

**BASEMENT**

10

E

75:1948-1951

UNIVERSITY OF CAMBRIDGE

DEPARTMENT OF  
APPLIED ECONOMICS

SECOND REPORT  
ACTIVITIES IN THE YEARS  
1948-1951



*July 1951*

**The Marshall  
Library of Economics**



*Alfred Marshall*  
**University of Cambridge**



UNIVERSITY OF CAMBRIDGE Ø6ALØ  
DEPARTMENT OF APPLIED ECONOMICS

*Director*

RICHARD STONE

*Committee of Management, June 1951*

E. A. G. ROBINSON (*Chairman*)

C. F. CARTER

N. KALDOR

S. R. DENNISON

D. H. ROBERTSON

H. G. JOHNSON

J. WISHART

RICHARD STONE (*Secretary*)

The following have also been members of the Committee of Management  
during the period covered by this Report:

Mrs J. V. ROBINSON (to December 1949)

W. B. REDDAWAY (to March 1951)

UNIVERSITY OF  
CAMBRIDGE

4 - MAY 2018

MARSHALL LIBRARY  
OF ECONOMICS

## CONTENTS

Section I Policy	page 3
II General Report on 1948-1951	5
III Finance	7
IV Research Activities, 1948-1951	8
V Other Activities	24
VI Publications	28
VII Premises and Facilities	31
VIII Staff	33

*Note.* The period covered by this report is from  
November 1948 to June 1951.

## SECOND REPORT

## ACTIVITIES IN THE YEARS 1948-51

## I. POLICY

1. In the first report of activities it was suggested that the Department's aims were most likely to be achieved by making simultaneous progress along three different lines. This objective has been followed throughout the years now under review and indeed it remains the objective for the future. Experience has suggested that the research programme can be better summarized under four heads than under the former three, but in all other respects the general aims remain as they were previously stated.

2. It may be said then that the objects of the Department's work in the years 1948-51 have been:

- (i) To restate economic theories and principles in a form which will allow them to be tested empirically.
- (ii) To collect together such relevant observations as have been made and to make others which are required in order that empirical tests may be applied.
- (iii) To develop the necessary statistical and other tools for the testing of economic hypotheses.
- (iv) Actually to make the tests, using either the new tools and data already mentioned or those provided by others working in the same field.

3. An example of the first of these is the work which has been done on the reformulation of certain aspects of the theory of consumer's demand, which has a direct relationship with the work on demand analysis falling under the fourth heading; and a further example may be found in the development of the principles of social accounting and attempts to relate these principles to readily measurable accounting concepts.

4. In the second category, work has been continued on the assembly of a considerable body of data on the British economy during the years 1920-38 and earlier years, post-war data are being assembled in the index numbers of production and other inquiries,

and the project for the collection of social accounting data by sampling methods has begun to take shape.

5. In the field of toolmaking, efforts have remained mainly concentrated on the development of methods for the satisfactory handling of time series and, in particular, relatively short time series such as are normally available to the economist. Problems associated with serial correlation have again been considered and much work has been done on the development of tests for serial correlation.

6. Demand analysis has been the main example of the testing of hypotheses, though it might be said that the index numbers of industrial production and of national product test the hypothesis that there has been no change (or any particular change) in the general level of those aggregates. But in these latter cases, as perhaps in certain others, the testing is so simple a matter in relation to the accumulation of the data that it is apt to be overlooked.

7. Somewhat outside these four headings, but contributing to each of the last three, is a project of quite a different nature. This is the compilation of a bibliography of applications of mathematical statistics to economics. This relates to the years from 1943 onwards and it is proposed to keep it up-to-date. A dual classification—economic and mathematical statistical—will facilitate its use both by workers seeking information on the ways in which particular economic problems have been attacked and by those seeking examples of the use of particular statistical methods.

8. But although there has been no marked change in objectives or in the programme by which it is hoped that these may be achieved, the years now under review have seen a notable shift toward the assembly and use of post-war data and the consideration of problems of direct relevance to current economic policy. The two index numbers and the regional social accounting project are all examples of the collection and collation of post-war data; while investigations of current problems include work on the post-war demand for food which is being done in conjunction with the Ministry of Food, and an attempt, undertaken on behalf of the Colonial Office and the Government of Nigeria, to estimate the national income of Nigeria.

9. These developments are made possible by the increasing availability of data relating to the post-war period, and are stimulated by a growing awareness in government departments—perhaps fostered by the Inter-Departmental Committee on Social and Economic Research—of the value of the results of fundamental research carried out by academic research organizations. This does not imply any

relaxation of the standards which the Department set itself in its first report. The research undertaken into current problems is still, we believe, fundamental research. We are not concerned with day-to-day issues nor with decisions on current economic policy, but we are very much concerned that those who do have to take such decisions should do so on the basis of a knowledge which is fundamentally sound.

10. We welcome these developments too for the contacts they provide with other research workers in the government departments concerned. While these investigators must of necessity be concerned mainly with urgent problems, and we should, we believe, restrict ourselves to more basic issues, there can be little doubt that a closer contact is likely to be of benefit to both. The research worker operating *in vacuo*, without contact with the practical world, may sometimes—even in an ‘applied’ subject—chance on a discovery which will revolutionize the practices of men of affairs. But such discoveries and such workers are rare; most of us can make greater progress if we can see in advance what are the problems towards which our work is directed. It has already been said, in the first report, that we hope to create in the Department a centre where those who make the tools of economic and statistical research, those who apply them, and those who provide the material may be brought together. The new contacts with workers more closely concerned with current problems represent a further bringing together of those whose interest lies in the formulation of a sound knowledge of economic forces.

## II. GENERAL REPORT ON 1948–51

11. The period since the first report of the Department’s activities appeared has seen a marked increase in the size of the Department’s staff and of its research programme. The research staff which at that time numbered ten, in addition to the Director, now consists of five senior research officers, four research officers, one honorary research associate and eight research assistants. There has necessarily been a corresponding increase in the number of computers and of administrative and clerical staff, and the present strength is six computers and five administrative and clerical assistants.

12. This rapid growth in the Department’s staff, combined with a corresponding growth of the library, and even of such auxiliary services as filing systems, has placed a considerable strain on the Department’s accommodation. During the last quarter of 1950 it

became necessary to resume use of the top floor of the Marshall Library, which had been the Department's original home, and even to overflow slightly into other rooms. However, the University made other accommodation temporarily available early in 1951 and this has eased the situation for the time being. It unfortunately means that the staff is located in two different buildings about a quarter of a mile apart and this necessarily has certain disadvantages, if only to the extent that some of the research staff are separated from the library and computing facilities.

13. The policy of drawing members of the research staff from overseas countries has been continued with further appointments of workers from Australia, Czecho-Slovakia, the Netherlands and the United States. Visitors and students from abroad, either for working periods or for shorter visits, have come from most of the Dominions and from numerous other countries, including Denmark, France, Germany, the Lebanon, the Netherlands, Switzerland, Turkey, the United States and Yugoslavia; and in addition members of the Department's staff were able to take part in fruitful discussions with the many scholars who attended the Cambridge meeting of the International Association for Research in Income and Wealth in September 1949.

14. Visits abroad by the Director and other members of the staff have been mainly for the purpose of attending international conferences and have thus provided connections with scholars from other countries in addition to those actually visited, which include Australia, Eire, France, India, Italy, the Netherlands and Switzerland.

15. Nearer at home, relationships have been maintained with workers in similar research organizations in other parts of the United Kingdom and have been extended by increased consultation with government departments at both the national and regional levels and with such bodies as the County Planning Department, which has been assisting the Social Accounts of Cambridgeshire inquiry.

16. The arrangement of seminars at the Department has been continued and these have been attended by many persons from the Faculty of Economics and Politics and from other faculties and departments (in particular from the Statistical Laboratory) in addition to staff members. Also, members of the research staff have attended and contributed to seminars arranged by other bodies. This two-way exchange of ideas between specialists in related disciplines is an important stimulus to the development of new theories and techniques.

17. In addition to the participation in the Department's work which results from membership of the Committee of Management, members of the Faculty have been increasingly concerned with specific research projects either through direct participation or as members of the advisory committees which have been set up in connexion with a number of inquiries. The Department has also been able to provide a certain amount of clerical and computing help to members of the Faculty in respect of work not directly connected with its own programmes. It is hoped that it will be possible to increase the scale on which such assistance can be given in the course of the next few years.

### III. FINANCE

18. There has been little change in the financial arrangements outlined in the last report. The original grants made by the Rockefeller and Nuffield Foundations come to an end in 1951 and, as was previously foreshadowed, the University has been making an increasing contribution from its own funds for the general support of the Department.

19. The balance of the Rockefeller Foundation's grant of £23,500 has continued to be used to meet the general budget of the Department, and the total amount will have been entirely exhausted by mid-1951, the end of the period to which it relates.

20. The Nuffield Foundation's contribution of £2000 a year for five years was specifically for the appointment of research fellows by the Nuffield Trustees on the recommendation of the Director of the Department. There has been one further appointment of a Nuffield Fellow in addition to those previously reported, that of Miss Phyllis Deane in 1950. This will not exhaust the whole of the grant before it ceases in 1951, and the balance remains available for further appointments.

21. The grant made by the National Institute of Economic and Social Research, to assist an investigation into wages and salaries paid in different branches of economic activity during the years 1920-38, was continued into 1949. The work for which this grant was made (see paragraph 36) is now completed and the results will be published as a volume in a series of Studies in the National Income and Expenditure of the United Kingdom, which is sponsored jointly by the National Institute and the Department.

22. A new kind of financial arrangement, so far as the Department is concerned, was initiated in 1950 when it was agreed to conduct

an inquiry into the national income of Nigeria. This inquiry is to be financed wholly by the Colonial Office and the Government of Nigeria. It will enable the Department to carry out an investigation which presents a number of fundamental problems and is closely related to other parts of the research programme, but which would otherwise be beyond the resources available. The work will have a direct bearing on problems which are important to the two official bodies concerned.

23. A further small source of income arises from contributions to the Index of Industrial Production. The Department circulates the monthly details of this index number to a number of subscribers who contribute towards the cost of the work involved.

24. The University's growing contribution to the finance of the Department has come chiefly from the special grants for the development of work in the social sciences which have been made available by the government through the University Grants Committee. This source provided about 40 per cent. of the Department's income in the financial year 1949-50. In addition, the University provides for the Director's salary from its own direct resources, and it is expected that this, together with the contribution from the social sciences fund, will cover some 55-60 per cent. of the estimated expenditure for 1950-51. Thereafter it is hoped that the normal continuing expenditure of the Department will be met wholly from the University's general funds (including the Social Sciences Fund) but that it will continue to be possible to obtain financial assistance from other sources for special inquiries, such as the Nigerian project, or for abnormal expenditures arising in the course of other work, such as those which will be incurred for fieldwork in the inquiry into the Social Accounts of Cambridgeshire (see paragraph 41).

#### IV. RESEARCH ACTIVITIES, 1948-51

25. The Department's research programme can conveniently be described under the four heads given in paragraph 2. It is true of course that any particular piece of work may well be concerned with more than one of the purposes which these heads describe; in the sections which follow, such pieces of work are grouped under that head which best describes their main emphasis. A few research projects which cannot be classified in this way are described in a miscellaneous group at the end.

#### (a) *The Re-statement of Economic Theory*

##### *The Theory of Consumer's Behaviour*

26. Differences in approach to the pure theory of consumer demand have sometimes proved an obstacle to the further development of the empirical content of that theory. The key to an elimination of these differences is the problem of integrability. It has been shown how the axioms of Professor Samuelson's 'revealed preference' approach can be generalized so as to become equivalent to previously proposed sets of postulates, between which a synthesis had already been achieved. These results have been given by Mr H. S. Houthakker in *Revealed Preference and the Utility Function*, (Reprint Series, No. 26), and have been commented on by Professor P. A. Samuelson in 'The Problem of Integrability in Utility Theory', in *Economica*, November 1950.

27. Another frequently ignored difficulty in consumption theory is the condition that quantities bought must be non-negative. This is not compatible with the customary mathematical assumptions as to the influence of prices and income on demand, so that the theory becomes less suitable for straightforward calculus methods. On the other hand, the introduction of the above conditions provides new insight into such problems as the shape of Engel curves or the effect of quality differences between goods. Some first reflections on these problems—which are related to those encountered in the modern theory of production—are contained in a paper by Mr Houthakker, 'Les Fonctions Quadratiques d'Utilité,' presented to a seminar in mathematical economics at the Centre National de la Recherche Scientifique in Paris. This is to be published in France in a volume of essays on the Theory of Choice.

28. Another subject which has been investigated is the effect on the theory of consumer's behaviour of dropping the assumption that the commodity space is continuous and of substituting the more realistic assumption that it is discrete. A brief treatment of this question was given in the Director's *The Role of Measurement in Economics* (Monograph No. 3, 1951) and a fuller treatment will be given in Volume 1 of the Joint Series with the National Institute (see paragraph 96 below).

29. Again, rationing affects not only the demand for rationed goods, but also that for non-rationed goods because of complementarity and substitution and thus has to be taken into account in most demand analysis based on contemporary figures, including the food demand

inquiry mentioned below. The theory of consumer's behaviour can be extended to cases where one or more goods are rationed. Formulae for the effect of ration changes on the demand for non-rationed goods and for the modifications of price and income effects caused by rationing are given by Dr Tobin and Mr Houthakker in a joint paper 'The Effects of Rationing on Demand Elasticities' which was read at the Varese conference of the Econometric Society (September 1950) and will be published in the *Review of Economic Studies*. Econometric applications of these methods are now being attempted.

#### *Social Accounting*

30. The study of the accounting basis for the measurement of aggregates of transactions by Mr F. Sewell Bray and the Director which was described in the first report has continued during the years now under review.

31. In September 1949 the Director presented a paper at the Cambridge meeting of the International Association for Research in Income and Wealth in which he laid out a form of social accounts which would be generally useful for economic analysis and policy, and which would be capable of practical realization whilst satisfying a number of important theoretical criteria. This paper, 'Functions and Criteria of a System of Social Accounting', appeared in a volume entitled *Income and Wealth, Series I* (1951) published for the International Association by Messrs Bowes and Bowes, Cambridge.

32. A contribution to the theory of networks, which is much used in connexion with social accounting, was made by Mr J. Durbin in a paper *Les Equivalents à la Somme de Transactions* which has appeared as No. 33 in the Reprint Series.

33. Mr Sewell Bray's book, *Social Accounts and the Business Enterprise Sector of the National Economy*, appeared during 1949 as No. 2 in the Department's series of monographs. He has since continued his work on the definition of the empirical correlates of certain important economic magnitudes and on the study of accounting statements appropriate to various sectors of the economy for recording transactions in a way which will be useful to the economist and, in particular, which will facilitate the collection of social accounting data. He is planning a comprehensive work on the problems involved and the treatment of various items in the accounts. He has also had under consideration the problem of whether it is possible to measure social costs in a way which would enable them to be incorporated into a social accounting system.

34. Also arising out of this work, the Director and Mr Utting presented a paper on 'The Relationship of Social Accounting to Input-Output Analysis' at a conference on input-output relations organized by the Netherlands Economic Institute and held at Driebergen in September 1950. This will be published in a volume of papers presented at that conference.

#### *(b) The Collection of Data*

##### *Consumers' Expenditure in the United Kingdom, 1900-19*

35. Dr A. R. Prest's manuscript with this title is being revised with the assistance of Mr A. A. Adams, to ensure consistency with the estimates for the period 1920-38 which the Director has prepared for the National Institute of Economic and Social Research. This is now to appear in the *Studies in the National Income and Expenditure of the United Kingdom* which are to be published by Cambridge University Press as a joint series for the Department and the National Institute. Dr Prest himself left the Department's staff when he was appointed to a University Lectureship in the Faculty of Economics and Politics in September 1949, but he has maintained a close connexion with this and other projects.

##### *Wages and Salaries in the United Kingdom, 1920-38*

36. Miss Agatha Chapman completed her work on the industrial distribution of salary and wage payments and of employment and earnings, and returned to Canada in the summer of 1949. Mrs R. Knight, who had assisted her with this work, has completed a final revision of their manuscript which is to be published with the above title. It has been sent to the Press, and will appear as one of the volumes in the Joint Series with the National Institute.

##### *Domestic Asset Formation in the United Kingdom, 1920-38*

37. Dr K. Maiwald joined the staff in October 1950 to work on estimates of gross and net asset formation in the United Kingdom for the years 1920-38. It is hoped that it will prove possible to present estimates both by branch of activity and by type of asset. Dr Maiwald is assisted in this project by Mr Adams. The work has the advice of a small committee with the Director as chairman and Dr R. F. Henderson and Mr H. G. Johnson, University Lecturers in Economics, Mr Adams, Mr Bray, Dr Maiwald and Mr Utting as members.

### *The Balance of Payments of the United Kingdom 1920-38*

38. The purpose of this project, which is part of the work on the national expenditure, output and income of the United Kingdom in the inter-war period undertaken by the Department in conjunction with the National Institute of Economic and Social Research, is to reconsider the statistics of the balance of payments of the United Kingdom for 1920-38. It involves, in the first place, an examination of the Board of Trade estimates of the items in the current account in terms of the definitions used and with a view to obtaining, where possible, more detailed breakdowns and estimates for gross as well as for net receipts and payments for the invisible items. It is designed, in the second place, to bring together as much information as possible on the items in the capital account with a view to filling some of the more obvious gaps. This analysis of the current and capital accounts will, it is hoped, indicate the extent to which the pre-war data on the balance of payments of the United Kingdom can be presented in a form similar to that now adopted in the White Papers on the post-war balance of payments. The work, which was begun in October 1950, is in the charge of Mr S. Adler and Miss D. C. Paige.

### *Indexes of Production*

39. The Department continues to compile monthly the Index of Industrial Production undertaken for the London and Cambridge Economic Service, which was described in the first report. The work of compilation and of circulating the results to subscribers to the index is in the charge of Mr Adams. A paper, 'Industrial Production; The Official and L.C.E.S. Index-Numbers Compared', by W. B. Reddaway and Arthur Adams, was published in the *Bulletin of the London and Cambridge Economic Service* in August 1949 (Reprint Series, No. 20).

40. The group responsible for this index, namely Mr C. F. Carter, Mr W. B. Reddaway and the Director, assisted by Mr W. T. Osborn and Mr Adams, began work on an annual index of the real product of the United Kingdom early in the summer of 1949. Since the beginning of 1951, Mr Osborn's share in the work has been continued by Miss S. Y. Mallett, his successor as Assistant in Statistical Research in the Faculty. The new index may be regarded as an extension of the index of industrial production to cover the whole economy of the United Kingdom, and has as its object the measurement of changes in real income viewed from the production side.

The first results of this work were embodied in a paper read by Mr Reddaway at the meeting of the International Association for Research in Income and Wealth in August 1949. This was called 'Some Problems in the Measurement of Changes in the Real Geographical Product', and has appeared in *Income and Wealth, Series 1* (1951) (see paragraph 31). A second paper, 'Movements in the Real Product of the United Kingdom, 1946-49', was read by Mr Reddaway at a meeting of the Royal Statistical Society in May 1950. This describes the methods of compilation of the index and gives preliminary estimates for the years 1946-49. It has appeared as No. 39 in the Reprint Series. A summary paper by Mr Reddaway, 'The Real Product of the United Kingdom, 1946-49', which appeared in the *Bulletin of the London and Cambridge Economic Service* for August 1950, has been reprinted as No. 31 in the Department's series. A detailed description of the components of the index and of its construction will appear in the *Journal of the Royal Statistical Society* (Series A).

### *The Social Accounts of Cambridgeshire*

41. This inquiry has as its prime object the testing of the possibility of using sampling methods for the collection of social accounting data. It is clear that the existing methods of estimating national income and social accounting statistics are in many respects far less than adequate, and it seems that the best hope of improvement must lie in the direct collection of the data required. At the same time the social accounting approach itself provides a basis for such a collection, and indicates what information is required from the different groups of transactors in the economy. A complete census of all transactors is clearly out of the question and direct collection must, therefore, depend on the development and use of suitable sampling methods. On the other hand, this is a field in which experience of sampling is still very limited. Difficulties arise from the confidential nature of the information on income and expenditure which is needed for this purpose, from the complexity of the information required and from the need to ensure complete coverage of the economy investigated. Proposals for overcoming these difficulties will be fully tested in the field, in an attempt to construct the social accounts of Cambridgeshire from information collected directly from transactors.

42. In addition to its contribution to the methodology of the collection of economic data, the project will yield much information

about the economy of Cambridgeshire and so make a contribution to the study of regional economics. The work is in the charge of Mr J. E. G. Utting who joined the Department in July 1949. Mr J. Durbin who had joined the staff in September 1948 had already worked on certain theoretical statistical problems involved in the inquiry, and some of the results of this work are embodied in a paper to be published shortly, entitled 'The Adjustment of Observations with application to National Income Statistics'. This is concerned with the estimation of quantities which are subject to a number of linear constraints, and arose from consideration of the problem of adjusting observations of national income and social accounting statistics to satisfy identities inherent in the underlying definitions.

43. A general paper 'The Use of Sampling Methods in National Income Statistics and Social Accounting', by Richard Stone, J. E. G. Utting and J. Durbin (Reprint Series, No. 29), was presented at the 26th Session of the International Statistical Institute, held at Berne in September 1949. The object of this paper was to set out in general terms the problems of using sampling methods in that field, as they were then seen, and to indicate the lines along which it was felt that those problems might be solved. It represents a first stage in the inquiry and is in no sense a statement of results. The same group also attended the 3rd Session of the United Nations Sub-Commission on Statistical Sampling, held in Geneva immediately after the Berne conference, and assisted in the formulation of a section of the Sub-Commission's report, relating to the use of sampling methods in the collection of national income statistics.

44. Work on the inquiry has since been mainly directed to the collection of basic data about the economy of Cambridgeshire which are essential for the design of appropriate sampling schemes. Contact has been established with the regional offices of a number of government departments, likely to be interested in and of assistance to the inquiry, with the County Planning Department, and with several other departments of the University which are concerned with similar or allied problems.

45. An investigation is also being made of the published forms of University and College accounts to determine the extent to which they may be adapted, and what additional detail is required, to fit them into the general social accounting scheme which is proposed for the region.

46. Other studies are primarily concerned with problems which will arise in sampling the personal sector of the economy. Assistance

has been sought from various bodies with experience of sampling among households and individuals, and preliminary consideration has been given to the design of questionnaires for use in this sector. A pilot investigation of the expenditure of undergraduates (an important influence on the economics of Cambridgeshire) was carried out during the Easter Term 1951, and the results are now being analysed.

47. Mr Durbin left the Department at the end of 1949 to take up an appointment at the London School of Economics, and Mr Utting has since been assisted in the general work of the inquiry by Mrs D. E. Cole, who joined the Department from the regional office of the Board of Trade in April 1950, and by Mr G. P. Smith and Miss S. Plant who joined the staff in October 1950. Mr A. A. Garrett, formerly Secretary of the Society of Incorporated Accountants and Auditors, has been assisting the inquiry in an honorary part-time capacity, and has been responsible for the work on College accounts.

#### *Regional Social Accounting*

48. This is a development of the inquiry into regional income and income-generating activity which was started by Mr E. J. M. Buckatzsch in October 1947. Miss Phyllis Deane was appointed in January 1950 to investigate the possibilities of achieving a regional breakdown of the United Kingdom social accounts and she was joined in March 1950 by Mrs Knight (on completion of the inquiry into Industrial Distribution of Wages and Salaries, 1920-38), and in October 1950 by Mr E. B. Butler. Mr Buckatzsch continued his investigations into the pre-war distribution of regional incomes until he left the Department in June 1950 to take up an appointment with the Oxford Institute of Statistics. A paper entitled 'The Geographical Distribution of Wealth in England, 1086-1843', written by him in 1949, was published in *The Economic History Review*, vol. III, no. 2, 1950.

49. In developing the regional incomes inquiry along social accounting lines, it was felt that the methodological advantages of making the regional estimates within a coherent framework on the national model are appreciable whether or not it is possible—in the present state of knowledge—to complete all the calculations necessary to arrive at finished regional accounts. Similarly the practical statistical advantages of setting estimates in an articulated regional set of accounts within the national model are considerable. Estimates based on inadequate data can thus be strengthened not only

by exploiting their relationships with each other but also by relating them to the official national estimates. The volume of basic data available in a regional form is, however, improving: the material of the Ministry of Labour earnings inquiry has been analysed regionally and the results of the 1948 Census of Production and of the 1949-50 Inland Revenue earnings inquiry will also be available eventually on a regional basis.

50. Meanwhile the present inquiry is being largely concentrated on five main aspects of the regional problem: (1) the construction of a formal system of accounts appropriate for purposes of regional economic analysis; (2) an industrial analysis of the 1948 wage and salary bill of the United Kingdom by standard regions; (3) the construction of the 1948 social accounts of local authorities of the United Kingdom by regions; (4) estimates of the main items in the 1948 Central Government balance of payments with regions of the United Kingdom, and the construction of regional social accounts for the main nationalized industries; and (5) estimates of the net output of agriculture by regions and of the regional distribution of agricultural incomes. Work is already in progress on the first four of these lines of investigation, and Mrs Knight was able to complete a set of preliminary regional estimates of the wage and salary bill by main industrial groups before she left the Department in January 1951. These estimates which owe much to the co-operation of the Ministry of Labour in making the results of its 1949-50 earnings inquiry available in regional form, will be revised and strengthened as new material becomes available, particularly as the further results of the 1948 Census of Production are published. The inquiry into the regional social accounts of local authorities which Mr Butler has undertaken, is being greatly facilitated by the co-operation of the Ministry of Health, the National Institute of Economic and Social Research, and the many local authorities which have sent copies of their accounts and estimates. The Department is particularly grateful to the Ministry of Health for permitting access to the Epitome returns for 1947-8 and 1948-9, and to the National Institute for making available original returns of Mr J. E. G. Utting's inquiry into the social accounts of local authorities.

#### *International Comparisons of Real Income*

51. Work on this project was begun in October 1950 by Mr Adler and Miss Paige. The aim of the inquiry is to investigate the principles and possibilities of making comparisons of real income between

countries with a more or less similar institutional framework and level of economic development. A beginning has been made with the collection of existing information covering the years immediately preceding and succeeding the war for a number of participating countries of the Organization for European Economic Co-operation, the United States and Canada, in order to provide the basis for a number of actual statistical comparisons. The evaluation of the scope and usefulness of such comparisons, based as they must be on admittedly incomplete data, should contribute to clarifying a problem which is of current interest to a number of international organizations.

#### *National Income of Nigeria*

52. Following discussions with the Colonial Office, the Department agreed to undertake an inquiry into the national income of Nigeria and active work on this subject was begun in September 1950. The inquiry is wholly financed by the Colonial Office and the Government of Nigeria (see paragraph 22) and has the advice of a Committee consisting of Mr P. T. Bauer, Miss P. M. Deane, Mr A. Emanuel (representing the Colonial Office), Professor M. Fortes, Dr A. R. Prest, Professor E. A. G. Robinson (chairman) and the Director. The research work is in the charge of Dr Prest, who is working on the inquiry on a part-time basis; and the full-time research staff are Mr I. G. Stewart and an African assistant, Mr G. Lardner, who was seconded from the Economics and Development Branch of the Lagos Secretariat to assist the inquiry from February 1951.

53. The inquiry provides a valuable opportunity for a reconsideration of the conceptual problems relating to national income and its components in underdeveloped territories, in the very practical setting of a compilation of estimates which will both fit the conceptual framework and yield useful new information on the economy of the Colony.

54. Dr Prest and Mr Stewart, after preparatory investigations in the United Kingdom, visited Nigeria in December 1950 and made a rapid preliminary tour of the Colony, where they established contacts and discussed the project with a large number of official and unofficial bodies and individuals. Dr Prest returned to Cambridge in January 1951, and since then Mr Stewart and Mr Lardner have been collecting information in Nigeria. It appears that a good deal of relevant information is available from various sources and that the major practical task will be the collection of all this information into one

centre, and the application of appropriate statistical techniques to provide a unified picture of the Nigerian economy.

55. It is hoped as a result of the inquiry to provide estimates of the total domestic product and national income of Nigeria and of the domestic product of the three main regions, together with many of their components and a number of significant cross-classifications (such as the division of income between European and African residents). It is proposed also to present a considerable amount of detailed information on internal trade, to provide consolidated accounts for all forms of government (central, regional, local and government agencies) and to make some independent checks on data relating to the balance of payments and asset formation.

(c) *The Development of Statistical and other Methods of Analysis*

*The Analysis of Time Series*

56. Since the last report of activities a number of papers which were mentioned in it have been published and have been reprinted in the Department's series. Among these is one by the Director entitled 'Prediction from Autoregressive Schemes and Linear Stochastic Difference Systems' which was read at the International Statistical Conferences in 1947 and has now appeared in the *Proceedings* of those conferences (Reprint Series, No. 42). Others which are more in the general line of the Department's time series research are 'Testing the Significance of Correlation between Time Series' by G. H. Orcutt and S. F. James (Reprint Series, No. 15), 'Application of Least Squares Regression to Relationships containing Auto-Correlated Error Terms' by D. Cochrane and G. H. Orcutt (Reprint Series, No. 19), and 'A Sampling Study of the Merits of Autoregressive and Reduced Form Transformations in Regression Analysis' by G. H. Orcutt and D. Cochrane (Reprint Series, No. 23).

57. As a result of his work at the Department in 1948-9, Professor G. Tintner contributed a paper to the *Journal of the Royal Statistical Society* (Series B) which was entitled 'A Test for Linear Relations between Weighted Regression Coefficients'; it has appeared as Reprint Series, No. 41.

58. Further theoretical investigations of problems arising in the analysis of time series were made by Mr Durbin while he was a member of the Department's staff, and since he left Cambridge at the end of 1949 he has continued to collaborate with Mr G. S. Watson, who joined the staff in October 1949 and has been working on similar problems.

59. A paper on the distribution theory of quadratic forms and their ratios, which is the mathematical foundation of all parametric significance tests in time-series analysis, has been prepared by Mr Watson and it is hoped that it will be published shortly.

60. Most of the time series research has centred around single equation regression models. In two papers, 'Testing for Serial Correlation in Least Squares Regression, I and II', by J. Durbin and G. S. Watson, which appeared in *Biometrika* for December 1950 and for June 1951, the problem of testing the error terms of a regression equation for serial independence was considered. A test statistic was proposed and tables of significance levels were given which are applicable to any regression model containing up to five independent variables. Details were also given which enable a similar test to be made for the special regression models associated with one and two-way classifications and polynomial trends. Related questions are also considered in a paper, 'Exact Tests for Serial Correlation using Non-Circular Statistics', by G. S. Watson and J. Durbin, to be published in *Annals of Mathematical Statistics* in September 1951.

61. An exhaustive mathematical investigation has been made of the least squares and difference transformation methods in regression analysis, when the behaviour of the error term is no longer that prescribed by the classical assumptions. In particular, the effects of serial correlation and of changing error variance have been examined. It is hoped to publish an account of this work soon, possibly in a Monograph in the Department's series.

*Multivariate Analysis*

62. Professor Tintner also prepared a paper establishing formal relations between four different special types of multivariate analysis: canonical correlation, principal components, weighted regression and discriminant analysis. This appeared in the *Journal of the Royal Statistical Society* (Series B) with the title 'Some Formal Relations in Multivariate Analysis', and has been reprinted as No. 34 in the Series.

*Probability Theory*

63. An account of Professor Carnap's theory of statistical inference was given in a paper 'Foundations of Probability and Statistical Inference' which Professor Tintner read before the Royal Statistical Society in March 1949. In this paper Carnap's theory was stressed as a pure, i.e. non-pragmatic, approach to the problem of

statistical inference and an indication was given of its possible uses in connexion with econometric analysis. A brief note on the relationship of this theory to the classical theory of probability, and on a certain problem of consistency involved in generalizing the theory, was given by Mr James in 'A Note on Carnap's Theory of Probability'. Both papers have appeared in the *Journal of the Royal Statistical Society* (Series A) and as Reprint Series, No. 24.

#### (d) Testing Hypotheses

##### *The Demand for Food*

64. The most exacting test of econometric analysis is prediction, and the Department therefore welcomed the opportunity, resulting from discussions with the Ministry of Food, to undertake an inquiry into the current demand for foodstuffs. Work was begun on this late in 1949. The method used consists mainly in the extrapolation of demand functions based on pre-war and, where possible, later information, taking into account changes due to rationing on the basis of the theory mentioned above (paragraph 29). The demand functions used were derived from the Director's paper 'The Demand for Food in the United Kingdom before the War', presented to the Varese Conference of the Econometric Society and shortly to appear in *Metroeconomica*. This inquiry was conducted by Dr Tobin, until his return to the United States in August 1950, together with Mr Houthakker. At present the latter is in charge, assisted by Mr S. J. Prais. From time to time preliminary results are communicated to the Ministry of Food, with whom close co-operation is maintained.

65. The inquiry also involves a new and detailed analysis of samples of returns taken from two pre-war budget surveys: the working-class survey of 1937-8 and the middle-class survey of 1938-9. The samples taken cover about 3600 households. Summaries of the basic documents were put at the Department's disposal by the Ministry of Labour and they are now being analysed by means of punched cards. It is hoped to carry out some of the final stages of the work on the electronic computer in the Mathematical Laboratory (see paragraph 77). Special attention will be paid to family size influences, including the problem of 'equivalent adult' scales, variations in quantity as distinct from expenditure, correlations between expenditure on various goods, and social class differences. It is intended to publish the main results of this study in the Department's series of Monographs. Grateful acknowledgement is made to the following

institutions for their generous assistance with the punched-card work: Ministry of Food; Royal Aircraft Establishment, Farnborough; National Physical Laboratory, Teddington; University Mathematical Laboratory, Cambridge; Ministry of Agriculture and Fisheries.

66. In addition to his work on the demand for food in the United Kingdom, Dr Tobin made a detailed study of the demand for food in the United States and a paper entitled 'A Statistical Demand Function for Food in the U.S.A.', which he read before the Royal Statistical Society, has been reprinted as No. 32 in the Department's Series.

67. Other papers on demand analysis, largely concerned with the demand for foodstuffs, which were referred to in the last *Report*, and which have since been published are the Director's 'The Analysis of Market Demand: An Outline of Methods and Results' (Reprint Series, No. 16), Dr Prest's 'Some Experiments in Demand Analysis' (Reprint Series, No. 17), and 'Household Expenditure on Food in Holland', by G. Stuvell and S. F. James (Reprint Series, No. 27).

##### *The Demand for Electricity*

68. Some economic peculiarities of electricity, notably the considerable regional differences in prices and the importance of two-part tariffs and other non-proportional methods of charging, make a demand analysis by means of regional comparison preferable to one based on time-series. The former was carried out for a number of provincial towns, using unpublished statistics relating to 1937-8. Seasonal fluctuations in electricity generated were also investigated. The results will be incorporated in a paper by Mr Houthakker, 'Some Calculations on Electricity Consumption in Great Britain', which is to appear in the *Journal of the Royal Statistical Society* (Series A).

##### *The Demand for Consumers' Durable Goods*

69. Mr M. J. Farrell, who joined the Department's staff in October 1949, has been investigating the demand for consumers' durable goods. He has been using a new form of demand function which he developed from theoretical considerations, and has applied it to a study of the demand for motor-cars in the United States during the inter-war period. The study, which makes use of family budget and time-series data, is concerned with the demand for both new and second-hand motor-cars.

### *The Explanation of Trends in Demand Analysis*

70. The possibility of explaining the trends, which often play an important part in demand analysis, in terms of economic factors has also been investigated by Mr Farrell. In particular, he has considered the possibility that demand functions are irreversible, and has tested this hypothesis statistically by reference to data relating to the consumption of beer, spirits and tobacco in the United Kingdom during the years 1870-1938. A paper on this subject has been completed.

### *The Saving Function*

71. During his year at the Department, Dr Tobin prepared a paper which considers the question whether the ratio of family saving to family income depends on the absolute size of family income or on the size of family income relative to that of other families. The two hypotheses are subjected to empirical test by the use of three kinds of family budget data: (a) budgets of the same families over successive years; (b) budgets of negro and white families in the same city and year; and (c) budgets of families in different cities in the same year. The paper, entitled 'Relative Income, Absolute Income, and Saving', has appeared in a volume in honour of Professor J. H. Williams of Harvard University.

### *The Distribution of Earnings and Output*

72. While he was working as a member of the Department's staff, Mr A. D. Roy began an investigation into the distribution of earned incomes and an attempt to explain that distribution by reference to the distribution of outputs of individual workers. He has made a statistical analysis of data on the outputs of workers engaged on a number of different industrial processes to test the hypotheses that the distribution of outputs in the population from which each sample was drawn was (a) normal, or (b) log-normal. Some results of these investigations have been published in the *Economic Journal* in two papers by Mr Roy, entitled 'The Distribution of Earnings and of Individual Output' (Reprint Series, No. 35) and 'A Further Statistical Note on the Distribution of Individual Output' (Reprint Series, No. 37). A third paper, 'Some Thoughts on the Distribution of Earnings', is to appear in *Oxford Economic Papers*.

### *(e) Miscellaneous*

#### *Bibliography of Applications of Mathematical Statistics to Economics 1943-*

73. This bibliography has been prepared for inclusion with the bibliography of recent advances in mathematical statistics which is to be published in the *Journal of the Royal Statistical Society* (Series A) during 1951. This part of the bibliography will cover the years 1943-9, but it is intended to keep the records up-to-date and to publish further sections as the opportunity arises. The bibliography is international in scope and is intended to be as complete as is possible from sources available in this country. The project has the assistance of a considerable number of experts overseas who have been kind enough to suggest papers for inclusion. The basis for the inclusion of any particular item in the bibliography is that the author should have applied a method involving stochastic considerations to the analysis of genuine economic data to obtain results of economic significance. Thus the mathematical treatment of pure economic theory is excluded and so is pure statistical theory which is not applied to genuine economic data.

74. The main bibliography is arranged alphabetically by author's name and each entry is given a serial number. In following sections the serial numbers are listed under thirteen general economic headings (subdivided into more specialized sections) and also under further headings relating to the mathematical statistical methods employed. Thus each entry is listed by author, by economic subject and by statistical method.

75. The bibliography was prepared by Mr A. D. Scott who worked at the Department for this purpose during the Summer of 1950. He was assisted by a committee of other members of the Department's staff.

### *Electricity Tariffs*

76. The demand analysis of electricity referred to in paragraph 68 called attention to the economic problems of electricity tariffs; so did the interest in Government Departments and elsewhere in possible solutions of the peak-load problem. A general discussion with specific proposals has been given by Mr Houthakker in an article entitled 'Electricity Tariffs in Theory and Practice' (Reprint Series, No. 40).

### *Application of Electronic Computing Machines*

77. In the University Mathematical Laboratory the EDSAC (Electronic Delay Storage Automatic Calculator) has now been in operation for some years, and has proved to be invaluable for mathematical calculations of the most varied kinds. It has great possibilities for statistical work, especially regression analysis, and for certain calculations in production theory. Statistical complications such as non-linear restraints on regression coefficients, that have so far been avoided because of computational difficulties, may now be attacked directly and some attempts of this nature are being considered. On behalf of the Department, Mr Houthakker attended a Summer School in Programme Design for Automatic Digital Computing Machines, held in Cambridge in September 1950. Since then he has been engaged in the construction of programmes (sequences of instructions) for the EDSAC, and some of these are now in regular use for statistical purposes. The Department is greatly indebted to Dr M. V. Wilkes, Director of the Mathematical Laboratory, and his collaborators for their kind co-operation.

### V. OTHER ACTIVITIES

#### *Seminars*

78. The Department has continued to arrange seminars which are attended mainly by its own staff, members of the Faculty of Economics and Politics and members of the staff and students of the Statistical Laboratory. These seminars were reorganized towards the end of 1949, after a period of inactivity earlier in the year, and are now known as seminars in econometrics and mathematical economics. The following have been held in the period covered by this report:

1948		
10 November	Mr P. H. Karmel	The conflict of male and female measures of population growth.
17 November	Dr G. H. Orcutt	A sampling study of the merits of autoregressive and reduced form transformations in regression analysis.
26 November	Professor W. Hoffman	The long-run industrial development of Great Britain.
6 December	Mr Richard Stone	The analysis of market demand.

1949		
23 November	Mr A. D. Roy	The distribution of earnings.
14 December	Mr H. S. Houthakker	Revealed preference and the utility function.
1950		
11 January	Dr J. Tobin	A statistical demand function for food in the U.S.A.
8 February	Mr J. de V. Graaf	The valuation of social income.
8 March	Mr J. E. G. Utting	The social accounts of local authorities.
22 March	Mr G. S. Watson	Some aspects of serial correlation.
26 May	Mr W. B. Reddaway	Movements in the real product of the United Kingdom, 1946-1949.
7 June	Mr G. S. Watson	Testing for serial correlation.
18 October	Professor W. W. Leontief	The input-output approach to empiricaleconomicanalysis.
1 November	Mr S. F. James	Confluence analysis.
15 November	Professor W. W. Leontief	The input-output approach to inter-regional trade.
7 December	Professor T. C. Koopmans	The theory of production and allocation.
1951		
7 February	Mr G. S. Watson	Further results in serial correlation.
22 February	Professor H. Wold	Least squares regression under debate.
14 March	Mr J. E. G. Utting	The relationship between input-output analysis and national accounting.
18 April	Mr H. S. Houthakker	A geographical analysis of electricity demand.
2 May	Mr H. G. Johnson	A demonstration of the Philips' hydraulic machine.
16 May	Mr M. J. Farrell	Irreversible demand functions.
30 May	Mr W. A. B. Hopkin	The National Income White Paper.
13 June	Professor S. S. Wilks	A Monte Carlo approach to a simple population problem.

### University Relationships

79. The Director has continued to serve as a member of a number of University Boards and Committees. At the present time he is a member of the Faculty Board of Economics and Politics, the Appointments Committee and Degree Committee of the Faculty, and the Social Sciences Grant Committee of the University. Mr Bray has given courses of lectures on 'Elements of Accounting' during the Lent terms 1950 and 1951. Supervision of research students in applied economics, of candidates for the Diploma in Mathematical Statistics whose applied field is economics, and of undergraduates, is undertaken by the Director and other members of the research staff.

### Relationships with Other Bodies

80. The Department's association with the London and Cambridge Economic Service continues. The index of industrial production is computed and circulated to subscribers by the Department, which has also been responsible for work in connexion with other contributions to the *Bulletin*. The Director remains a member of the Executive and Editorial Committees.

81. Work on various aspects of the national expenditure, output and income of the United Kingdom for publication jointly by the Department and the National Institute of Economic and Social Research in a series of *Studies in the National Income and Expenditure of the United Kingdom* has already been reported in paragraphs 35-38. Fuller details of the series, of which the Director is the general editor, are given in paragraph 96.

82. The Director has continued his membership of the Inter-departmental Committee on Social and Economic Research, the Sub-Committee on Social Sciences of the University Grants Committee, and the Cost of Living Advisory Committee and Retail Prices Technical Committee which were recalled by the Minister of Labour and National Service at the end of 1950.

83. In the spring of 1949, the Director delivered the Newmarch Lectures at University College, London. His subject was the Role of Measurement in Economics, and his four lectures were published as Monograph No. 3 in the Department's series early in 1951.

84. The Director is also in charge of the National Accounts Research Unit of the Organisation for European Economic Co-operation, which was set up in Cambridge in 1949. This body which

draws its staff from the various participating countries of O.E.E.C., exists to coordinate the work of those countries in the field of national accounting and national income studies on a uniform basis. Its reports are being published by O.E.E.C.

85. In August 1949 the International Association for Research in Income and Wealth held a conference in King's College. Papers presented by the Director and Mr Reddaway have already been mentioned (paragraphs 31 and 40). In addition, a number of other members of the Department's staff attended the meetings and participated in the discussions. At the conclusion of the conference the Director was elected Chairman, and Miss Deane, Secretary, of the Association for the following two years.

### Visits Abroad

86. In September 1949 the Director, Mr Durbin and Mr Utting attended the meetings of the 38th Session of the International Statistical Institute at Berne to present their paper on 'The Use of Sampling Methods in National Income Statistics and Social Accounting'. This provided a useful contact with persons having experience of sampling in other fields which might prove relevant to its economic applications, as well as a broader contact with statisticians generally. After the I.S.I. meetings the same group attended a session of the Sub-Commission on Statistical Sampling of the United Nations Statistical Commission, which was held at Geneva. The group contributed to the Sub-Commission's discussion of the use of sampling in national income work and assisted in the formulation of its recommendations on this subject. Mr Durbin and Mr Utting also delivered lectures at the Statistical Seminar held in Berne and Geneva in connexion with the I.S.I. meetings.

87. During the latter part of 1949, Mr Bray visited Australia as a member of the British delegation to the Australian Congress on Accounting. Whilst there he delivered a series of lectures at the various Australian Universities which, together with his address to the Congress, have been reprinted as a volume, *The Accounting Mission*, which was published by the Melbourne University Press in 1951.

88. In September 1950, the Director and Mr Houthakker attended the European meeting of the Econometric Society at Varese in Italy, and read the papers on the demand for food in the United Kingdom and on the effects of rationing on demand elasticities, referred to in paragraphs 64 and 29 above.

89. In the same month, the Director and Mr Utting read a paper on the relationships between national accounting and input-output analysis (see paragraph 34) at a conference at Driebergen, the Netherlands. The conference which was organized by the Netherlands Economics Institute, was wholly concerned with aspects of input-output relations and provided an opportunity for the exchange of ideas on this subject between workers in a number of different countries.

90. During the months of December 1950 and January 1951, the Director attended a series of meetings in New Delhi, as one of three foreign advisers to the National Income Committee of the Government of India. The advisers assisted in formulating the First Report of the Committee, which has since been published by the Government of India, and in planning future official work on national income statistics in India.

#### *Visitors from Abroad*

91. A considerable number of distinguished economists and statisticians from abroad have visited the Department. Several of them have spent substantial working periods at the Department or have made it their headquarters while visiting Britain. Among such visitors were Professor W. Hoffman of Munster University who spent some time at the Department whilst on a visit to Cambridge late in 1948, Professor Richard Ruggles of Yale University during the spring of 1949, Professor W. W. Leontief of Harvard University from September 1950 to January 1951, and Professor T. C. Koopmans of the Cowles Commission, Chicago, in December 1950.

92. A number of students from abroad have also spent substantial periods at the Department, studying various branches of applied economics on which work was in progress.

### VI. PUBLICATIONS

#### *Reprint Series*

93. The Department continues to circulate reprints of selected papers contributed to learned journals and other publications by members of its staff and others collaborating in its work. These are now sent to just under 300 institutions and scholars at home and abroad.

94. The following reprints have been issued since the last Report:

- No. 15. 'Testing the Significance of Correlation between Time Series', by G. H. Orcutt and S. F. James (*Biometrika*, vol. xxxv, Parts III and IV, December 1948).
- No. 16. 'The Analysis of Market Demand: an Outline of Methods and Results', by Richard Stone (*Review of the International Statistical Institute*, vol. 16, 1948).
- No. 17. 'Some Experiments in Demand Analysis', by A. R. Prest (*Review of Economics and Statistics*, vol. xxxi, no. 1, February 1949).
- No. 18. 'Determination of Linear Relations between Systematic Parts of Variables with Errors of Observation the Variances of which are Unknown', by R. C. Geary (*Econometrica*, vol. 17, no. 1, January 1949).
- No. 19. 'Application of Least Squares Regression to Relationships containing Auto-correlated Error Terms', by D. Cochrane and G. H. Orcutt (*Journal of the American Statistical Association*, vol. 44, March 1949).
- No. 20. 'Industrial Production: The Official and L.C.E.S. Index-Numbers Compared', by W. B. Reddaway and Arthur Adams (*Bulletin of the London and Cambridge Economic Service*, August 1949).
- No. 21. 'Worst Spinning Costs', by F. Sewell Bray, Charles Smith (Bradford) and D. R. Bedford Smith (London) (*Accounting Research*, vol. 1, no. 2, July 1949).
- No. 22. 'Scope and Method of Econometrics', by Gerhard Tintner (*Journal of the Statistical and Social Inquiry Society of Ireland*, 1949).
- No. 23. 'A Sampling Study of the Merits of Autoregressive and Reduced Form Transformations in Regression Analysis', by Guy H. Orcutt and Donald Cochrane (*Journal of the American Statistical Association*, vol. 44, September 1949).
- No. 24. 'Foundations of Probability and Statistical Inference', by Gerhard Tintner, and 'A Note on Carnap's Theory of Probability', by S. F. James (*Journal of the Royal Statistical Society, Series A (General)*, vol. cxii, Part III, 1949).
- No. 25. 'The United States Tariff', by A. R. Prest and A. D. Roy (*Bulletin of the London and Cambridge Economic Service*, February 1950).
- No. 26. 'Revealed Preference and the Utility Function', by H. S. Houthakker (*Economica*, New Series, vol. xvii, no. 66, May 1950).
- No. 27. 'Household Expenditure on Food in Holland', by G. Stuvell and S. F. James (*Journal of the Royal Statistical Society, Series A (General)*, vol. cxiii, Part I, 1950).

- No. 28. 'La Position de L'Économétrie dans la Hiérarchie des Sciences Sociales', by G. Tintner (*Revue d'économie politique*, nos. 5-6, September-December 1949).
- No. 29. 'The Use of Sampling Methods in National Income Statistics and Social Accounting', by Richard Stone, J. E. G. Utting and J. Durbin (*Review of the International Statistical Institute*, vol. 18, 1/2, 1950, and *Accounting Research*, vol. 1, no. 4, July 1950).
- No. 30. 'Replacement Cost Depreciation', by A. R. Prest (*Accounting Research*, vol. 1, no. 4, July 1950).
- No. 31. 'The Real Product of the United Kingdom, 1946-1949', by W. B. Reddaway (*Bulletin of the London and Cambridge Economic Service*, August 1950).
- No. 32. 'A Statistical Demand Function for Food in the U.S.A.', by James Tobin (*Journal of the Royal Statistical Society, Series A (General)*, vol. cxiii, Part II, 1950).
- No. 33. 'Les Équivalents à la Somme de Transactions', by J. Durbin (*Economie Appliquée*, vol. III, no. 1, January-March 1950).
- No. 34. 'Some Formal Relations in Multivariate Analysis', by Gerhard Tintner (*Journal of the Royal Statistical Society, Series B (Methodological)*, vol. XII, no. 1, 1950).
- No. 35. 'The Distribution of Earnings and of Individual Output', by A. D. Roy (*Economic Journal*, vol. LX, no. 239, September 1950).
- No. 36. 'Testing for Serial Correlation in Least Squares Regression, I', by J. Durbin and G. S. Watson (*Biometrika*, vol. 37, Parts 3 and 4, December 1950).
- No. 37. 'A Further Statistical Note on the Distribution of Individual Output', by A. D. Roy (*Economic Journal*, December 1950).
- No. 38. 'The Form of Government Accounts, I', by A. A. Garrett, and 'The Form of Government Accounts, II' by W. B. Reddaway (*Accounting Research*, vol. 2, no. 1, January 1951).
- No. 39. 'Movements in the Real Product of the United Kingdom, 1946-1949', by W. B. Reddaway (*Journal of the Royal Statistical Society, Series A (General)*, vol. cxiii, Part IV, 1950).
- No. 40. 'Electricity Tariffs in Theory and Practice', by H. S. Houthakker (*Economic Journal*, vol. LXI, no. 241, March 1951).
- No. 41. 'A Test for Linear Relations between Weighted Regression Coefficients', by Gerhard Tintner (*Journal of the Royal Statistical Society, Series B (Methodological)*, vol. XII, no. 2, 1950).
- No. 42. 'Prediction from Autoregressive Schemes and Linear Stochastic Difference Systems', by Richard Stone (*Proceedings of the International Statistical Conferences*, 1947, vol. v).

### Monograph Series

95. The Cambridge University Press has now published three volumes in the Department's Monograph Series. These are:

- No. 1. *The Measurement of Production Movements*, by C. F. Carter, W. B. Reddaway and Richard Stone (1948).
- No. 2. *Social Accounts and the Business Enterprise Sector of the National Economy*, by F. Sewell Bray (1950).
- No. 3. *The Role of Measurement in Economics*, by Richard Stone (1951).

### Studies in the National Income and Expenditure of the United Kingdom

96. This series of studies is sponsored jointly by the Department and the National Institute of Economic and Social Research, and will be published by Cambridge University Press. The Director is the general editor of the series and the first five titles will be:

- No. 1. *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom 1920-1938*, vol. I, by Richard Stone.
- No. 2. *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom 1920-1938*, vol. II, by Richard Stone and D. A. Rowe.
- No. 3. *Consumers' Expenditure in the United Kingdom 1900-1919*, by A. R. Prest.
- No. 4. *Income and Expenditure of Public Authorities in the United Kingdom, 1920-1938*, by J. E. G. Utting.
- No. 5. *Wages and Salaries in the United Kingdom, 1920-1938*, by Agatha L. Chapman assisted by Rose Knight.

Nos. 3 and 5 have been prepared at the Department; the others wholly or mainly at the National Institute.

## VII. PREMISES AND FACILITIES

### Premises

97. The growth of the Department meant that by the middle of 1949 the temporary building on the Downing Site, excellently equipped though it was, was quite inadequate for the Department's needs. Unfortunately the Regent House decided against a proposal to add another wing to the existing building, and it has been necessary to seek accommodation elsewhere. After a period towards the end of 1950 when members of the research staff had again been

accommodated on the top floor of the Marshall library, the University made available, in January 1951, the house in Lensfield Road which had just been vacated by the Appointments Board. This, together with the building on the Downing Site, provides ample accommodation for the Department's present needs; but it is only a very temporary solution since the house must soon be pulled down to make way for new chemical laboratories.

98. In addition there are marked disadvantages in having the Department housed in two buildings some distance apart. Although care has been taken to make the two parts as self-contained as possible, the library and computing facilities have necessarily to be retained on the Downing Site, and it is a considerable inconvenience to the research staff in Lensfield Road to be separated from these ancillary services. It is earnestly hoped that it will soon be possible for the University to house the whole Department in a single permanent building.

#### *Computing Facilities*

99. The computing staff now numbers six, and the Department has seven electric calculating machines (four Marchants, two Madas and one Monroe). In addition, one hand adding machine and an electric calculating machine of somewhat old-fashioned design have been lent to the Department and are in fairly regular use. It has been found that, with machines so constantly in use, at least one of the seven modern machines is normally out of action for minor repairs or adjustments, and it is hoped shortly to provide a further spare machine.

#### *Library*

100. The library, in spite of the intention to keep it small and specialized, has expanded very considerably in the period under review. Relatively few books are included since, apart from those on mathematical or very highly specialized subjects, most of these are available in the Marshall Library. The Department has instead concentrated on obtaining runs of the many periodicals of economic or statistical interest, and on building up a collection of the publications of the British and foreign governments and of international agencies, and unpublished papers and similar documents relevant to economic research.

101. Many periodicals and other publications are received from abroad in exchange for the issues in the Department's Reprint

Series. The library has also received during the period under review very generous gifts of periodicals and of books through the Book Scheme of the Rockefeller Foundation and from the American Economic Association. The Department is most grateful to these bodies and to certain individual donors for their valuable additions to its collection.

102. At the end of June 1951 the library contained the following:

Books	840
British government publications	3100
Pamphlets, papers etc.	2190
Periodicals, series received:	
British	57
Foreign	69

#### VIII. STAFF

##### *Research Staff*

103. In addition to the Department's research staff, listed below, Dr James Tobin of Harvard University spent a complete year from September 1949 to September 1950 as a Junior Harvard Research Fellow working at the Department. During that time he worked as a staff member and participated in the Department's programme of research, including the inquiry into the demand for food in the United Kingdom (see paragraph 64), of which he was in charge.

104. Mr S. F. James also worked in the Department with a research grant from the Department of Scientific and Industrial Research, after taking the Diploma in Mathematical Statistics with economics as his applied field in 1948, until he left Cambridge in April 1951. Whilst at the Department he contributed largely to its research work, particularly in respect of mathematical problems.

105. The following is a list of the research staff at June 1951:

Mr J. R. N. STONE, M.A. (Cantab.), Fellow of King's College.	Director.
Mr S. ADLER, B.A. (Oxon), M.Sc. (Econ.) (Lond.).	Senior Research Officer.
Mr F. SEWELL BRAY (Senior partner of Messrs Tansley Witt and Co., London; Member of the Research Committee of the Society of Incorporated Accountants).	Senior Nuffield Research Fellow.
Miss P. M. DEANE, M.A. (Glasgow).	Nuffield Research Fellow.

Dr K. MAIWALD, JuDr. (Brno) (formerly Professor of Economics in the School of Political and Social Science and Lecturer in Economics in the Faculty of Law at the Charles University, Prague).	Senior Research Officer.
Mr J. E. G. UTTING, M.A. (Cantab.).	Senior Research Officer.
Mr H. S. HOUTHAKKER, ec.drs. (Amsterdam).	Research Officer.
Miss D. C. PAIGE, B.Sc. (Econ.) (Lond.).	Research Officer.
Mr I. G. STEWART, M.A. (St. Andrews).	Research Officer.
Mr G. S. WATSON, B.A. (Melbourne).	Research Officer.
Mr A. A. GARRETT, M.A. (Cantab.), B.Sc. (Econ.) (Lond.) (Honorary Member of the Society of Incorporated Accountants).	Honorary Research Associate.
Mr A. A. ADAMS, M.A. (Cantab.).	Research Assistant.
Mr E. B. BUTLER, B.Sc. (Econ.) (Lond.).	Research Assistant.
Mrs D. E. COLE, M.A. (Cantab.).	Research Assistant.
Mr M. J. FARRELL, B.A. (Oxon.).	Research Assistant.
Miss E. KELLY, B.A. (Cantab.).	Research Assistant.
Miss M. S. C. PLANT, B.Sc. (University of Wales).	Research Assistant.
Mr S. J. PRAIS, M.Comm. (Birmingham).	Research Assistant.
Mr G. P. SMITH, B.A. (Cantab.).	Research Assistant.

106. The following have also been members of the research staff during the period covered by this report, but had left the Department before June 1951:

Mr E. J. M. BUCKATZSCH, M.A. (Oxon.).	Nuffield Research Fellow.
Miss A. L. CHAPMAN, M.A. (Toronto).	Senior Research Officer.
Professor G. TINTNER, Ph.D. (Vienna).	Senior Nuffield Research Fellow.
Dr A. R. PREST, M.A., Ph.D. (Cantab.).	Research Officer.
Mr J. DURBIN, M.A. (Cantab.).	Research Assistant.
Mrs R. KNIGHT, B.Sc. (Econ.) (Lond.).	Research Assistant.
Mr A. D. ROY, M.A. (Cantab.).	Research Assistant.
Mr A. D. SCOTT, M.A. (Harvard).	Research Assistant.

### *Administrative Staff*

107. The administrative staff at June 1951 is:

Mr R. M. D. DAVIES, B.A. (Lond.).	Secretary to Director
Mrs J. SIMPSON, B.A. (Capetown), Dip.Ed. (Oxon.).	Librarian
Mrs A. COSGROVE, B.A. (Manitoba)	Clerical Assistant
Miss E. M. SMART	Clerical Assistant
Miss A. HOBBS	Junior Clerical Assistant

### *Computing Staff*

108. The computing staff at June 1951 is:

Mrs E. M. CHAMBERS, M.A. (Cantab.)	Senior Computer
Mr R. A. ARNOULD	Computer
Miss A. BENDALL	Computer
Miss D. BRIGHAM	Computer
Mrs A. V. CHURCH	Computer
Miss J. PETERS	Computer

*Printed in Great Britain at the University Press, Cambridge  
(Brooke Crutchley, University Printer)*