*(t+d) - X^*(t)] \} - \min_{0 \leq u \leq d} \{ X^*(t+u) - X^*(t) - (u/d)[X^*(t+d) - X^*(t)] \}$$

and

² Two articles by myself and J. R. Wallis: "Robustness of the Rescaled Range R/S in the Measurement of Noncyclic Long-Run Statistical Dependence," *Water Resources Research*, October 1969, pp. 967-988; and "Computer Experiments with Fractional Gaussian Noises," *Water Resources Research*, February 1969, pp. 228-267.