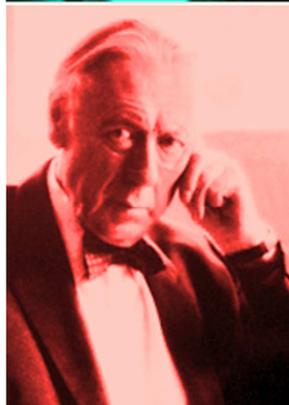


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Richard Stone: an Annotated Bibliography



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**Richard Stone:
an Annotated Bibliography**

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The 'Stone Collection' at the Central Library of the University of Lugano comprises Richard Stone's complete works in the field of economics.

The collection consists of approximately 200 articles and books, published between 1936 and 1991, the year of his death, as well as some posthumous works, manuscripts and secondary literature.

Much of the material comes from a donation by Richard Stone's wife, Giovanna. The remaining part has been assembled and made available by the authors of this bibliography and by the Library of the University of Lugano (BUL).

This Annotated Bibliography is also part of the Collection. It presents brief comments on each item in the collection, biographical notes and some more general considerations.

The authors would like to thank Domenico Rossignoli for bibliographical research and Nigel and Caroline Webb for text revision. Particular thanks are due to the Director of the University Library, Giuseppe Origi, for his valuable collaboration with this project.

The task of presenting the contributions of Richard Stone to economics, and in particular to the theory of income distribution, is facilitated, to some extent, by the existence of a number of complete lists of his publications, issued in books and international journals [see, for instance, Bibliography of Richard Stone's Works, 1936-1984, *The Scandinavian Journal of Economics*, Vol. 87, No. 1, 1985, pp. 33-43; The ET Interview: Professor Sir Richard Stone (interviewer M. H. Pesaran). *Econometric Theory*, Vol. 7, No. 1, 1991, pp. 85-123; Richard Stone, *Some British Empiricists in the Social Sciences 1650-1900*. Cambridge University Press, 1997, pp. 441-463].

In this annotated bibliography, we refer to the bibliography provided by Richard Stone on the occasion of the interview with M. H. Pesaran published in *Econometric Theory* in 1991. The bibliography is organised according to the date at which items were written rather than the date of publication.

1913

John Richard Nicholas Stone was born in London, on 30 August 1913, the only son of Gilbert and Elsie Stone.

1932

After attending Westminster School, he entered Gonville & Caius College, Cambridge in 1932, achieving 1st class honours in the Law Tripos, part 1, in 1933.

Not being interested in this subject, which he had only chosen to please his father, he changed to Economics.

In his autobiography for *The Nobel Prizes 1984* [192] Stone explains his switch from law to economics in these terms:

'At that time the world was in the depth of the great depression and my motive for wanting to change subject was the belief, bred of youthful ignorance and optimism, that if only economics were better understood, the world would be a better place'.

The College had no teaching Fellow in the subject but he was supervised by Richard Kahn and Gerald Shove of King's College and J. W. F. Rowe of Pembroke College.

He achieved a First in Economics Part II in 1935, probably influencing the College, as Pasinetti suggests, in its decision to appoint its first teaching Fellow

in Economics, John Hicks, who joined the College in October 1935. But by then Stone had gone down [Pasinetti, 1992, p. 113].

1936

001. A study of costs (with W.A. Tweddle). *Econometrica* 4 (1936): 226-241.

[Access the article via JSTOR: <http://www.jstor.org/stable/10.2307/1905421>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In 1936 Stone publishes his first article, in collaboration with W. A. Tweddle [001]. This is a study of eight British industries, determining the mathematical functional relationships between volume of employment and volume of production.

From the very beginning Stone is attracted to applied economics. He believed that economics was not sufficiently quantitative and that there was a gap between theory and facts. According to him, theory must be used to interpret facts and facts must be the source of economic reasoning.

In 1936 Richard Stone marries Winifred Jenkins, who had also read economics at Cambridge.

1937

002. Trends (with W.M. Stone). Monthly articles in *Industry Illustrated*, June-December 1937.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

From June 1937 to May 1939, Stone and Winifred Jenkins wrote the column entitled '*Trends*' [002, 004, 007] in the monthly publication *Industry Illustrated*. The column, which had been the responsibility of Colin Clark prior to his departure to Australia, provided information, statistics and comment on the British and worldwide economy. In Stone's words: 'It could be considered as a very modest forerunner of the British official monthly *Economic Trends* which began to appear after the war' [Stone & Pesaran, 1991, p. 90].

Nevertheless, this was an important experience for Stone. The information collected was used in his early articles as well as in *Trends* and his call to the Ministry of Economic Warfare, at the outbreak of the Second World War, probably owes much to his consequent growing reputation.

Issues:

May 1937, pp. 10 – 14.

June 1937, pp. 19 – 24.

July 1937, pp. 19 – 26. In-depth analysis: Local Economic Movements No. 1. The Regional Development of Employment.

September 1937, pp. 17 – 28. In-depth analysis: Local Economic Movements No. 2. The Regional Development of House Building.

October 1937, pp. 12 – 20. In-depth analysis: The General Economic Outlook; Local Economic Movements No. 3. The Regional Development of Factory Building.

November 1937, pp. 13 - 21. In-depth analysis: The General Economic Outlook; Car Sales and the Motor Show; The Rise of the Motor Trade.

December 1937, pp. 12 – 22. In-depth analysis: The General Economic Outlook; Local Economic Movements No. 4. The Regional Growth of Building Labour. A Problem of the Future.

1938

003. The marginal propensity to consume and the multiplier (with W.M. Stone). *The Review of Economic Studies* VI (1938): 1-24.

[Access the article via JSTOR: <http://www.jstor.org/stable/10.2307/2967535>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

During the same period, Stone and his wife publish three articles in economic journals.

The first one [003] provides a series of estimates of the marginal propensity to consume and its effect on the Keynesian multipliers.

The marginal propensity to consume is estimated for several countries by three different methods: the budget method, Kahn's method of leakages and the historical method.

The starting point is Keynes' 'fundamental psychological law' [J. M. Keynes, *The General Theory of Employment, Interest and Money*, Macmillan, 1936] that 'men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income'.

Stone wonders if Keynes' hypothesis is not too simplistic and if there are other determinants of consumption in addition to income and its variations. In particular, Stone investigates Staehle's hypothesis [H. Staehle, *Short-Period Variations in the Distribution of Incomes, Review of Economic Statistics*, 1937] that the distribution of income also plays an important role in determining consumption.

Stone concludes, however, that 'This is a very interesting analysis, but it seems that its conclusions do not hold universally, and before the end of this paper we propose to exhibit calculations based on an entirely different method which suggest that changes in the distribution of incomes are not important in general for the community as a whole or are highly correlated with changes in aggregate money income' [003, p. 8].

004. Trends (with W.M. Stone). Monthly articles in *Industry Illustrated*, January-December 1938.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

January 1938, pp. 10 – 15. In-depth analysis: The Rally in Confidence – Temporary or Permanent?

February 1938, pp. 18 – 24. In-depth analysis: Can We Afford Unemployment?

March 1938, pp. 16 – 23. In-depth analysis: Changing Trends in 1937.

[April 1938, pp. 12-14. Article in *Industry Illustrated*: Fundamental Statistics in the Light of Modern Economics.]

April 1938, pp. 16 – 22. In-depth analysis: Foreign Trade in Prosperity and Recession.

May 1938, pp. 15 – 21. In-depth analysis: Has Confidence Collapsed?

27th May 1938, pp. 15 – 20. In-depth analysis: Is There a Practical Case for Protection?

24th June 1938, pp. 17 – 23. In-depth analysis: The Next Six Months in Industry.

22nd July 1938, pp. 15 – 21. In-depth analysis: Is Wall Street Right?

26th August 1938, pp. 16 – 19.

- 23rd September 1938, pp. 12 – 18. In-depth analysis: Autumn Prospects.
 28th October 1938, pp. 16 – 21. In-depth analysis: America Steps Forward.
 25th November 1938, pp. 18 – 24. In-depth analysis: Where is the Slump?
 23rd December 1938, pp. 18 – 23. In-depth analysis: The Anatomy of Employment.

1939

005. Indices of industrial output (with W.M. Stone). *The Economic Journal* XLIX 195 (1939): 477-485.

[Access the article via JSTOR: <http://www.jstor.org/stable/10.2307/2224804>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

The second article [005] presents a comparison between different indices of British industrial output.

006. Pitfalls in assessing the state of trade (with W.M. Stone). In *British Management Yearbook 1939*, pp. 21-78.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

A third one [006] draws attention to the risks in assessing the state of trade.

007. Trends (with W.M. Stone). Monthly articles in *Industry Illustrated*, January-May 1939.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

- 27th January 1939, pp. 14 – 19. In-depth analysis: A New Year and a New Recovery?
 25th February 1939, pp. 16 – 22. In-depth analysis: The Economic Position of Germany.
 24th March 1939, pp. 17 – 23. In-depth analysis: Boom Ahead.
 29th April 1939, pp. 19 – 22.

27th May 1939, pp. 20 – 22.

24th June 1939, pp. 19 – 21.

1940

At the outbreak of war Stone is called to the Ministry of Economic Warfare, initially being asked to work on shipping statistics.

In 1940 he is transferred to the Central Economic Information Service of the War Cabinet Offices at the request of James Meade who is working on the financial aspects of the War and who needs someone to work alongside him on statistical computation. 'That was the beginning not only of the British national accounts but also of a friendship that is still going strong' [Stone & Pesaran, 1991, p. 92].

1941

008. The construction of tables of national income, expenditure, savings and investment (with J.E. Meade). *The Economic Journal* LI (1941): pp. 216-231. Reprinted in *Readings in the Concepts and Measurement of Income*, R.H. Parker and G.C. Harcourt, eds., Cambridge University Press, 1969.

[Access the article via JSTOR: <http://www.jstor.org/stable/2226254>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

Reprinted in *Readings in the Concepts and Measurement of Income*, R.H. Parker and G.C. Harcourt, eds., Cambridge University Press, 1969.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742388]

Pasinetti [1992, p. 113] observes that 'the success of Maynard Keynes's major work – *The General Theory of Employment, Interest and Money* – which had appeared in 1936, had given relevance to a whole series of macro-economic relations, which at that time could not be used for actual Government policy, simply because the data on macro-economic variables (such as total national income, total expenditure, investment, replacement, consumption, savings, etc.) did not exist'.

The work of Meade and Stone between 1938 and 1940 represents, in fact, the construction of the first system of national accounts.

Thanks to Keynes, who had made use of preliminary accounts for 1938-1939 in *How to Pay for the War*, these tables were published as an Appendix to a White Paper entitled *An Analysis of the Sources of War Finance and an Estimate of the National Income and Expenditure in 1938 and 1940* which supplemented the Budget of 1941.

In 1941, Stone and James Meade publish in *The Economic Journal* a methodological article on the foundations of national accounts entitled '*The construction of tables of national income, expenditure, savings and investment*' [008].

The article presents, in five tables, a detailed classification of all the elements that a system of national accounts should record: the basic material for a national income survey (table A), the composition and uses of personal incomes (table B), flow of savings (table C), foreign investment (table D) and home investment (table E).

The purpose of these classifications is twofold: to bring order to a field still lacking common rules and to provide a powerful statistical tool for estimating national income and making international comparisons.

From the *Introductory* [008, p. 216]:

'The national income may be defined in a number of different ways. Differences in definitions, which are all too infrequently given with precision by writers on this subject, may lead to great confusion in economic discussion. It is the purpose of this paper to show that the construction of balance-sheets of national income and expenditure clears up some of these problems of definition and provides a powerful statistical instrument for the cross-checking of various methods of estimating the national income. Such tables may serve two further useful purposes. First, they make it possible for the statistician to provide estimates of the national income and expenditure in the various forms which are most useful to the economist for the elucidation of many economic problems. Secondly, if a form of tables of this kind could be generally accepted, international comparisons of national incomes would be greatly facilitated'.

Of particular interest are the entries which are concerned with the *functional distribution* of income (rents, profits and interest, salaries, wages) and the distribution of personal incomes, or *size distribution* (groups of income-recipients arranged according to the size of their incomes).

At the end of 1941 the Economic Information Service was split into two: the Economic Section (to which Meade went) and the Central Statistical Office (C.S.O.) where Stone, thanks to Keynes' recommendation, was responsible for the national accounts. Every year, at budget time, and till 1945, he provided up-to-date data for a White Paper. 'These thin White Papers', records Stone, 'were the

forerunners of the Blue Books on *National Income and Expenditure* in which our small beginnings have been immensely magnified' [Stone & Pesaran, 1991, p. 92].

Stone stayed at the C.S.O. until the end of the war, working under Keynes, not without conflict, as described in his Keynes lecture to the British Academy in 1978 [167].

[Quotations: Economic Journal]

The marriage with Winifred Jenkins was dissolved in 1940 and in 1941 Richard Stone married Feodora Leontinoff, who was Secretary of the National Institute of Economic and Social Research, where he had started to run a project on the interwar national accounts.

Pasinetti [1992, p. 114] comments that 'these events were the prelude to the development of national accounting as a policy tool, not only for Britain, but for the world'.

1942

009. The national income, output and expenditure of the United States of America, 1929-41. *The Economic Journal* LII (1942): 154-175.

[Access the article via JSTOR: <http://www.jstor.org/stable/2225770>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

The theoretical framework developed with Meade in the article of 1941 is used by Stone to estimate the national income, output and expenditure of the United States from 1929 to 1941, and 1942, in a form which is comparable with the official estimates for the United Kingdom [009, 011].

A review of the estimates of national income and expenditure for the United States, the United Kingdom and three other English-speaking countries, Australia, Canada and Eire, would be presented in a later article published in 1947 [028]. Some particular aspects of income distribution are considered: the size distribution of personal income, the distribution of private income before and after direct taxation, income distribution and legal and medical services.

010. The precision of national income estimates (with D.G. Champernowne and J.E. Meade). *The Review of Economic Studies* IX (1942): 111-125.

[Access the article via JSTOR: <http://www.jstor.org/stable/2967664>]

One of the first problems facing Stone and his colleagues in the construction of national income accounts is reconciliation of observed data with estimates from different sources. In a pioneering article of 1942, Stone clarifies this problem thus: 'Let us suppose in the first place that we have succeeded in estimating independently the national income, output and expenditure and that we cannot distinguish between the precisions with which each has been measured. In such a case we should be justified in taking the unweighted arithmetic mean of the three measurements as the best estimate of each of the terms of the identity. On the other hand we may have good reason to believe that one of the estimates is much more reliable than the other two. It would be reasonable to give it a larger weight in arriving at the average value of the three identical terms. We must therefore consider the principles on which these weights are to be allotted' [010, pp. 111-112].

In commenting on this article, Stone observes that 'If one tries to estimate the national accounts it is immediately obvious that with the data available they will never balance without adjustment. So from the beginning I was anxious to devise a technique for balancing them, and David Champernowne, Meade, and I developed a means based on the method of least squares which was published in the paper you refer to [10]. Later in the decade Durbin, while he was at the Department, extended our work to deal with systematic errors and the adjustment of a sequence of years rather than an individual year; unfortunately his study was never published' [Stone & Pesaran, 1991, p. 110].

Despite the simplicity of the proposed method, the Stone-Meade-Champernowne adjustment technique is not widely taken up.

1943

011. National income in the United Kingdom and the United States of America. *The Review of Economic Studies* X (1943): 1-27.

[Access the article via JSTOR: <http://www.jstor.org/stable/2967492>]

This paper follows previous works on national income [009], a topic which is becoming increasingly important and influential in Stone's scientific interests. This

paper benefits from the first efforts at gathering comprehensive national statistics both in the United States and in the United Kingdom. This task was felt to be relevant to obtaining estimates of the economic effects of the war. As Stone warns, 'any attempt to compare the structure of two economies is a hazardous business' [011, p. 1]. This inherent difficulty derives, according to Stone, from an economic and a logical problem: the former relates to the definition of what is measured and in particular to the conventions to be followed in compiling the tables (e.g. this article focuses on net income at factor cost and on private disposable income); the latter centres on the need for unambiguous and consistent organisation of the relationship between the items, essentially to avoid overlap in the accounting procedure. The rest of the paper is dedicated to a thorough presentation of the new American quarterly estimates that are subsequently employed to compare British and American economies in relation to disposable income and to different utilisation of national resources. Finally, Stone concludes by outlining the main problems in estimating national income statistics. Interestingly, his concerns about the reliability of the estimates are driven by practical, policy-oriented considerations. In fact, as he concludes: 'If estimates of this kind could be reviewed continuously in peace time and were used to direct policy it should prove possible, with a little experience, to prevent the appearance of unemployment on a serious scale since the position would be kept continuously under review and it would be possible to act before it got seriously out of hand' [011, p. 14].

012. The fortune teller, *Economica* X (1943): 24-33.

[Access the article via JSTOR: <http://www.jstor.org/stable/2549652>]

At the same time Stone writes some reviews and comments on books and articles on the subject of national income.

The first is a very critical review of the book by Colin Clark entitled *The Economics of 1960* [Macmillan, 1942] [012]. With an almost sarcastic tone, Stone highlights all the gaps and inaccuracies in the text and states that 'The general conclusion that emerges from this examination is that the sole merit of the book is that its subject matter is interesting. ... It is regrettable that such a celebrated writer can bring himself to publish so misleading and inadequate a study' [012, p. 24].

Such a strong position is surprising, because Stone considered Colin Clark his mentor and predecessor.

In his long interview by M. Hashem Pesaran, published in *Econometric Theory*, 1991, to which we shall often refer, to the question 'What drew you to

economics in the first place? Which economists in Cambridge influenced you most?' Stone answers:

'Of my teachers, the two best on the theoretical side were Richard Kahn and Joan Robinson, but without doubt the greatest influence on me came from Colin Clark, who at the time was teaching statistics to economists in Cambridge. He had written a small book on the national income in 1932 and was [...] engaged on a much larger book on the national income and outlay, which came out in 1937. For this work he brought together estimates of income, output, consumers' expenditure, government revenue and expenditure, capital formation, saving, foreign trade and the balance of payments. [...] I found all this fascinating and Colin and I became great friends' [R. Stone and M. H. Pesaran, 1991, p. 88].

And to the question. '*During a time when most prominent economists in Cambridge were preoccupied with economic theory, what attracted you to focus on empirical analysis?*' Stone's answer is:

'My interest in economics was from the beginning in its applications. I thought that the economics I was taught was insufficiently quantitative and that theory and facts were too widely separated. This is why I was so attracted by Colin Clark's work. It seems to me that the development of a science requires attention to both facts and theories and I agree with Marshall that economic theory is as mischievous an imposter when it claims to be economics proper as is mere crude unanalysed history. I cannot imagine why anyone should think otherwise or why economists should tend to put theorists on a pedestal. The real difficulty is to combine the two so that theory can be used to interpret facts and facts can show what has to be interpreted' [R. Stone and M. H. Pesaran, 1991, p. 89].

This response expresses, very clearly, Stone's attitude to economics.

It is also worth remembering that when Colin Clark moved to Queensland in 1937, he bequeathed to Stone and his wife the monthly *Trends*, which was certainly a springboard for the young economist.

Angus Deaton, in his obituary to R. Stone [A. Deaton, 1993, p. 477], notes that:

'Clark was possibly the first of the many economists who were to be counted, not only as collaborators and colleagues, but as close friends, and it was Clark's interest in estimates of national income, in measuring prices and standards of living, and in the whole range of economic statistics that laid the foundations for Stone's subsequent work. Even so, there is a lack of theory in Clark's work that was not to characterize that of his pupil. Although Stone was always impatient with theorizing for its own sake, and with those who made no attempt to test their theoretical predictions, he enjoyed and appreciated economic theory, as would any talented student of Kahn and Keynes. He also realized from the first

how formal theory could be used to organize data, and how to confront theory with the data'.

We can hypothesise about Stone's scathing attack against Clark. The problem, possibly, may have been that Stone, especially by 1943, being a statistician at heart with his academic feet firmly on the ground, had moved on quite a long way from the sort of approach he had learnt from Clark: he had become very intolerant of other economists who claimed a greater relevance of their models to reality than they could justify statistically in making their initial assumptions.

013. Comment (on U.S. national income statistics by Milton Gilbert). *The Economic Journal* LIII (1943): 82-83.

[Access the article via JSTOR: <http://www.jstor.org/stable/2226291>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In the issue of April 1943 of the *Economic Journal* Milton Gilbert published a very positive review of the article *The national income, output and expenditure of the United States of America, 1929-41*, which Stone had published the year before in the same journal. The review is followed by a *Comment* by Stone answering some questions raised by Gilbert [013].

014. Two studies on income and expenditure in the United States. *The Economic Journal* LIII (1943): 60-75.

[Access the article via JSTOR: <http://www.jstor.org/stable/2226289>]

The strong interest, on both sides of the Atlantic, in national income problems is highlighted by three contributions of the National Bureau of Economic Research - N.B.E.R.

The first is a weighty two-volume study by Simon Kuznets [S. Kuznets, *National Income and its Composition, 1919-38*, New York, N.B.E.R. 1941, pp. xxx + 929. 2 Vols.]; the second a book by Harold Barger [H. Barger, *Outlay and Income in the United States, 1921-38*, New York, N.B.E.R., 1942, pp. xxvii + 391], and the third a book by Solomon Fabricant [S. Fabricant, *Employment in Manufacturing, 1899-1939*, New York, N.B.E.R., 1942, pp. xix + 358]. The review of these three studies by Stone and published in *The Economic Journal* [014, 015] is basically favourable.

It must be remembered that in the early thirties Simon Kuznets had published his estimates of U. S. national income and a measure of the depth of the depression,

and for this and following methodological works he was later awarded a Nobel Prize.

The visions of Stone and Kuznets about the definition of national income and income distribution were not coincident. The differences were not to be irreconcilable, however, since in 1950 the first national accounts for India were compiled by Stone and Kuznets working together.

015. Employment in U.S. manufacturing. *The Economic Journal* LIV (1944): 246-252.

[Access the article via JSTOR: <http://www.jstor.org/stable/2225926>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

This paper reviews Solomon Fabricant's book *Employment in the U.S. manufacturing*. This book contains detailed data and analysis on the 'variations that have taken place in employment and hours worked in American manufacturing industries' over the period 1899-1939. According to Stone, the book is to be recommended for at least two reasons. Firstly, it traces a number of interesting and compelling interrelations between the variables under examination (e.g. change in employment, variation in output, etc.). Secondly, it includes an extensive amount of valuable information that can be used to study further hypotheses not considered in the book itself. 'An example of this is the analysis of variations in output in terms of the short-period variations in man-hours worked, and a trend due partly to an increase in inventiveness and organisation and partly to an increase in capital equipment' [015, p. 249]. A large part of the paper is indeed dedicated by Stone to the examination of such a further relationship and on discussion of the findings.

1944

016. *National Income and Expenditure* (with J.E. Meade). Oxford University Press, 1944; second edition, Bowes and Bowes, Cambridge, 1948; third edition, Bowes and Bowes, Cambridge, 1952, fourth edition, Bowes and Bowes, London, 1957. (See also no. 79 below.)

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742341]

In 1944 R. Stone and J. Meade publish a booklet, *National Income and Expenditure* [016], which shows, in a parallel scheme, the national accounts for Britain and the United States. Completely rewritten as a textbook, in 1961, with his third wife, Giovanna Stone [079], this work has been the standard reference for generations of students and has appeared in ten editions, the last in 1977. They are also known as the Blue Books.

The first edition was written mainly by Meade and Stone's contribution was limited to statistical data analysis. For subsequent editions Meade retired and Stone developed the conceptual framework well beyond the original size.

The publication of *National Income and Expenditure* gave Stone a national and international visibility that identified him as the most suitable person to design and develop a standard system of national accounts.

In particular, in 1944, Stone was invited to get in touch with Canadian and American colleagues who were responsible for national accounts, including Milton Gilbert and Edward F. Denison, looking for a common classification and methodology. The meetings were very friendly and constructive and the results were presented in conferences and international publications.

1945

On 1 July 1945, on his return to Cambridge after the war, Stone is appointed Director of the Department of Applied Economics (DAE), the establishment of the Department and the appointment of Stone as Director being strongly desired by Keynes. Under his directorship, the Department will become one of the most prestigious research centres in the world in the field of applied economics and quantitative analysis.

At the same time he is appointed Fellow at King's College.

The research programme of the Department can be summarized by what Stone writes in the report sent to the Nuffield Foundation for request for funding:

'The ultimate aim of applied economics is to increase human welfare by the investigation and analysis of economic problems of the real world. It is the view of the Department that this can best be achieved by the synthesis of three types of study which now tend to be pursued in isolation. The Department will concentrate simultaneously on the work of observations, i.e. the discovery and preparation of data; the theoretical appraisal of problems, i.e. the framing of hypotheses in a form suitable for quantitative testing; and the development of statistical methods appropriate to the special problems of economic information. The special character of the Department's approach to the problems of real world

will lie in this attempt at systematic synthesis' [quoted by Pesaran & Harcourt, 2000, pp. 149-150].

Many distinguished economists, econometricians and statisticians have worked at the DAE, either as researchers on the staff or as visiting scholars. Pesaran & Harcourt [2000, p. 150] produce a long list of brilliant researchers involved in different fields of activity: 'Durbin and Watson on testing for residual serial correlation, Cochrane and Orcutt on the estimation of regression models with serially correlated errors, Aitchison and Brown on the lognormal distribution, Brumberg on life-cycle models, Houthakker on revealed preference and applied demand analysis, Prais on family budgets, Farrell on dynamic demands and on aggregation theory, Alan Prest and Derek Rowe on demand analysis, A.D. Roy on the distribution of income, Phyllis Deane and Brian Mitchell on British economic history'. Among the visitors we may mention T.W. Anderson, Duesenberry, Friedman, Frisch, Geary, Koopmans, Samuelson, Tintner, Tobin, Wold, but also Klein, Leontief and Pasinetti.

The first four reports of the Department give a thorough account of its first ten years of life.

G. Pyatt points out that Stone 'in the course of less than a decade, established for the Department an international reputation which was unprecedented in British social science and has not been equalled since. Moreover, while Stone's continuing work on national accounts was preeminent throughout this period, leading up to the first official international guidelines, published by OECD in 1953, it was not for this work that the DAE became so famous. Rather, the Department's reputation was built on the role its members played in developing the methodology of econometrics and, in particular, their pioneering work in the field of demand analysis. It was largely on the strength of this contribution to applied microeconomics that Richard Stone was subsequently awarded the Doctor of Science degree by Cambridge University' [Pyatt, 1992, pp. 245-246].

In his interview with Pesaran, Stone recalls in detail the long path, which began before the war, which led to the creation of the Department of Applied Economics:

'Its forerunner was a short-lived initiative known as the Cambridge Research Scheme. The chairman of the steering committee was Keynes and the finance was found by the National Institute of Economic and Social Research. It may amuse those who now have the task of raising funds for research to know that the grant to the Cambridge Scheme in 1938-1939 was £600 and that not all of it was spent.

The general subject of research was the process of economic change in the United Kingdom. One of the initial items in the program was Kalecki's quantitative work on prices and prime costs, in which he was assisted by Brian Tew, Y.N. Hsu, and

intermittently me. At the same time P. R. Marrack was working on the British demand for imports, and Erwin Rothbarth on consumption and its composition in relation to the level of activity. Work was planned on foreign trade and the balance of payments. Keynes himself intended to direct an investigation into the measurement of saving, and with the help of Piers Debenham made a start on it in the summer of 1939. Some publications arose from this series of projects, but little could be finished before it was all swept away by the war. However, enough had been going on to show that the program had a strong econometric flavor.

From an administrative point of view the Cambridge Research Scheme was highly informal. By way of providing a formal link between the group and the University, the Faculty Board of Economics and Politics, doubtless at Keynes' instigation, proposed to the General Board of the Faculties in the summer of 1939 the establishment of a Department of Applied Economics. This was accepted in the course of the Michaelmas term of that year. But in view of the outbreak of war the project had to be put into cold storage.

Keynes did not forget about it, however, and as the war drew to a close, arrangements were put in train to get the Department going as soon as possible. In 1944 the Faculty Board appointed a Committee of Management consisting of Keynes (chairman), David Champernowne, Austin Robinson, Joan Robinson, Gerald Shove, and Piero Sraffa, with Dennis Robertson as a coopted member, and in November of that year the Committee decided to offer the directorship to me.

When the offer came I was surprised and delighted. But before I could actually enter into my functions two things had to happen: the office of Director of the Department had to be approved by the University and I had to obtain my release from the Civil Service. The University took some months to make up its mind; I remember a letter from Gerald Shove in which he informed me that "this project is not quite dead." Eventually, on 15 May 1945, the University gave its consent, my release from the Civil Service was obtained without difficulty, and I was appointed Director as from 1 July of that year.

And so in the summer of 1945 the work began of formulating a research program, raising finance, finding accommodation, and recruiting staff. For the record, our first grant came from the Rockefeller Foundation, primed by Keynes. Without their help we might never have got off the ground. I also owe them my gratitude for renewing the grant in subsequent years. Another early supporter was the Nuffield Foundation' [Stone & Pesaran, 1991, pp. 96-97].

017. The analysis of market demand. *Journal of Royal Statistical Society* 108 (1945): 1-98.

[Access the article via JSTOR: <http://www.jstor.org/stable/2981291>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

During the war years, in addition to his work on national accounting, Stone carried out research for the National Institute of Economic and Social Research into national expenditure, output and income of the United Kingdom over the period 1920-38. The first results of the research were presented at the Royal Statistical Society and published in its journal in 1945 under the title 'The analysis of market demand'.

The study analyses separately the demand for a wide range of consumer goods even though Stone realises that the demand functions must be treated globally, as a single coherent system. The determining variables of the demand functions are the total consumption expenditures, the price of the commodity in question, the price level of other goods and a trend factor.

Among the key points in his analysis, Stone considers difficulties associated with variation of income distribution. Stone's concerns, regarding this, are well expressed in the following passage:

'In practice, however, there is one serious and one possible danger. In the first place, for example, it has not been possible to introduce variations in the distribution of income explicitly, and it is assumed that such changes in distribution as have in fact taken place will be mainly reflected in the parameters b and r . This in turn assumes that changes in distribution take place in a simple regular way. But it may be that between the period of observation and the date of forecast a radical change will have taken place in the distribution of incomes, so that the relationship previously assumed between the distribution of income, income itself and time no longer holds. If this happens, the forecast will not be successful unless the influence of changes in the distribution of income is in any case unimportant. Accordingly it is necessary to consider how far such changes are likely to affect the result, and not to apply the results of past experience uncritically' [017, p. 312].

In all respects Stone's work is incredibly thorough and complex, both as regards the collection and processing of data, and in the problems of statistical theory confronted. Here also is the first appearance of time series and cross section econometric techniques.

One must fully support Deaton's claim in his tribute to Richard Stone [1993, p. 483]:

‘Stone’s paper ‘The analysis of market demand’ which appeared in 1945 in the *Journal of the Royal Statistical Society*, established its author as Britain’s leading econometrician, fully conversant not only with his data – as would be expected from the author of the national accounts – but with the latest methods in what was then an extremely technical subject that had only officially come into existence twelve years before (the Econometric Society was founded in 1933). Certainly it was an extraordinary achievement for someone with no formal training in mathematics’.

1946

018. John Maynard Keynes (obituary). *Economisch-Statistische Berichten* (Amsterdam), 17 July 1946.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

The death occurred, on 21st April 1946, of John Maynard Keynes, the polished mathematician of *A Treatise on Probability*, the far-seeing prophet of *The Economic Consequences of the Peace*, the brilliant intellectual of the Bloomsbury Group, the unorthodox economist of *The General Theory of Employment, Interest and Money*, the tireless and insuperable negotiator at Versailles and Bretton Woods.

In the obituary of his *Maestro* [018], Richard Stone dwells on Keynes’ attitude to mathematics and its use in economics. The subject, which is to be taken up again and developed further in a lecture many years later [167], is close to Stone’s heart because it was the source of bitter arguments with Keynes.

Stone begins by observing that Keynes ‘rarely indulged in purely theoretical writings except insofar as these were necessary as a basis for the solution of practical problems’.

At the same time Keynes insisted that new ideas should be developed with accepted doctrine and quantified as far as possible.

On the use of mathematics in economics Keynes seemed to share Marshall’s opinion that “the chief use of pure mathematics in economic questions seems to be in helping a person to write down quickly, shortly and exactly, some of his thoughts for his own use”.

Consequently ‘he was frequently impatient of the laborious calculations and tentative conclusions of statistical economists’.

Typical of his personality, 'He would delight in saying that a statistical estimate of a parameter was all right if it accorded with his notions of what it ought to be, otherwise not'.

However Stone observes that 'despite all this (Keynes) never lost sight of the importance of quantitative economics and insisted on all occasions that economic policy must be based on a solid foundation of numerical observations and estimates'.

Stone's conclusions are important in order to understand the origins and development of the construction of an extensive system of national accounts: 'It was largely to his persuasive genius that we owe the origin and acceptance in official circles of the work on national income and expenditure which has appeared each year at Budget time since 1941. In official circles in Britain the war period saw virtually a revolution in the extent to which reliance is placed on quantitative data, a development of which Keynes at the Treasury was perhaps the most powerful advocate. Even in statistical economics and econometrics he would often show the warmth of his encouragement and approval to a degree which might not be expected on the evidence of his published utterances'.

019. Lord Keynes: the new theory of money. *Nature* 158 (1946): 652.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In this obituary, published in November 1946, Stone highlights the major contributions of John Maynard Keynes to economic analysis.

According to Stone, Keynes's approach to economic problems is characterized by two features that are not always found together: a strong interest in practical problems and continual reference to existing theories. Keynes constantly relates experiences encountered in his professional life and institutional roles to existing theories and proposes corrections and generalization when theories are shown to be deficient. As Keynes himself writes in the preface to the *General Theory*, the volume is 'an attempt by an economist to bring to an issue the deep divergences of opinion between fellow economists which have for the time being almost destroyed the practical influence of economic theory and will, until they are resolved, continue to do so'.

The main contribution of Keynes to economics was perhaps that of having highlighted the complex links between the monetary and real aspects of an economic system, and having shown that in a modern economy it can be possible to achieve a position of so-called equilibrium even in the presence of an income level well below that which ensures full use of resources, especially labour.

Stone presents a simple dynamic model that, without claiming to represent the functioning of an economic system along the Keynesian lines, helps the reader to understand the main assumptions and the main consequences of his approach. Given the presence of time lags, the problem of whether the Keynesian system is explosive, oscillatory or stable depends on a set of behaviouristic coefficients.

020. The national income: a statistical account of the British economy. *The Times*, 27 May 1946.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

021. National income and expenditure: the local authority sector. *Local Government Finance*, July 1946.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

The paper comments on the annual Budget White Paper on national income and expenditure with particular reference to local authorities.

022. Economic models with special reference to Mr. Kaldor's system (with E.F. Jackson). *The Economic Journal* LVI (1946): 556-567.

[Access the article via JSTOR: <http://www.jstor.org/stable/2225986>]

In the article 'Economic models with special reference to Mr. Kaldor's system' [022], Stone illustrates and discusses the model presented in Nicholas Kaldor's appendix to *Full Employment in a Free Society* by W. H. Beveridge [W. Beveridge, *Full Employment in a Free Society*, London, Allen & Unwin, 1944].

Among the problems arising in interpreting and estimating the effectiveness of economic models, Stone mentions that of changes in income distribution during the war, which will also have implications for research on demand for individual commodities.

In Section II [pp. 555-558] Stone indulges in a digression on the nature and use of economic models pointing out that 'It is not essential that the model should cover the whole of an economic system (such as the interrelated world economy), but, if it does not, it represents a system of "inside" relationships which are subject to disturbance by variations from outside'.

He notes that Kaldor, being primarily concerned with use of fiscal means to achieve full employment, models only what he sees as the relevant part of the economic system, thus omitting many factors.

But, says Stone, one may not only restrict the extent of the model, but also vary the level of simplification:

‘The extent to which a model may be restricted and the degree to which it may be simplified depends on the purposes for which it is to be used. A model which is perfectly satisfactory for some purposes may be quite useless for others which involve the same variates’.

Furthermore, Stone argues, ‘the concepts and relationships chosen for the construction of a model are not given by nature, but are largely the invention of the investigator and depend on the way in which he thinks it profitable to represent experience’.

On the subject of the relationships used in models, Stone says that ‘These may take the form of (I) definitions, (II) institutional or behavioural equations, and (III) assumptions. The last category may be further subdivided into (i) values ascribed to variates which enter the model but whose laws of variation do not form part of the model, and (ii) equilibrium conditions’.

He looks at these in greater detail:

‘First, the freedom of a set of variates to vary independently may be restricted by the fact that some of the variates [...] are so defined as to add up to another set of variates [...].

These relationships are nothing more than the definitions introduced by the investigator as a result of the concepts with which he works. They are largely independent of the economic system which is being studied, and contain no adjustable parameters. They may be linear, [...] or non-linear [...].

The second type of relationship is quite different, and represents some aspect of the economic system studied. While it will be formulated as an hypothesis, and theory will suggest its general character, observations are capable of rejecting the hypothesis and, if it is not rejected, are needed to provide information on the numerical value of the adjustable parameters that enter into it. [...] Relationships of this kind involve adjustable parameters, and depend on observation for their validation.

The third type of relationship is essentially a condition imposed by the investigator. Its purpose may be either to assign a value to a variate which enters into a model but is not determined by it, or it may be to see what would happen if the model were to operate subject to certain constraints which for policy reasons it is desired to impose on the system of which the model is a representation’.

Stone also distinguishes between static and dynamic models and illustrates appropriately with examples, then looking in detail at Kaldor's (static) model.

023. Social accounting in Holland. *Accountancy*, October 1946.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

This very brief article presents the first comprehensive statistical summary of Holland's economy, produced by a newly established 'Central Planning Office', whose purpose was precisely to deliver periodical reports on the national economy. The article presents and comments on the main figures resulting from this report, showing an economy that has not yet fully recovered after wartime. Stone praises these developments in social accounting in Holland, pinpointing the importance of such statistical improvements - fruitfully introduced during the war and now implemented also in peacetime - as they help governments to sustain the national economy. This task was felt as particularly urgent (in Holland as well in most of Western Europe) to meet reconstruction objectives.

1947

024. Definition and measurement of the national income and related totals. Appendix to *Measurement of National Income and Construction of Social Accounts*, UN, Geneva, 1947.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742264]

At the end of World War II, Richard Stone begins a collaboration with the UN designed to implement a system of national accounts. The liaison, which lasted over more than twenty years, started with the preparation of an Appendix to a UN publication entitled '*Definition and Measurement of the National Income and Related Totals*' [024], and ended with the publication of '*A System of National Accounts*' in 1968. Two further revisions of the standard system of national accounts have been published in 1993 and 2008.

The Appendix provides the basic framework for the *System of National Accounts* (SNA) currently used throughout the world. It presents an economy as a system of interlocking transactions, and the accounting as a way of arranging and recording these transactions. The accounting scheme is a theoretical scheme which however enables many practical applications: it provides an ideal structure for empirical analysis.

In the Appendix, Stone stresses the need for investigation and proper analytical formulation of the 'structure of the constituent transactions' that constitutes the National Accounts, and 'the mutual interdependence of these transactions'. This focus is driven both by the clarity of the exposition and presentation, and by the practical fact that actual transactions take place 'between accounting entities' [024, p. 23].

Stone remembers the origins of this work, which would have had such a profound and pervasive influence on the accounting systems of all nations of the world, with these words:

'Well, it began in a way I hadn't expected. At the end of the war I was invited by Winfield W. Riefler, who was a member of the American Board of Economic Warfare stationed in London, to visit the Institute for Advanced Study in Princeton after the war. I decided to take advantage of this invitation before I entered actively into my duties at the Department and so September 1945 found me in Princeton. At the Institute I met Alexander Loveday, the head of the Intelligence Department of the League of Nations. He had been there with his department during the war and one of the first things he said to me was that he had been looking for someone to write a report on national income statistics for the League of Nations' Committee of Statistical Experts and would I like to take the job on. My answer was an emphatic yes, as for the past five years I had been wanting to write up the subject properly but had never found the time and, indeed, was intending to do it here in Princeton. "Well," he said, "if you can get out a draft in the next two or three months I'll organize a committee here and we can finalize the whole thing." I did this and the committee met from 17 to 20 December. I was in the chair and the other eight members were H.P. Brown (Australia), J.B.D. Derksen (Netherlands), C.M. Isbister (Canada), George Jaszi (U.S.A.), Hildegard Kneeland (Inter-American Statistical Institute), Raul Ortiz Mena (Mexico), Arne Skaug (Norway), and Julius Wyler (Switzerland). Though not a member of the committee, Agatha Chapman (Canada) also took part in the discussions. The report was published by the United Nations, Geneva, in 1947 [24] [Stone & Pesaran, 1991, p. 94].

The new approach suggested and implemented by Stone provides some important advantages, both to economists and to policy-makers. These advantages are outlined by Stone at the end of the Appendix and consist essentially of the following:

- the social accounting approach makes explicit the structure of the interdependence of all transactions, allowing consistent presentation and provision of cross checks between accounts;
- the interdependence in turn requires measurement to be consistent, reliable and comparable, demanding improvement in measuring techniques and providing

groundwork for better data collection, highlighting problems to be faced in pursuing the task (to ease the search for a solution), and favouring comparison between theory and practice;

- finally, social accounting enables international comparison and opens the door to forecasting.

The table below, available on the website of the United Nations

<http://unstats.un.org/unsd/nationalaccount/hsna.asp>,

presents a concise but complete scheme that summarizes the evolution of the System of National Accounts.

Historic Versions of the System of National Accounts

The broad objective of the System of National Accounts (SNA) is to provide a comprehensive conceptual and accounting framework for compiling and reporting macroeconomic statistics for analysing and evaluating the performance of an economy.

1947

The origins of the SNA trace back to the 1947 Report of the Sub-Committee on National Income Statistics of the League of Nations Committee of Statistical Experts under the leadership of Richard Stone.

At its first session in 1947, the United Nations Statistical Commission (UNSC) emphasized the need for international statistical standards for the compilation and updating of comparable statistics in support of a large array of policy needs.

In view of the emphasis on international statistical standards throughout the history of the Commission, the following national accounts standards were produced:

1953

The 1953 SNA was published under the auspices of the UNSC. It consisted of a set of six standard accounts and a set of 12 standard tables presenting detail and alternative classifications of the flows in the economy. The concepts and definitions of the accounts were widely applicable for most countries, including developing countries. Two slightly modified editions of the 1953 SNA were published.

1960

The first revision in 1960 reflected comments on country experience in the implementation of the 1953 SNA.

1964

The second revision in 1964 improved consistency with the International Monetary Fund's Balance of Payments Manual.

1968

The 1968 SNA extended the scope of the national accounts substantially; by adding input-output accounts and balance sheets; giving more attention to estimates at constant prices; and making a comprehensive effort to bring the SNA and the Material Product System (MPS) closer together.

1993

The 1993 SNA represents a major advance in national accounting and embodies the result of harmonizing the SNA and other international statistical standards more completely than in previous versions.

2008

The 2008 SNA, which is an update of the 1993 SNA, addresses issues brought about by changes in the economic environment, advances in methodological research and the needs of users.

025. Social accounting: I. National income before and since the war; II. Consumption and the course of prices. *The Times*, 29 and 30 August, 1947.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

This contribution to the debate on social accounting is included in two newspaper articles, published in *The Times* on 29 and 30 August. War has been over for rather more than a year and public opinion has shown an increasing interest in the state of the economy. Using his expertise in national accounting, Stone compares British data for 1945 and 1946 with the pre-war period (1938). His purpose is not merely descriptive: he tries to explain to the general public the way in which official statistics are constructed and the methodological problems faced in pursuing the task. In particular, the first article focuses on public and private spending, while the second one looks at the way national resources are distributed among different sectors of industry and the population. In the first article, Stone highlights the importance of a multi-sector decomposition of national income, in order to show where income is generated and spent. At the time of writing, data were collected only for the main industries, while Stone's

wish was to extend the development of this task to income and property as well. The second article stresses some more technical points, in particular highlighting the importance of adjusting for price level when presenting comparisons over different years. In fact, one purpose of this kind of analysis is to show the pattern of economic and social life standards. The adjusted data can then be used as a starting point for economic planning, intended as a tool for reaching, in the economy of the country as a whole, some economic targets (namely, in Stone's article, a high and stable level of employment and a socially desirable distribution of income). In these two newspaper articles, reflecting the climate of public opinion on applied economics, Stone intends to provide public decision makers with tools to enable them to decide and implement their desired economic targets. In fact, the main picture emerging from Stone's figures is that of an over-stretched economy, in which the side effects of the war have not yet been overcome. Therefore, in Stone's view the need for economic planning and forecasting is as urgent at this time as it has been during wartime.

026. On the interdependence of blocks of transactions. *Supplement of the Journal of the Royal Statistical Society IX (1947): 1-45.*

[Access the article via JSTOR: <http://www.jstor.org/stable/2983570>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

One of the purposes of statistical methods is to reduce the number of explanatory variables, identifying the most important ones. The statistical method of factor analysis deals with precisely this issue. The method was developed and applied primarily by psychologists and extended for the first time to economic analysis, as Stone argues, by Hotelling [H. Hotelling, Analysis of a Complex of Statistical Variables into Principal Components, *Journal of Educational Psychology*, 1933, pp. 417-41 and 498-520].

In the article 'On the interdependence of blocks of transactions' published in 1947 [026] Stone considers 17 components of the national income and expenditure of the United States for the years 1922 to 1938 and shows that 97.5 percent of the combined variances can be explained by only three factors: the national income, its rate of change and a time trend.

The result, amply illustrated and proved from a theoretical point of view, leads Stone to conclude:

'It seems clear that factorial methods are potentially valuable in the analysis of economic data, particularly in dealing with problems of classification, or the formation of ideal types of variation by which sets of variables such as

transactions or prices may be characterized. The method of principal components seems well adapted to economic investigations, and leads to measures which have many desirable algebraic properties. From this point of view the purpose of factor analysis lies in its usefulness in the reduction of data, enabling us to replace a large number of series by a small number which provide the principal components of variation of the original data' [026, p. 30].

027. Prediction from autoregressive schemes and linear stochastic difference systems. Paper presented at the ISC, Washington, 1947. In *Proceedings of the International Statistical Conferences, 1947*; Eka Press, Calcutta, 1951.

[Access the article via JSTOR: <http://www.jstor.org/stable/1907289>]

This is a statistical article, outside Stone's usual lines of research, concerning prediction from linear stochastic difference systems.

028. The measurement of national income and expenditure: a review of the official estimates of five countries. *The Economic Journal* LVII (1947): 272-298.

[Access the article via JSTOR: <http://www.jstor.org/stable/2225673>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

Stone's interest and expertise in national accounting led him to explore different national accounting systems, highlighting strengths and weaknesses. In particular, Stone is interested in driving national accounting towards common standard procedures that increase inter-country comparability. The paper explores the measurement of national income in the United States, United Kingdom, Eire, Canada and Australia, and opens with an appraisal of the common efforts made by the respective statistical offices to adopt similar approaches and methods, a task clearly facilitated by the fact that the five countries under examination share a common official language. After some remarks on the problems related to the estimation of national income and expenditure, Stone briefly outlines the main feature of each national system, stressing similarities and differences. Finally, he suggests a common framework to be adopted. In particular, Stone stresses the fact that 'The accounting approach has been used so far mainly as a theoretical model which has helped the compiler with problems of logical consistency and, as in the preceding paragraphs, as a means of presentation and exposition. These developments have helped to introduce a larger measure of economic design into the measurement of transactions and have transformed the earlier study of the national income into a broader field of enquiry' [028, p. 298]. Although these

developments have been important in furthering economic design, Stone has reservations about practical aspects: 'Up to now, however, the process has not gone so far as to influence radically the mode of collecting the necessary information' [028, p. 298]. As usual, Stone, being mostly concerned with practical rather than theoretical issues, calls for a further effort to increase the statistical reliability and feasibility of comprehensive social national accounts. This was indeed the main purpose of the work carried on at the Department of Applied Economics in Cambridge.

1948

029. National accounting and national budgeting for economic policy. *Nationalekonomiska Föreningens Förhandlingar, 1947 (Stockholm), pt. 3, (1948): 63-72.*

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

Richard Stone's output is mainly technical and only rarely does he allow himself personal observations. In this little known article of 1947 Stone expresses his personal view on the sort of control which he thinks the state should exercise over the economy. For Great Britain the Second World War is just over and there is gradual change from a wartime to a peacetime economy.

Stone has developed progressive ideas during his first years at university, and is convinced that the study of economics can improve people's living conditions:

'In my second year, 1932-1933, I did a foolish and rather unkind thing; I was determined, if possible, to switch to economics. I never opened a law book after Christmas 1932. What I read was Irving Fisher, Marx, Freud, Lenin and popularized science. [...] youthful inexperience and innate optimism combined to make me think that if there were more economists the world would be a better place' [Stone & Pesaran, 1998, pp. 87-88].

The purpose of national accounting and national budgeting is, according to Stone, 'to maintain a balance between over-all supply and over-all demand and in this way we make it possible to avoid the extremes of deflation and mass unemployment on the one hand and inflation and continuously rising wages and prices on the other' [029, p. 68].

Beyond this main objective there is a second. National accounting and national budgeting permit an estimation of the effects that certain types of final

expenditure can have on the economy. National budgeting thus becomes a tool for economic planning.

Stone emphasizes however that 'It is important to recognise the differences between planning based on national budgeting in the way which has just been described and planning based on physical controls' [029, p. 69].

Stone notes part of a parliamentary debate relevant to this point in which a member of parliament declares: "I am sure an immense amount of harm has been done by the confusion of planning and controls. Planning and controls in this country are irreconcilable enemies. The better the planning the fewer the controls; the more the controls the less flexibility we have in our economy and without that flexibility it is not possible for a British government to plan for abundance" [029, p. 69].

Stone declares himself substantially in agreement with these words, but says: 'In a period of acute shortage after a war in which the whole economic system had been driven far from its normal peace time structure it would hardly be practicable to do away with controls with a stroke of the pen and return to a complete reliance on the price mechanism. Few of those anxious to see a return to something more nearly like free market conditions would recommend such a course in Britain today. They would I think advocate a policy which would bring the economic structure of the country more nearly back to its normal peace time form and to relaxation of controls in favour of the price mechanism by stages which would be reached at different times in the future in different industries' [029, p. 69].

Stone's position is indeed progressive (one notes also the use of the word 'equity' in what follows) but also very positive and substantially open to a return to the free market.

'At present', Stone concludes 'we need national accounting and national budgeting to help us to get an outline in quantitative terms of the economic situation that we are in and we also need some measure of physical controls, partly in the interest of equity and partly to ensure that certain essential jobs, such as the increase in exports, are carried through. As things get easier we may reasonably hope to get rid of many of the controls but if a rational economic policy is to be followed national accounting and national budgeting will continue to be necessary' [029, pp. 71-72].

030. Social accounting, aggregation and invariance. *Cahiers du Congrès International de Comptabilité*, 1948. French translation: *Economie Appliquée*, vol. II, no.1, (1949): 26-54.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

Essentially, there are three strands to Stone's work in the field of national accounting.

The first is to develop a system of national accounts easily understood by, and acceptable to the officials handling such statistics in different countries, so as to achieve a common, shared model.

The second is to prepare an outline of national accounts sufficiently disaggregated and coherent as to form the basis for construction of macroeconomic models.

The third is to build a system comparable with other classification systems for economic data, such as input-output tables.

In *Social accounting, aggregation and invariance* [030] Stone presents a classification of economic accounts which demonstrates the equivalence between a matrix representation, a network representation and an accounting representation of an economic system.

The various technical aspects analysed include invariance, i.e. the conditions under which the basic data can be manipulated without introducing unwanted effects on the accounting system.

An example of such manipulation is the aggregation of economic sectors, sometimes necessary on account of the origin of the data available and for reasons of simplification, or, at the corporate level, vertical integration. Other examples concern different types of transactions, monetary or non-monetary, or changes in the value of money over time.

031. The analysis of market demand: an outline of methods and results. *Review of the International Statistical Institute* 16 (1948): 23-35.

[Access the article via JSTOR: <http://www.jstor.org/stable/1401230>]

This paper provides a methodological outline of the analysis of market demand. Although the paper is mainly technical, it illustrates the procedures adopted to investigate consumers' expenditure in the United Kingdom. The paper constitutes a follow up to a previous work on the same topic [017], subsequently further developed in [044] with the purpose of obtaining a comprehensive presentation

of consumers' expenditure in the United Kingdom in 1920-1938. The analysis of market demand developed in these works will be then combined in *The Measurement of Consumers' Expenditure and Behaviour* [056], and will eventually be implemented in the more general model of economic growth that was work-in-progress at the Department of Applied Economics in Cambridge.

032. *The Role of Measurement in Economics. The Newmarch Lectures, 1948-49, Cambridge University Press, 1951.*

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742769]

This is a collection of the Newmarch Lectures given by Stone at University College, London, in the academic year 1948-1949. Beyond the technical content, covering issues related to measurement of economic phenomena, Stone presents and justifies the use of mathematical and statistical tools in economics.

Lawrence Klein, in his review published in *Econometrica* [L. Klein, Review of R. Stone, *The Role of Measurement in Economics*, *Econometrica*, 20, 1952, pp. 104-105] writes:

'Richard Stone uses the occasion of the Newmarch Lectures, 1948-1949, University College, London, to develop material for a new monograph of the Department of Applied Economics, Cambridge. Econometricians will be delighted to see sound publications like this coming out of England where the lack of a large-scale movement by scholars toward econometrics has retarded achievements commensurate with the best British traditions in more conventional economics.

Measurement in Economics treats the following topics: (1) a blending of theory into measurement techniques, (2) parameter estimation, (3) an expository macroeconomic model and prediction, (4) social accounting with lucid diagrams and examples, and (5) "the theory and measurement of demand."

Stone possesses a rare combination of abilities - an intimate knowledge of data collecting, of the use of data in statistical manipulation, of theoretical methods of statistics, and of theoretical economics. In most cases we find experts specializing in only one or two of these areas simultaneously. His best work, in the reviewer's opinion, occurs in the sections of the volume on social accounting, the proposal for careful statistical design of economic data collection receiving the strongest endorsement. Moreover, Stone shows great elegance of style in dealing with social accounting, a quality which makes his work far more acceptable than that of most national income statisticians. The empirical demand studies merit special notice because of the wide variety of products covered'.

Stone's defence of econometrics is not only forward-looking, but also courageous, given the opposition of most of the economists of the time, especially Keynes, to this new science.

Stone speaks of 'a growing cleavage' among economists and recognizes that 'The econometric approach with its inevitable emphasis on mathematics in formulating theories and analysing observations calls for a technical knowledge if its methods are to be understood, let alone used, which many economists and economic statisticians do not possess and do not see the need of. There is a reluctance to believe that the complexities of economic change can ever be ensnared in a mathematical net, or rather there is a misunderstanding of the part which the mathematical net must play in getting the economic fish to the table' [032, p. 3].

As an example of this reluctance Stone quotes the famous comments of J. M. Keynes on research conducted by J. Tinbergen for the League of Nations:

'No one could be more frank, more painstaking, more free from subjective bias or *parti pris* than Professor Tinbergen. There is no one, therefore, so far as human qualities go, whom it would be safer to trust with black magic. That there is anyone I would trust with it at the present stage or that this brand of statistical alchemy is ripe to become a branch of science, I am not yet persuaded. But Newton, Boyle and Locke all played with alchemy. So let him continue' [Keynes, 1940, p.156].

One of the many issues tackled by *The Role of Measurement in Economics* is the proposed replacement of some national accounts data with survey data.

The attempt to encourage this proves unsuccessful, as Stone will explain forty years later:

'In my Newmarch Lectures, published as *The Role of Measurement in Economics* [32], I discussed the question of the introduction of statistical design into the collection of social accounting data. The idea was to replace data that happened to be available from a variety of usually administrative sources with data derived from samples of different sectors of the economy. This idea was tried out on Cambridgeshire by John Utting and Dorothy Cole with a number of assistants. We had considerable success with households, farms, government, and the university world. We were, however, finally defeated by business. There were reasons for this: there was hardly any large-scale enterprise in Cambridgeshire; in the early 1950s businesses were not so used to cooperating over statistics as they have since become; and we were not set up to deal with public relations in an adequate way. We wrote up the successful bits but they were too incomplete to make a monograph though they made a number of papers' [Stone & Pesaran, 1991, p. 100].

033. The theory of games. *The Economic Journal* LVIII (1948): 185-201.

[Access the article via JSTOR: <http://www.jstor.org/stable/2225934>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

The work of von Neumann and Morgenstern [J. von Neumann and O. Morgenstern, *Theory of Games and Economic Behaviour*, Princeton University Press. First edition 1944, pp. xviii + 625. Second edition 1947, pp. xviii + 641] sets the basis for the analysis of individual behaviour. This is of major importance, after Keynes' works on the analysis of aggregate agents. Starting from the circumstances of a single-agent economy (the example of Robinson Crusoe), the authors highlight the fundamental differences as compared with a social economy: the participants' choices depend on the relationships they enter into with each other. As Stone points out in his review:

'The object of this book is not to add perceptibly to our knowledge of actual economic behaviour, but rather to provide us with a new set of concepts and relationships in terms of which such behaviour can be rigorously and exhaustively discussed. The authors see in the conduct of games of strategy the essential features of economic behaviour and, accordingly, the greater part of the book is devoted to building up a theory of such games. The results of these labours should be of interest not only to the mathematician, the student of the nature of games and the economist, but also to all those whose subject encompasses the sort of problem sketched out above' [033, pp. 186-187].

Having summarised the main ideas of the book and basic game theory reasoning, Stone focuses on the illustration of multiple solutions, to highlight what he finds 'puzzling' about the rationale of von Neumann and Morgenstern's work:

'different standards are associated by the authors with different solutions rather than with different imputations. The implication seems to be that a solution containing an unfair imputation must have all its remaining imputations deemed unfair so that the whole solution is rendered morally unacceptable. I must confess that I do not see why this should be so, though I do not feel able to go further with the matter at present' [033, p. 194].

Finally, Stone gives some attention to the Appendix which contains a thorough formalisation of the concept of utility, pointing out that:

'This treatment of utility involves the use of mathematical expectations, which means that the value in the sense of the expected value of a one millionth chance of winning one million pence is one penny. In fact it may be more, as witness the success of the football pools. Put another way, the treatment seems to imply that there is no specific utility in gambling. The authors recognize this problem, but see

great difficulties in formulating such a concept as this in a manner free from contradiction' [033, 197].

Stone is clear that the book is a 'great work', in line with current 'ordinary theory', though somewhat too 'exacting' (both in content and size) to reach a wide public.

034. The presentation of the central government accounts (with F. Sewell Bray). *Accounting Research 1* (1948): 1-12.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In this work, co-authored with F. Sewell Bray, Stone proposes a way to present central government accounts formally, in response to a speech by the Chancellor of the Exchequer in which these sorts of suggestion were invited. The approach is very practical. In particular, Stone and Bray suggest adoption of a scheme analogous to those in vogue for companies' profit and loss accounting, in particular by putting expenditure on the left-side and revenue on the right-side of double-entry book-keeping accounts. Moreover, the authors stress the importance of keeping current and capital transactions distinct in published accounts. Finally, they also propose a form of aggregated accounts for publicly controlled enterprises, urging the Chancellor to foster the development and publication of such accounts, adopting common rules and principles, in order to make later aggregation easier. The practical suggestions included in this document reflect two connected purposes: to provide a technical tool to enable public officers to achieve better understanding and presentation of public finance, and to foster the knowledge and diffusion of comparable and compatible accounting methodologies.

035. British output in 1946-47 (with C.F. Carter and W.B. Reddaway). *The Times*, 18 February 1948.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In this article, which appeared in *The Times*, Stone comments on a general index of industrial production developed by the London and Cambridge Economic Service. This was the first general index of the output of British industry, designed to complete a series of partial indicators, such as output of coal or cotton yarn, or the number of employees in the industrial sector.

036. National income: shift of purchasing power from rich to poor. *The Times*, 3 June 1948.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

In a further article in the same newspaper, Stone focuses on the importance of measuring the national output in “physical” or “real” terms, rather than in monetary terms. Although more complicated, this approach is more accurate and allows a more precise assessment of the growth of various economic sectors.

037. *The Measurement of Production Movements* (with C.F. Carter and W.B. Reddaway). Cambridge University Press, 1948: reprinted, 1965.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742354]

Stone, C. F. Carter and W. B. Reddaway suggest a different index of industrial production. The proposal is presented in a monograph which is the first of a series of monographs from the Department of Applied Economics. Carter describes the formal features of the index, Reddaway exposes the difficulties associated with its construction and Stone presents a brief summary of the statistics on industrial production back to 1907.

038. A new index of industrial production (with C.F. Carter, W.B. Reddaway and F. Winter). *Bulletin of the London and Cambridge Economic Service* XXVI (1948).

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

039. *The Distribution of Income and Saving*. W.F.L. 359. The National Savings Committee, London, 1949.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

1949

040. Function and criteria of a system of social accounting. Paper presented at the IARIW conference. Cambridge, 1949. In *Income and Wealth, Series I*, Bowes and Bowes, Cambridge, 1951

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747241]

Definition and measurement of the national income and related totals [024] and *Function and criteria of a system of social accounting* [040] are the two most important pioneering studies by Stone in the field of national accounts.

Function and criteria of a system of social accounting presents a full and detailed description of all the elements that must be taken into account for the construction of a system of national accounts, which is not limited to being a simple bookkeeping system, but can serve as a basis for building more complex economic models.

The latter objective is explicitly stated by Stone himself:

'In this paper I have tried to lay out a form of social accounts which will be generally useful for economic analysis and policy. The system which emerges is intended to satisfy certain theoretical criteria and at the same time to be capable of practical realization' [040, p. 72].

In his clear and precise style Stone discusses all aspects of a system of national accounts: the classification of transactions, the information needed, the amount of detail to be retained, the defining principles of the entries, the structure of accounts, the presentation of economic information, and the advantages of a system of social accounting.

Behind the presentation of these principles of national accounts are always present Stone's two major concerns: to make available the proposed rules to a wide audience of users, with the aim of popularizing an internationally standardized system of national accounts; to build a data base useful for economic modelling.

Stone always pays close attention to the mathematics and statistics related to national accounts. A significant example is found in this article, the last section of which is devoted to a description of an accounting system in terms of the theory of sets.

1950

041. The use of sampling methods in national income statistics and social accounting (with J.E.G. Utting and J. Durbin). Paper presented at the ISI conference, Berne, 1949. *Reviews of the International Statistical Institute* 18 (1950): 21-44; reprinted in *Accounting Research* 1 (1950): 333-356.

[Access the article via JSTOR: <http://www.jstor.org/stable/1400757>]

This paper, presented at the 26th Session of the International Statistical Institute, Berne, September 1949, addresses the issue of sampling methods in national and social accounting.

Stone starts thus: 'Although the practical importance of national income studies and social accounting has led to very rapid developments both in the theoretical framework and in the practical task of filling in the figures which fit into that framework, present methods of estimating those figures still leave very much to be desired' [041, p. 30].

'It is clear therefore', continues Stone, 'that radical improvements are called for in the quality of social accounting data. These could only be achieved to a limited extent by refinements of existing methods, so that if substantial progress is to be made it will be essential to develop methods of direct collection of the information required in forms suitable for social accounting purposes' [041, p. 30].

After recalling the present methods of collection of data, Stone explains the advantages of a sampling approach. He then looks in more detail at the population to be sampled; methods of sampling for private businesses, for households and individuals, for public authorities; sampling errors and adjustment of the results.

Stone also mentions the fact that, sometimes, it is desirable to make an industrial breakdown of the business enterprise sector, in such a way as to enable the construction of input-output tables similar to those obtained by Leontief [W. W. Leontief, *The Structure of American Economy, 1919-1939*, 2nd edition, 1951].

[Quotations: Reviews of the International Statistical Institute]

042. The relationship between input-output analysis and national accounting (with J.E.G. Utting). Paper presented at the first International Conference on Input-Output Techniques, Driebergen, 1950. In *Input-Output Relations*, H.E. Stenfert Kroese, Leiden, 1953.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743562]

This article opens the series of Stone's significant contributions to input-output analysis.

Stone aims to complement the national accounts statistics with input-output statistics, in such a way as to make the input-output analysis more flexible and capable of extension to many aspects of economic activity, in addition to the productive sphere.

Stone's contribution is both theoretical and empirical, and ranges from a redefinition of the methods of classification of economic activities to the study and estimates of changes in input-output coefficients.

Stone will publish, in the 70s, three excellent reviews of the then latest developments in input-output analysis: *The expanding frontiers of input-output analysis* [152], *Input-output analysis and economic planning: a survey* [168] and *Where are we now? A short account of the development of input-output studies and their present trends* [172].

Below, we briefly review these works, as well as other more technical publications: [076], [138], [155], [165] e [171].

1951

043. Simple transaction models, information and computing. Paper presented at a conference on Automatic Control, Cranfield, 1951. *The Review of Economic Studies* XIX (2) (1951-52): 67-84.

[Access the article via JSTOR: <http://www.jstor.org/stable/2295735>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

In this article Stone discusses *transaction models*, that is models of economic interdependence which involve a *matrix of transactions* and a *matrix of response*.

A *matrix of transaction* records the transactions between the different sectors of an economic system. A *matrix of response* introduces particular hypotheses concerning technology or behaviour.

Stone points out how many models used in economic analysis are particular cases of *transaction models*. As examples, Stone presents and examines some static and dynamic models, including an elementary static model on Keynesian lines, the input-output model of Leontief and Goodwin's models. In Leontief's model, the *transaction matrix* coincides with the input-output matrix and the *response matrix* introduces the hypothesis of fixed technical coefficients.

044. The demand for food in the United Kingdom before the war. *Metroeconomica* III (1951): 8-27.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This paper is a contribution to some comprehensive research on British national income and expenditure (see [016] and its later editions for more details). The purpose of the article is mostly methodological. It addresses the techniques for obtaining reliable estimates of food consumption in the United Kingdom by combining budget information with time-series data (constructed by study of previous figures). The procedures illustrated in the article are the following. First, Stone shows how to calculate income elasticity of demand from budget data, including a number of devices to overcome the shortcomings of the limited information available. In particular, the estimates are adjusted for potential shift in consumption due to the quality of the goods rather than their price. In addition, the model takes into account the fact that estimates are based on total expenditure rather than on disposable income. The second step consists of the inclusion of the calculated elasticities in the time-series model of food consumption, in order to analyse the effect of prices on demand. Statistical tests on the estimated results are also provided, showing that although the available information is limited, it is still possible to obtain sound statistics about the determinants of food demand by adopting the techniques suggested by Stone. Finally, Stone shows that the estimation of income elasticities based only on time-series data does not yield robust results, hence strengthening the relevance of the procedure he suggested. Furthermore, the analysis provided in the article highlights the fact that income elasticities are better estimated from budget data than from time-series because the former are more effective in capturing shifts in consumption driven by quality rather than prices. However, the combination of the two methods helps to overcome the practical difficulties due to lack of data availability especially for the war period.

045. The use and development of national income and expenditure estimates. *In Lessons of the British War Economy*, Cambridge University Press, 1951.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742373]

Lessons of the British War Economy is a collection of essays written by academic economists and other specialists in the field of social studies who had collaborated with the state government during the war years.

In his essay Stone recalls the events that led to the first national accounts schemes in Britain.

The need for an analytical tool, complete and consistent, in order to determine the national income and the main economic variables is traced by Stone back to Keynes.

Keynes had published in November 1939 three articles in *The Times* and, at the beginning of 1940, a booklet, *How to Pay for the War*, which dealt with the question of war economy and finance.

The deficiencies identified by Keynes and the need to have complete and accurate data had led the British administration to create an office with the aim of collecting and re-organizing the data necessary for the preparation of the annual Budget. First Meade and then Stone had been asked to do this work.

In the post-war period, with the world divided between totalitarian ideologies and Western liberalism, Stone had outlined his position regarding the role of the state in the economy.

Stone had expressed his thoughts clearly in an article three years previously, *National accounting and budgeting for national economic policy* [029]: the state can and should intervene in the economy through programming and planning when these forms of control can achieve a quicker return to free market conditions, and can and should use financial and fiscal levers to achieve social objectives.

'In wartime', says Stone, 'the brunt of economic change must for practical reasons be borne by physical controls such as rationing, restriction, allocation and direction, whereas in peacetime much more could be done to achieve social ends by fiscal and financial policies'.

He continues:

'Anyone who believes in the maintenance of a social economy and the avoidance of the totalitarian direction of all aspects of economic life must be concerned at the present time with the creation of an institutional framework which will permit a social economy, with the essential features of free markets, free choice of occupations and free choice in the spending of disposable income, to function more in accordance with contemporary social ideals. In the achievement of this goal and in re-drafting the rules of the economic game in such a way that both laissez-faire and overall physical control are rejected as a basis for economic organization, national income and expenditure studies and their extension to the technique of national budgeting have, I believe, a great deal to offer' [045, p. 94].

Among the social objectives to be achieved Stone lists 'the level and stability of economic activity as a whole', 'the distribution of income between rich and poor, between individuals in and out of work, and between individuals with different family responsibilities', and 'actions in restraining of trade whether by associations of enterprises or by trade unions' [045, pp. 94-95].

Stone concludes by pointing out, with some pride, that the national accounts can help to achieve these goals:

'A common feature of all these policies, whether physical or financial, is that they are greatly aided by, even if they do not in part depend on, a statistical programme of national budgeting based on the national (or social) accounts' [45, p. 96].

046. Inter-country comparisons of the national accounts and the work of the national accounts research unit of the OEEC (with Kurt Hansen). Paper presented at the IARIW conference, Royaumont, 1951. In *Income and Wealth, Series III*, Bowes and Bowes, Cambridge, 1953.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

The paper presents the system of national accounts as a suitable means of comparing the economic structure and performance of different countries. The paper also provides a brief account of the work of the National Accounts Research Unit of the Organisation for European Economic Co-operation.

Stone recalls his collaboration with the OEEC in the following terms:

'In Europe, interest in social accounting had been growing, and I had, around that time, many fruitful exchanges with my European colleagues. The catalyst, again, was an international body. In the late 1940's the Organisation for European Economic Cooperation was established in Paris with the initial aim of administering American aid under the Marshall Plan. It was decided, at the instigation I think of Richard Ruggles, that the national accounts would provide a useful framework for reviewing the progress of the member countries, and with this in mind, a National Accounts Research Unit was set up in Cambridge under my direction. The brief my European colleagues and I were given was, first, to produce a standard system of accounts; second, to prepare studies of the national accounts of individual countries; and, third, to train other statisticians from member countries in the appropriate techniques. It was a lively group, which included visitors from Austria, Denmark, France, Greece, the Netherlands, Norway, Sweden and Switzerland. Several reports resulted from our activity, among them, *A Simplified System of National Accounts* and *A Standardised System of National Accounts*, published by the OEEC in 1950 and 1952, respectively. The research unit lasted from 1949 to 1951, when its work was taken over by the economics and statistics section of the organisation in Paris, then directed by Milton Gilbert' [192].

Among the issues considered by the Unit there was the extension of the system of national accounts. Many countries had started working on more complex and larger national accounting systems, which included, for example, input-output tables, national balance sheets, purchases and sales of financial assets, etc.

As regards input-output analysis, see the work undertaken in the United States (mainly by W. Leontief), Denmark and the Netherlands and the aforementioned paper by R. Stone and J. E. G. Utting on the relationship between input-output analysis and national accounting [042].

1952

047. Systems of aggregative index numbers and their compatibility (with S.J. Prais). *The Economic Journal* LXII (1952): 565-583.

[Access the article via JSTOR: <http://www.jstor.org/stable/2226900>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

Another area in which Stone helps to create an international standard is that of index numbers: see [005], [035], [036], [037] and [061].

Stone is interested not so much in the construction of price indices or indices of production, but rather in achieving compatibility with a complete system of national accounts. The necessity of this is explained by Stone in the following terms:

‘Once national accounting and input-output studies reach a certain stage and the information presented in them becomes available for a number of years, it is inevitable that attempts will be made to adjust the series expressed in current money terms for changes in prices. This involves the construction of index numbers of quantities and prices. But the construction of these different index numbers can no longer be regarded as isolated and independent investigations, since the series from which they are constructed are related to one another, and these relationships should be retained as far as possible in the index numbers. In this situation the index numbers themselves form a system, and their interdependence should be recognised both in planning the collection of price and quantity information and in choosing the methods to be followed in constructing the index numbers. It is the object of this paper to investigate these problems of consistency in the case of aggregative index numbers’ [047, p. 565].

1953

048. Model-building and the social accounts: a survey. Paper presented at the IARIW conference, Castelgandolfo, 1953. In *Income and Wealth, Series IV*, Bowes and Bowes, London, 1955.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

Stone opens this article by classifying models of social accounts on the basis of the methodology adopted for the consolidation of the variables included. According to Stone, there are basically two approaches. On the one hand, social accounts have been consolidated 'without much regard to the details of the commodity composition of production' [048, p. 29], as in the case of the models provided by Keynes and Harrod-Domar. The second approach is focused on the technological relationships which exist in the production sphere. Typical are Leontief's works on input-output analysis and the related activity analysis. Stone accurately surveys different types of models, or parts of them. Two particular contributions are worth mentioning. The first one is the summary of Kaldor's fiscal policy model, useful in identifying the effect of some policies on final output. The second one is a very interesting and valuable historical reconstruction of the first input-output tables for the United States, the United Kingdom, the Netherlands, Denmark, Norway and Italy. After a brief historical excursus, Stone illustrates the huge efforts made by public-funded research groups to develop a very large matrix, in order to obtain a more and more precise estimation of the national economy. The first tables were developed by Leontief based on the US economy, at Harvard University. In the UK, the pioneer attempts were pursued by Barna, for the year 1935, while in 1952 'a large-scale investigation relating to 1948 was started by the Board of Trade and the Department of Applied Economics in Cambridge' (048, p. 59). In the Netherlands the Central Bureau of Statistics developed original tables for the national economy, while there were also studies relating to Denmark and Norway in the same period. Finally, according to Stone, 'a most interesting study for Italy has recently been prepared and published by the Program Division of the M.S.A. Mission to Italy [133]. This contains a rectangular table relating to some two hundred products and sixty industries. An attempt is made to test the accuracy of the model and it is used to predict the probable structure of the Italian economy in 1956 and as a basis for regional analysis' [048, p. 60].

049. Recent developments in national income and social accounting (with Milton Gilbert). Paper presented at the ISI conference, Rome 1953. *Bulletin de l'Institut International de Statistique*, XXXIV (1954): 367-397; reprinted in *Accounting Research* 5 (1954): 1-31.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

The paper examines concisely some recent research in the field of national income and social accounting. The main aspects considered concern development of standardized national accounts, input-output tables, national and sectoral budgets, inter-temporal comparisons at constant prices, international comparisons of income and production, progress in developing countries, time series of income and wealth, and, finally, the work taken on by the International Association for Research in Income and Wealth to provide an up-to-date bibliography on the subject.

050. Forecasting from econometric equations: a further note on derationing (with S.J. Prais). *The Economic Journal* LXIII (1953): 189-195.

[Access the article via JSTOR: <http://www.jstor.org/stable/2226784>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This is a statistical article, outside Stone's usual lines of research, concerning forecasting from econometric equations.

051. Report on the evaluative committee for *Econometrica* (with P. A. Samuelson and T.C. Koopmans). *Econometrica* 22 (1954): 141-146.

[Access the article via JSTOR: <http://www.jstor.org/stable/1907538>]

In 1953 P. A. Samuelson, T. C. Koopmans, and J. R. N. Stone were given the task of assessing the development of *Econometrica*, in order to make recommendations to the Council. The report, published in [051], tackles the definition and mission of econometrics, addressing three key issues that provide a snapshot of the attitudes to economics in the early 1950s. First, the report stresses that econometrics should serve as a tool for furthering economics. In fact, 'econometrics may be defined as the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation, related by appropriate methods of inference' [051, p. 142]. Secondly, the authors highlight the need for an increase in the proportion of empirical, rather than theoretical and

methodological articles, in line with the intended scope of the Journal. Finally, though acknowledging that ‘mathematics, in one way or another, is an essential ingredient in quantitative economic analysis’ [051, p. 143], the report recommends ‘an increase in the proportion of articles written in expository style’ [051, p. 144]. These recommendations demonstrate the authors’ concern that economics should be regarded as a social science, a mission that can be enhanced by a proper utilization of econometrics tools.

Among the research areas in economics, and of interest in relation to econometrics, are listed: national accounting definitions and international comparisons; the conceptual basis of input-output models and tabulations; linear programming and activity analysis; the use of un-systematized information in forecasting; fitting of econometric relations; electronic computation in econometrics; economic interpretations or applications of the theory of games; theory and econometrics of international trade; the theory and measurement of utility; value judgments and the aggregation of preferences; the theory of organization [051, p. 143].

1954

052. Input-output and the social accounts. Paper presented at the second International Conference on Input-Output Techniques, Varenna, 1954. In *The Structural Interdependence of the Economy*, Wiley, New York; Giuffrè, Milan, 1955.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742305]

This work stems from the papers presented at a Conference on Input-Output Analysis held in Varenna and promoted by the University of Pisa. The main focus of Stone’s work is the formulation of a proper methodology to link input-output analysis to social accounting, resulting in a paper that combines his two most important contributions to economics.

Johansen [1985, pp. 10-11] clarifies:

‘In his article “Input-output and the Social Accounts” [52], this representation was used to explain the relations between input-output analysis and national accounts. The matrix form was used in an effective way so that reclassifications and aggregations of the basic figures emerge by multiplying the complete national accounts matrix by suitable classification and aggregation matrices. These transaction matrices have become more extensive and complete in that they have come to include financial transactions, balances of financial assets and real assets,

and capital gains (or losses) on changes in the values of different kinds of assets. In addition, they contain sector classifications which may be used to construct ordinary input-output tables on the basis of the figures in national accounting matrices'.

053. Linear expenditure system and demand analysis: an application to the pattern of British demand. Paper presented at the second International Conference on Input-Output Techniques, Varenna, 1954. *The Economic Journal* LXIV, 255 (1954): 511-527. Also in *The Structural Interdependence of the Economy*, Wiley, New York; Giuffrè, Milan, 1955.

[Access the article via JSTOR: <http://www.jstor.org/stable/2227743>]

Also in *The Structural Interdependence of the Economy*, Wiley, New York; Giuffrè, Milan, 1955.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742305]

In this paper, Richard Stone abandons estimation of individual demand functions in favour of a complete demand system, where the demand for each commodity is calculated according to the prices of all other goods

The theoretical model had already been presented by L. Klein, H. Rubin and P. A. Samuelson. Stone's contribution consists essentially in identifying a system of demand relationships that satisfies certain theoretical conditions, such as the principle of utility maximization, and developing an iterative method for the estimation of the parameters.

Stone lists with precision the five objectives that the study aims to achieve:

'The first objective is to derive a practical system of demand equations which possess properties usually considered desirable from the standpoint of elementary economic theory. The second is to consider the statistical problems involved in applying the system of equations. The third is to analyse the pattern of demand for consumers' goods in terms of this system on the basis of annual data relating to the United Kingdom over the years 1920-38. The fourth is to compare the results of this system, and systems like it, with the actual state of demand in 1900. Finally, the fifth is to compare the post-war structure of demand with what might be expected from the inter-war relationships under free-market conditions' [053, p. 511].

[Quotations: Economic Journal]

054. Misery and bliss. Paper presented at the World Population Conference, Rome, 1954. *Proceedings of the World Population Conference, 1954*, vol. V. pp. 779-798, UN, New York, 1955. Also in *Economia Internazionale* VIII (1955): 72-93.

[Included in 118]

Stone's interest in savings and consumption functions is shown by the number of articles he wrote on the topic. In this paper, Stone looks at the topic with reference to economic growth and development. Recalling Ramsey's theory of saving, Stone shows that a steadily 'growing community should not endeavour to reach the maximum point on its production function since by aiming at a lower level of assets and output per head it will be able to enjoy a higher level of consumption per head' [118, pp. 48-49]. This claim is demonstrated analytically in a clear and concise way that anticipates by some years the full formulation of the 'neoclassical theory' of growth: 'in order to maximize consumption for a given value of λ [where $(\lambda-1)$ denotes the rate of population growth] assets should be acquired up to the point at which their marginal product is $(\lambda-1)$ and not beyond this to the point at which their marginal product falls to zero' [118, p. 49]. In a survey of Stone's work on this topic, Johansen expresses surprise that no acknowledgement of Stone's contributions can be found in neoclassical growth literature: 'It seems rather strange that it has gone unnoticed since the theorem has some of its roots in Cambridge, and since it has aroused considerable interest there' [Johansen, 1985, p. 29]. Finally, the paper proposes a normative model of economic growth based on the assumed optimal desired output per capita, that can be reached through an appropriate intervention on the saving rate, which could be achieved, for instance, through foreign aid and through 'a more direct influence over spending and saving behavior' [118, p. 55]. Thus, Stone is casting light on a possible route for the transition from the 'misery' postulated by Malthus to the 'bliss' of Ramsey's optimal steady-state.

055. The way the money went. *The Times*, 25 and 26 February 1954.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This article is published in *The Times* in two parts. The first, on February 25, is entitled *Fifty years of consumer's expenditure* and highlights the increase in the standard of living of the population in the '20s and '30s, despite the global economic crisis. It is necessary, says Stone 'to place the twenties and thirties in a truer light. In the legend that has grown up around them what is remembered is the high unemployment, the depressed areas, and, in the earlier 1930s, the great

depression. These profound social and economic evils should not be allowed to obscure the substantial and fairly steady advance in real consumption a head, in the average standard of living, an advance which was retarded but hardly reversed in the slump after 1929'.

The second, entitled *Influence of price and taste of spending*, published the day after, analyses the main changes that have occurred in the twentieth century in private consumption and the corresponding price movement.

056. *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-938*, Vol. I (with D.A. Rowe and others). Cambridge University Press, 1954.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742412]

Stone's work on demand analysis is presented in a challenging and systematic survey of his research entitled *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920 - 1938*, published in two volumes, known as the 'Red Books', the first printed in 1954 and the second in 1966.

The volumes present a large amount of data and background material used to construct and estimate the demand functions of many commodities and commodity groups. For each commodity a log-linear function is presented in which the quantity of a commodity demanded is a function of income and of prices of other goods, as well as of other factors specific to each commodity. There is a detailed discussion of the methodological problems encountered in estimating demand functions, such as skewness and autocorrelation, and special testing methods are used, such as the Durbin-Watson test.

The difficulties encountered by Stone and his collaborators are countless and they are addressed and resolved, as explained by Deaton [1987, p. 511], with great competence:

'Stone's major practical problem is lack of degree of freedom; with only nineteen annual observations, disentangling the separate effects of prices, income, and other influences requires generous application of theory and or of prior information. Stone uses both. In the first place, he uses the Slutsky decomposition to absorb the income effects of prices into the income term, thus converting the latter into real rather than money income. Second, he uses zero degree homogeneity to convert prices to relative prices, saving one degree of freedom. Third, he uses elasticities estimated from Engel curve analysis on cross-sectional household budget data to estimate the income elasticities so that, with these imposed, the time-series data are liberated to estimate as many price effects as

precisely as possible. Fourth, Stone recognizes the difficulties presented by strong positive autocorrelation in the residuals and to counteract them takes first differences of model and data prior to estimation. The problems that non-stationary time-series pose for econometrics is very much a current research topic, and Stone's procedure, though less than perfect, is much superior to and much less misleading than the ignoring of the problem that characterized most applied work for the quarter of a century after Stone's book. His general procedure set up, Stone then goes on to analyse commodities one by one, reporting results and testing alternative specifications with a care and conviction that has been a model for generations of those of us who have tried to follow him'.

The huge amount of data and empirical results presented, and the variety of methods used, make these volumes a milestone in economic research literature.

Stone provides some further interesting details about the genesis of this first volume:

'I was greatly impressed with the work of Henry Schultz and had in mind to produce something on similar lines. The economic theory in my book is fairly traditional, the main influences in my case being, I think, Pareto and Hicks. The statistical analysis owed much to my colleagues and particularly to Durbin and Orcutt. It is perhaps surprising that I did not discuss Haavelmo's simultaneous equation system. In principle I fully agreed with it but in practice I thought that, with the many other difficulties in time series regression analysis, this one could perhaps be left over for the time being' [Stone & Pesaran, 1991, p. 103].

Stone [Stone & Pesaran, 1991, p. 100] quotes some works influenced by *The Measurement of Consumers' Expenditure*:

'In the early days Alan Prest and Arthur Adams took the expenditure back to 1900 and Agatha Chapman and Rose Knight produced a book on inter-war wages and salaries. Later Phyllis Deane, John Utting, Kurt Maywald, and Charles Feinstein worked on the project and in 1972 Feinstein carried the whole work, including the parts that had not been published separately, back to 1855 in *National Income, Expenditure and Output of the United Kingdom 1855-1965*'.

A little further on [Stone & Pesaran, 1991, p. 101] Stone provides additional information on the studies at the DAE in the field of consumers' behaviour and demand:

'As for the theoretical work we conducted at the time, much of it was in the field of consumers' behavior and was undertaken as a basis for empirical application. There were two major studies. First, the work of Prais and Houthakker on cross-section data, specifically prewar working-class and middle-class budget studies, from which they calculated a variety of forms of Engel curve for a wide range of

goods and services, estimated unit-consumer scales, quality variations in consumer patterns and some of the social, occupational, and regional factors in consumption. Second, there was my work on the theory of consumers' behavior and the econometric problems of analyzing time series and combining them with cross-section data which helped to reduce collinearity in the determining variables.

In addition to these studies a number of papers on demand appeared at the time. Alan Prest analyzed the demand for a number of commodities over the period 1870-1914. Michael Farrell noticed that in Prest's study, little of the variation depended on income and prices and introduced the idea of irreversible demand functions in which the upward and downward movements of demand were differently determined; in these the role of income and prices was much increased. Geer Stuvell (from the Netherlands) and S.F. James contributed a cross-section study of the demand for food in Holland in which a number of variables were introduced in addition to income. Finally, I shall mention that for a time James Tobin was a visitor and produced an excellent study of the demand for food in the United States based on time series and cross-section data and also, in cooperation with Houthakker, a paper on the demand for rationed foodstuffs'.

1955

In 1955, Stone leaves the directorship of the Department of Applied Economics and accepts the new P. D. Leake chair of Finance and Accounting at the University of Cambridge, which he will hold until retirement in 1985.

The direction of the Department falls to Brian Reddaway, and then to Wynne Godley and David Newbery, but Richard Stone never leaves his office, where he continues his research work.

057. National income and national accounts: their construction and use in economic policy (in Greek). *Review of Economic and Political Sciences (Athens) X (1955): 1-33.*

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

Original in Greek.

058. Transaction models with an example based on the British national accounts (in Spanish). *Boletín del Banco Central de Venezuela XV* (1955): 12-29. English version: *Accounting Research VI* (1955): 202-226.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

In this work, Stone explores the short-term forecasting power of transaction models, i.e. an analytical framework 'in which each flow between accounts is expressed in terms of the total revenue of the paying account and certain other variables' [058, p. 202]. This technique had been applied by Leontief and other authors within in the field of input-output analysis. In this paper, Stone demonstrates an original application to national accounts. Though based on rather rigid assumptions (about the relationships existing between different accounts), the model can be used as a powerful tool for short-term predictions. In the early sections the paper provides an in-depth technical illustration of both a simple and an extended version of the model, highlighting the possibility of extension and flexibility provided by this technique, once a simple baseline model has been set up. In the later sections, Stone illustrates an application of the model to the British national accounts from 1948 to 1953, showing that predictions based on the model are reliable, and can be improved further by increasing the precision of underlying data. In summary this paper demonstrates the breadth of Stone's interest in measurement and estimation in the field of national accounts and his valuable contribution to the development of the study of this subject.

[Quotations: Accounting Research]

059. Some estimation problems in demand analysis (with J. Aitchison and Alan Brown). *The Incorporated Statistician 5* (1955): 165-177.

[Access the article via JSTOR: <http://www.jstor.org/stable/2986485>]

This paper, prepared for the 1955 Annual Conference of the Royal Statistical Society, illustrates the state of the art in quantitative economics with reference to the behaviour of consumers in a free market. In the opening lines, Stone stresses that 'the collection and refinement of economic data should go hand in hand with the development of techniques of analysis' [059, p. 165]. Stone has two particular concerns. He stresses that 'mathematical and statistical methods of analysis should continually tend to demand better and more comprehensive data' [059, p. 165]; also that 'a refinement in analytical method requires testing against adequate data' [059, p. 165], as a means of indicating the best direction for future research and development. In particular, the paper discusses two different

models, based on different methods of data collection and definitions of consumer behaviour. In the words of Stone, 'the first is a model designed to describe the demand for consumers' goods in a framework which simultaneously takes account of all the prices of these goods and consumers' total expenditure; and the second is a model designed primarily for the analysis of a budget collection made at one point of time' [059, p. 166]. The purpose of the authors is to show that when a statistical estimation technique is adequate for the underlying data, the final estimates are consistent with each other. In particular, both methods involve estimation using a maximum likelihood technique, the implementation of which requires a high number of iterations. Interestingly, this progress in estimation technique by Stone and his colleagues was made possible by the technological improvements in digital computing at Cambridge University (notably EDSAC, owned by the Mathematics Laboratory, which Stone used for the preparation of this paper). In conclusion, Stone stresses that 'in statistical investigations of economic problems, the form of the mathematical model we use must be influenced by the type and quality of the data we have available. The resources of economic theory should be used to isolate those elements from more complex conceptual models which are thought to have a significant and stable influence on the observations' [059, p. 177]. In this way, suggests Stone, the discipline will probably proceed slowly, 'but with the reasonable hope of consolidating the advances' [059, p. 177].

060. Aggregate consumption and investment functions for the household sector considered in the light of British experience (with D.A. Rowe). Paper presented at the IARIW conference, Hindsgavl, 1955. *Nationaløkonomisk Tidsskrift (Copenhagen)* 94 (1956): 1-32.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

In this paper, of which Rowe is co-author, Stone explores a development in the formulation of the aggregate consumption function. The authors state that the paper is a contribution to the progress in econometrics since Kahn's article in 1931, in attempting to relate aggregate consumption to aggregate income. In fact, though such a connection seems very plausible, as Stone notes, 'experience shows that it is more difficult than might be supposed to find a satisfactory relationship of this kind' [060, p. 1-2]. After a brief exposition of existing theory, Stone focuses on the Modigliani/Duesenberry modifications, which allow separation of the analysis of short-period and long-period marginal propensities: building on this work, Stone and Rowe develop their own dynamic demand functions, introducing the analysis of consumer durables. The authors' purpose is to relate aggregate consumption to income and price. Although the theoretical

construction of the model seems to be less satisfying than in other works, Stone's main concern is empirical. Therefore, much of the paper is dedicated to the estimation of marginal propensity to consumption according to different model specifications. Stone and Rowe themselves acknowledge the limitations of their specification. However, their empirical results allow them to highlight two important conclusions: 'first, that [the consumption function] should be formulated in dynamic terms and, second, that a distinction should be made between responses to changes in high and in low incomes' [060, pp. 30]. Finally, the authors stress the importance of making more realistic assumptions in data aggregation. Again, Stone's main argument involves the practical implications of his work as an economist, rather than pure speculations on methodology.

1956

061. *Quantity and Price Indexes in National Accounts*. OEEC, Paris, 1956.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742353]

This book addresses, directly and comprehensively, the issues concerning measurement of the real gross product of an economy. It tackles many practical and conceptual problems that can emerge in the complex task of aggregating index numbers. This work, read alongside *A Standardized System of National Accounts* and *The Measurement of Production Movements* (to which Stone contributed), shows Stone's determination to obtain a useful tool for measuring national accounts. In fact, the book, published by the Organization of European Economic Co-operation, is ideally pitched for civil servants and officers in international institutions devoted - as has been Stone for much of his life - to the development of an international standard for national accounts. Throughout the book, many issues about the measurement of real gross product are dealt with. In particular, Stone suggests an alternative construction methodology based on known facts about consumer behaviour and income distribution. However, most of the methodological and practical questions arising from his ideas remain unsolved in the book.

062. *Social Accounting and Economic Models* (in Turkish). Ajans-Türk Matbaasi, Ankara, 1956.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

Original in Turkish

063. The market demand for durable goods (with D.A. Rowe). *Econometrica*, 25 (1957): 423-443. Reprinted in *Consumer Behaviour*, A.S.C. Ehrenberg and F.G. Pyatt (eds.), Penguin Books, Middlesex, 1971.

[Access the article via JSTOR: <http://www.jstor.org/stable/1907959>]

Reprinted in *Consumer Behaviour*, A.S.C. Ehrenberg and F.G. Pyatt (eds.), Penguin Books, Middlesex, 1971.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000383284]

Stone, in collaboration with D.A. Rowe, wrote a number of papers on the subject of durable goods. This field of research interest stems from Stone's efforts to improve the construction and modelling of the demand function and the study of aggregate saving. In particular, this paper forms the basis for further work on durable goods (see [065], [072]). Stone and Rowe elaborate a simple dynamic theory of demand where they formally separate stocks from flows. Building on this distinction, the consumption function depends both on current purchases and existing stocks. As Pesaran and Harcourt note, this paper includes new thinking on error correction: 'This produced what is now readily recognized as a first order error correction specification in the three variables: real expenditure on durables, total real expenditures and their relative prices' [Pesaran & Harcourt, 2000, p. 158]. The model produced quite satisfying estimates, tested on clothing and household durable goods. The results gave rise to a lively academic debate, carried on in several papers, especially in response to Marc Nerlove's remarks on them.

1958

064. Can economists help business? *The Accountant*, 22 March 1958, pp. 337-340.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This article appeared in *The Accountant* in 1958 and is based on Stone's lecture at the Summer Course of The Institute of Chartered Accountants in England and Wales at Oxford in 1957. It is interesting in that it illustrates, in plain and simple words, Stone's core conception of economics, especially its purpose and scope. Speaking about his own main research interests (namely national income accounting and quantitative analysis of consumer behaviour), Stone clarifies his idea of the objective of economics: 'to increase our understanding of the actual world and so give us, if we want it, a greater control over our environment' [064, p. 337]. With this in mind, Stone outlines his research interests in quantitative economics. His concern with measurement in economics is driven by the purpose of obtaining 'more information, so that the element of judgment is not allowed to waste its vigour in guessing about matters which can be measured almost exactly' [064, p. 337]. These very practical concerns generate Stone's hope of a more fruitful and respectful co-operation between 'the world of affairs and the academic world' [064, p. 337]. This is the way to achieve 'a fuller understanding of the economic world in which we live' [064, p. 340]. Hence Stone wishes to see these ideas 'absorbed more and more into the thinking of practical men' [064, p. 340].

065. Dynamic demand functions: some econometric results (with D.A. Rowe). *The Economic Journal* LXVIII (1958): 256-270.

[Access the article via JSTOR: <http://www.jstor.org/stable/2227594>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This article is a follow-up to [063] and contains an econometric test of the formulation, by Stone and Rowe, of the dynamic demand function. The main task of the authors is the identification of a reasonable estimation of the durability of goods. This practical concern is driven by the core idea developed in [063], namely that the consumption of durable and perishable goods should enter the demand function separately. In fact, as they observe: 'In the real world it is possible to observe only the current purchases of the good by consumers, and these purchases are partly for the replacement of their stocks as they are used up and partly for the expansion of their stocks. But it is the argument of the following sections of this paper that if reasonable assumptions are made about the durability of the good in question, then from the data of current purchases, prices and real incomes it is possible to derive estimates of the stocks held, of the stocks which consumers would like to hold and of the rate at which consumers adjust their actual stocks towards the level of their desired stock' [065, p. 256]. The task

is far from simple and is undertaken by the authors using an empirical test on the British pre-war and post-war periods. From their estimates, Stone and Rowe find that: 'an important part of the demand structure remains relatively stable over time' [064, p. 269] allowing them to make accurate estimates. This paper and its conclusions will be challenged in 1960 by Marc Nerlove [M. Nerlove, The Market Demand for Durable Goods: A Comment, *Econometrica*, Vol. 28, No. 1, 1960, pp. 132-142], leading Stone and Rowe to write a further article on the subject, [072], taking into account their colleague's remarks.

1959

066. Market forecasting and the family income. *The Times Review of Industry* 13 (new series) (1959): 6 and 9.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

In this article, intended as a general, non-technical exposition, Stone illustrates the advantages of demand analysis for forecasting purposes. The presentation focuses on the main technical problems encountered in the process of forecasting. In particular, Stone highlights the importance of understanding the timing of change (either short-term or long-term) and the importance of stating correctly the hypotheses that underlie prediction of future values. Stone illustrates how forecasting works in practice with two examples. The first one outlines the comparison between actual sales data and sales calculations for a specific group of commodities (furniture and floor coverings). Once the reliability of the model is confirmed, it is possible to analyse the key determinants of demand for that group of commodities, identified as income, stock and the general price level. Then, these results form the basis of the assumptions used for predicting the future level of consumption. Hence the second example, in which the demand for three different groups of commodities is related to variation of income, taking also into account the existence of a saturation level that acts as an upper limit to consumption of a given commodity. The applications illustrated by Stone are intended to show the potential of demand analysis in forecasting, in particular to favour the spreading of such applications beyond universities and research centres, as a working tool for business enterprises.

067. *Social Accounting and Economic Models* (with Giovanna Croft-Murray). Bowes and Bowes, London, 1959. Japanese translation (with additions): Tōyō Keisai Shinposha (New Publishing Co. of the Eastern Economist), 1964. Spanish translation (with no. 79 below): Ediciones Oikos-tau, Barcelona, 1965.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000744839]

In this book, co-authored with his wife Giovanna, Stone provides a comprehensive exposition of the framework of national accounting to which he dedicated a great part of his professional life. As explicitly stated by the authors, the book is intended 'as a more advanced sequel to Meade and Stone's *National Income and Expenditure*' [067, p. 7]. The purpose of the book is to provide a more complete model of the economy as a whole, starting from the analysis of national income and expenditure. This objective is the focus of most of Stone's work from the late 1950s to the early 1970s. As Deaton points out: 'As always, the vision is of a framework of accounts each of which opens a window on the operation of the economic system, supplemented with models that describe the processes revealed through those windows. A clear statement appears as early as 1959 in the book *Social Accounting and Economic Models*, co-authored with Giovanna Croft-Murray (née Saffi) who became his wife in 1960 and who until his death helped him in all his work. The book sets forth the principles of national accounting, shows how the various transactions can most conveniently be laid out as matrices – social accounting matrices, inevitably known as SAMs – and then discusses the various models of behaviour: an input-output system for production, a linear expenditure system for the demand for non-durable goods, and dynamic demand functions for durable goods. (The last was based on his work with Deryck Rowe where he had introduced the simple stock-adjustment model, another lasting contribution to the empirical arsenal.) This remarkable little book gives what is in effect a skeletal model of the economy, and this was to be progressively filled out and expanded in Stone's next enterprise, the Cambridge Growth Project' [Deaton, 1993, p. 486]. After a detailed description of social accounting from a conceptual point of view, the book provides two chapters on economic models, representing details of relationships within the framework outlined in the first part. The book is important in the context of dynamic models of consumer behaviour, as well as for the introduction of a technical arrangement to allow for the inclusion of the effect of price on the demand of commodities.

1960

068. A comparison of the economic structure of regions based on the concept of distance. *Journal of Regional Science* 2 (1960): 1-20.

[Included in 118]

In this paper Stone addresses the issue of comparison between the economic structures of regions. He aims to develop the conceptual definition of economic structure to take account of distance. The core elements of the analysis are the total quantity of transactions in a given year and various geometrical definitions of distance. Recalling the contribution of Thurstone in 1947, the paper is an attempt to improve the application of factor analysis to the study of economic structures. It offers a further example of Stone's lively interest in different applications of mathematical tools to economics.

069. A dynamic model of demand (in Polish). *Przegląd Statystyczny (Warsaw)* VII (1960): 255-270. English version in 118 below.

[Included in 118]

In this paper Stone recalls previous articles [060, 065] co-authored with Rowe, involving the development of a dynamic demand function. In particular, the paper starts with a dynamic model for durable goods, then providing a suggestion for some possible generalisations. The model relates to the broader project for an economic growth model being pursued at Cambridge by Stone and colleagues, the on-going results of which have been and will be presented from time to time at international conferences and workshops. The overall objective is stated in the opening sentence: 'In any empirical science, theory must lead to statements about the actual world which are not merely truisms, and these statements can be tested by comparing them with actual observations' [118, p. 179]. With these premises, the long-term research on the development of a more comprehensive and realistic demand function will be one of Stone's main professional preoccupations.

070. Social accounts at the regional level: a survey. Paper presented at the OEEC conference on Regional Economic Planning, Bellagio, 1960. In *Regional Economic Planning: Techniques of Analysis*, OEEC, Paris, 1961.

[Included in 118]

This paper provides a thorough survey of the issues concerning the development of social accounts at a regional level. Regional accounting is one of the research projects conducted at the DAE and the paper refers to a study by Phyllis Deane on aggregated accounts for British regions.

The starting point is the national accounting system, the development of which has been largely determined by Stone's contributions. In particular, the strategy suggested by Stone is conceptually simple, though difficult to convert into practice, and is summarized as follows: 'We may take the national accounts as a standard of reference and apply this form of accounting to a set of interconnected regions' [118, p. 118]. Stone's initial model is based on the traditional three-fold classification of economic activity, comprising production, consumption, and accumulation. Once this first stage has been accomplished, the model can be further refined by including a set of input-output accounts to capture the different branches of activity that give rise to the final output. This is one of the most important contributions by Stone to the task of combining national accounts with input-output analysis, with a view to obtaining a realistic picture of a country's economic activity. Through this paper Stone demonstrates an application of his transaction model approach to regional accounts, illustrating a broad range of problems and suggesting some possible practical solutions.

071. Three models of economic growth. Paper presented at the International Congress for Logic, Methodology and Philosophy of Science, Stanford, 1960. In *Logic, Methodology and Philosophy of Science*, Stanford University Press, 1962.

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This paper provides three examples of models of economic growth. Stone's objective is to illustrate the possible fruitful incorporation of the utility maximization principle within a macro-economic model. In fact, according to Stone: '[in complete macro-economic models] since the phenomena studied are so vast, it is usual to start off with aggregated variables such as total consumption or total investment, with the result that attention is fixed on variables which at the outset are distanced through aggregation from individual behaviour. As a consequence theories in this field tend to be relatively superficial and to ignore any optimizing principle which might be supposed to lie at the roots of human endeavour' [118, pp. 56-57]. The search for a more accurate theoretical construction is continued by the examination of Ramsey's model with endogenous saving rates. In Stone's opinion, this model of economic growth represents a more accurate formulation with a stronger link to real individual

behaviour. Stone is concerned to identify accurately the interrelationships within the economic system, in order to measure and analyse them. This task requires recognition of the necessary interdependence of empirical and theoretical activity: 'Only by going back and forth between theory and observations can we hope to progress in an empirical science like economics' [118, p. 67].

072. The durability of consumers' durable goods (with D.A. Rowe). *Econometrica* 28 (1960): 407-416. Reprinted in *Readings in Economic Statistics and Econometrics*, Arnold Zellner (ed.), Little, Brown and Co., Boston, 1968.

[Access the article via JSTOR: <http://www.jstor.org/stable/1907730>]

The model of dynamic theory presented in [063] and tested in [065] was subject to a review by Marc Nerlove who advanced some possible improvements in the estimation of durability. In particular, while in [063] and [065] durability is calculated by 'a reasonable guess' [072, p. 407], Nerlove suggested direct estimation from the time-series as for any other parameter. The results provide estimates which are considerably lower than their reasonable values as Stone and Rowe themselves realise. In the final conclusions, they suggest some possible reasons for this, such as for instance a 'high premium' that consumers put on newness, an imprecise formulation of durable goods consumption or, finally, the need to include more detailed data on second-hand markets. However, this paper provides a further step in the development of the dynamic demand theory. In combination with [063] and [065] it provides a major contribution to this branch of economic theory.

[Quotations: *Econometrica*]

073. An econometric model of growth: the British economy in ten years time. *Discovery XXII* (1961): 216-219.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This paper illustrates the general framework of an econometric model of economic growth developed by Stone at the Department of Applied Economics of the University of Cambridge. The purpose of the paper is to present an algorithm to be implemented with the help of the EDSAC high-speed computer. As Stone notes: 'Until the development of large electronic computers, detailed analysis of the economic system were too complex to be attempted' [073, p. 216]. The progress in computer science in the late 1950s made it possible for Stone to

attempt complex calculations. Interestingly, the model developed by Stone reverses the rationale of previous models of growth accounting. In fact, according to Stone, those models said: ‘ ‘If you behave so and so you will achieve such results.” [...] The present model says: “if you want to achieve such results you must behave so and so” ‘ [073, p. 216]. Therefore, this paper, as other similar publications by Stone, reflects the practical orientation of his mind and his conception of economics as a tool for better understanding of and, possibly, controlling of the economic system (see [064]).

074. Consumers’ wants and expenditures: a survey of British studies since 1945. Paper presented at the CNRS conference, Grenoble, 1961. In *L’évaluation et le rôle des besoins de biens de consommation dans les divers régimes économiques*, Centre National de la Recherche Scientifique, Paris, 1963.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This paper, along with [073] and [075] for instance, provides a picture of Stone’s actual work as an applied economist. The paper presents an accurate and detailed survey of data and bibliographic sources related to consumer behaviour in Britain from 1945 to about 1960. The short article is therefore intended mainly as a research aid, as it provides only ‘an account of sources of information and topics studied but it does not provide even a summary of the results obtained’ [137, p. 95]. It shows clearly the huge amount of information handled by Stone in order to further the applications of his models of consumer behaviour.

075. How fast can Britain grow? *The Director* 13 (1961): 286-288.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This brief article is a passionate plea by Stone for faster economic growth in Britain. The starting point is a plain fact. In the previous two decades Britain has been growing, but at a slower rate than most European countries and the US. Therefore, the international economic and political position of the United Kingdom is threatened. For this reason, Stone calls for Britain to be prepared ‘to do what it takes’ to grow faster. The first step is a better understanding of the national economic system, by the adoption of the model which he briefly sketches in this article and which he explains more extensively in [073]. Then, the nation should take consistent action. In the words of Stone: ‘I suggest that we must first examine carefully and with as few preconceptions as possible the workings of our

economic system, see how far we can go if all the productive forces in the country agree to collaborate, fix our aims accordingly and then let ourselves be guided by the implications of these aims' [075, p. 3]. This brief article explicitly reveals Stone's belief that public policies based on sound economic evidence can achieve better living standards. It also includes a passionate call for a nation-wide agreement among all economic agents about the fundamental objectives of society.

[Quotations: offprint]

076. *Input-Output and National Accounts*. OEEC, Paris, 1961. Russian translation: Statistica Publishing House, Moscow, 1964.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742656]

This report is intended as a sequel to two reports issued by OEEC in, respectively, 1952 (*The Standardized System of National Accounts*) and 1956 (*Quantity and Price Indexes in National Accounts*). The purpose is to further the examination of some conceptual problems arising in the previous reports. In particular, this report deals 'with the sub-division of the national accounts on an industry basis so as to provide a detailed picture of industrial structure' [076, p. 5]. Stone illustrates the application of input-output analysis to national accounting, in order to provide a more complete framework for the economic system. In this way 'input-output tables are viewed as a bridge between statistics that can actually be collected about the productive process and the requirements of applied economic analysis' [076, p. 11]. The methodology adopted shows Stone's concern for a re-positioning in economics based on a reconciliation between theory and empirical methods. According to Stone: 'all models must be capable of being checked by observation' [076, p. 11].

077. Multiple classifications in social accounting. Paper presented at the ISI conference, Paris, 1961. *Bulletin de l'Institut International de Statistique XXXIX (1962): 215-233.*

[Included in 118]

In this paper Stone demonstrates a further development of social accounting, by addressing the issue of the classification of all the agents involved in the economic system. The problem, then, is mainly practical as Stone points out: 'A complete system of social accounts must be able to handle transactors in all their aspects:

as producers, consumers and accumulators. To reduce the number and variety of transactors to manageable dimensions it is necessary to classify them, but experience shows that it is impossible to find a single classification which will be equally suitable for each aspect' [118, p. 230]. In the international standard systems of national accounts this classification is generally achieved by what Stone calls 'the limited solution', by which classification is reduced to a minimum, such as for instance 'private' and 'public'. However, Stone proposes a multiple classification (that he defines as 'the proper solution') to be applied to social accounting as well. According to this method, as many classifications can be chosen as thought useful by the model-builder. Then, in order to transpose different classifications to different transactors it is necessary and sufficient to introduce some appropriate classification converters, which, as Johansen puts it, are merely 'matrices with different types of proportional constants'. As Stone himself stresses, his model is based on the distinction between real and financial economic activity and focuses mostly on the former, rather than the latter. The concepts postulated by Stone reflect directly the Programme for Growth at Cambridge. In fact, as will be usual in his later publications, the final part of the paper provides a detailed examination of the provisional results of the computational model developed at the Department of Applied Economics of the University of Cambridge, which serves as a sort of test for the concepts expounded in the paper.

078. Population mathematics, demand analysis and investment planning (in Polish), *Przegląd Statystyczny* (Warsaw) VIII (1961): 127-136. English version in 118 below.

[Included in 118]

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

This paper offers a valuable example of Stone's originality in applying mathematical models drawn from different disciplines to economic problems. In particular, Stone develops a model, using a method adopted in population mathematics, to study the survival rate of technical equipment needed for the production of commodities. His aim is to answer this question: 'how many machines must we produce in each period in the future to maintain and increase the stock in such a way that at all times there are just enough machines to produce the amount of commodity which we expect will be demanded?' [118, p. 172]. Though the paper is mostly dedicated to the development of a formal model, Stone aims to provide a tool for solving a practical problem of economic planning, by tackling the issue of the optimal renewal of existing stocks of production equipment.

079. *National Income and Expenditure* (with Giovanna Stone). Fifth edition, rewritten, 1961; sixth edition, 1962; seventh edition, 1964; eighth edition, 1966, ninth edition, 1972; tenth edition, 1977; all Bowes and Bowes, London. Spanish translation (with no. 67 above): Ediciones Oikos-tau, Barcelona, 1965. Japanese translation, 1969.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742337]

The book of this title by Meade and Stone (see [016]), *National Income and Expenditure*, achieved immediate success among academics and policy-makers when the first edition was issued in 1944. There were several further editions in the years following but, in place of a fifth edition, a new rewritten version was published, in agreement with Meade, by Richard Stone and his wife Giovanna Croft-Murray.

In this book, the authors provide a simple though very detailed presentation of national accounting. With reference to the ninth edition, the first chapter includes a description of national income, including definitions, methodology for calculation and a summary of the sources that are to be adopted for its implementation. Chapter 2 explains the construction of the national accounts, providing a definition of the concepts, as well as a detailed investigation into each of its components separately. The third chapter is dedicated to the further decomposition of the national income into sectors and activities, in order to clarify the way income is generated and distributed within the economy. Chapters 4 and 5 focus on the technical problems concerning comparisons over time and space. The final chapter summarises the state of the art and suggests possible future developments of national accounting. The main structure of the book is not different from the original [016]. However, this revised version contains updated tables and statistics, and includes some extensions and refinement in the chapter dedicated to measurement over time, by adding a section on quarterly statistics and on seasonal adjustment.

[Quotations: ninth edition]

080. A long-term growth model for the British economy (with Alan Brown). Paper presented at the IARIW Conference, Tutzing, 1961. In *Europe's Future in Figures*, North Holland Publishing Co., Amsterdam, 1962.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000168434]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747243]

Along with [073] and [075], this paper, written with J. A. C. Brown, highlights Stone's involvement in the huge project, based at the Department of Applied Economics of Cambridge University, aiming to develop an accurate quantitative model of the British economy. This research is generally referred to as the Cambridge Growth Project, the purpose of which was, primarily, to establish a standard approach to growth. As Stone clearly states: 'modern societies must learn to examine the implications of different rates of growth, make up their collective mind about what they are going to try to achieve and only then interest themselves in forecasts' [080, p. 288]. The paper provides an outline of the guidelines of the project and illustrates the main features of the formal model. The formal model incorporates the advances in input-output analysis and in mathematical formalisation, made possible by the team of economists working on the project (all of them acknowledged on the first page) and the resulting complex framework is converted into a computer-program, run on the EDSAC digital computer. The lively environment of Cambridge shines through this account. As an interesting final comment, Stone stresses that 'the model has not been designed exclusively from a government point of view. Almost all the variables in the model are 'decision variables' from the point of view of one or other social group, whether it be government, industry, labour, or consumers. Our final aim is to present a perspective of the British economy which may be acceptable and convincing to all who participate in its development' [080, p. 310]. This claim derives from Stone's view of the role of economics in shaping economy itself. In fact: 'In the end it is human beings who determine the rate of growth of economies and if a significant increase in the British rate of growth is achieved it will be mainly because large numbers of people in government, employers' federations and trade unions become convinced of the need for a new approach and consequently bring about an adaptation of social behaviour in line with new technical possibilities' [080, p. 310].

[Quotations: offprint]

1962

Retracing the history of the Cambridge Growth Project means reliving one of the most important periods of applied economic research in Great Britain. It is useful to quote a long excerpt from the *Economic Theory* interview with Stone [Stone & Pesaran, 1991, pp. 105-108]:

'Alan Brown, who had been working with me at the Department since 1952 [59, 88, 108] and played an important role there until he left in 1965 to take up the new chair of Econometrics at Bristol, thought it might be a good idea to pull

together the Department's work on social accounting, input-output and consumers' behaviour and build a model of the British economy. We discussed the matter, in fact we composed a set of lectures to explain what we had in mind. These appeared in *A Computable Model of Economic Growth* [85] which was published in 1962 and was the first in our Green Book series "A Programme for Growth." The second, which came out a little later in the same year, set out in progressive stages of disaggregation our social accounting matrix for 1960, which we christened SAM [86]. We continued this series, which dealt with various aspects of the model, until number 12 appeared in 1974. We then started a new series, "Cambridge Studies in Applied Econometrics, " of which five issues have appeared.

Some of the issues in both series described our projections. The first, *Exploring 1970* (no. 6 in the old series) was written by Alan Brown and appeared in 1965. It was not a forecast but looked at 1970 on the assumption that the economy grew at the rate of 4 percent or a little more during the 1960s compared with rather less than 3 percent during the 1950s. Several variants were given and a do-it-yourself kit was provided which would enable the reader to work out the consequences of changing our assumptions.

Our next *Exploring* volume (no. 9 in the old series) appeared in 1970 and related to 1972. It was written by Terry Barker and Richard Lecomber, who in 1967 had written a report relating to 1972 for the National Ports Council. A new look at the future of the economy seemed desirable since apart from the devaluation of 1967 there were the consequences of the "Kennedy Round" tariff reductions, the effects of the selective employment tax, and the development of North Sea gas.

After this our next forward-looking volume, relating to 1980 and edited by Terry Barker, appeared in 1976 with the title *Economic Structure and Policy* (no. 2 in the new series). This was far more than a set of projections, it was the final volume on the static model, the first stage of our project.

In the meantime, Terry had developed a dynamic version which thereafter replaced the static one. A full description of the new version, *A Multisectoral Dynamic Model of the British Economy* (no. 5 in the new series), edited by Terry Barker and William Peterson, appeared in 1987.

The model has changed a great deal in 30 years. It was never very small but it is now very large, with 5686 variables of which 507 are exogenous (mostly tax rates), leaving 5179 equations. Given the data for a base year, the data for certain preceding years in the case of lagged endogenous variables, and the values of the exogenous variables for the period after the base year, the computer program calculates the endogenous variables year by year into the future. Initially only consumers' expenditure was sensitive to prices, now most of the relevant

variables are. Many variables which were previously exogenous have been endogenized. Financial relationships are coming to play an increasing role.

All this has been the work of relatively few people. The team working on the project at any one time was never more than ten, usually six or seven, but it kept renewing itself. Many left to take up chairs or lectureships, among them Alan Brown, Graham Pyatt, Angus Deaton, and Jack Revell. I have rather lost count, but over the years there must have been about 30 people in all attached to it in one way or another.

The project's first sponsor was the Ford Foundation. Later we were supported mainly by the British SSRC (now the ESRC) with sporadic contributions from various government departments. In 1978 it was suggested that we might raise some money ourselves by selling our services, so we set up a company, Cambridge Econometrics, to provide forecasts based on the model, the main research being carried on by the group at the DAE. In 1980 I retired and the project continued for several years at the DAE under the direction of Terry Barker. It is now no longer part of the University and the development of the model has been entirely taken over by Cambridge Econometrics, still under Terry's direction'.

To the question: '*Did the Growth Project have the impact you had anticipated?*', Stone answers:

'It is difficult to say. In the 1960s it was clear that the British economy was falling behind its neighbours and competitors and so there was a considerable interest in the idea of indicative planning as a means of enabling the country to improve its economic performance. We had a Department of Economic Affairs and a national plan which aimed to raise the national output by 25 percent between 1964 and 1970; this amounts to 3.8 percent a year over the period, very much the figure suggested in our first *Exploring* exercise. However, the pound had been overvalued since Winston Churchill as Chancellor of the Exchequer decided in 1925 to maintain the prewar parity with the dollar. After a series of devaluations a further one took place in 1967. Following this, as we have seen, we made a projection for 1972 which led to relatively optimistic conclusions. Then the 1970s brought their difficulties, including the oil crisis, and these were reflected in our projections for 1980.

The Treasury and other government departments followed our work and made use of it for specific projects; the report for the National Ports Council I mentioned above is a case in point. But other people were producing forecasting models and the government itself began to set up its own. I don't know how much any of these owed to ours.

In any case it would appear that large econometric models of the economy have ceased to be fashionable and have lost the popularity they had a generation ago.

Needless to say, I wholly dissent from this view. I was shocked to be told not long ago that our model was too big, since for policy purposes it seems to me that you need all the detail you can get and that a highly aggregated model is not really suitable. It is foolish to give up the advantages of disaggregation just when computer technology has made it so much easier to cope with'.

In the Appendix there are two tables from the Cambridge Growth Project (CGP) Catalogue in The Marshall Library, University of Cambridge.

The first table shows the number of publications of various people involved in the CGP from 1960 to 1967, divided into Books, Journal Articles, Book Sections, Conference papers and Unpublished papers.

The second table, in the form of a timeline, shows the periods of time that they spent working at the CGP.

081. A demonstration model for economic growth. *The Manchester School of Economic and Social Studies XXX (1962): 1-14.*

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This paper provides an update on work on the growth model being developed by Stone at Cambridge. Here the focus is on relative prices, both in the demand and production functions. This further refinement of the model - intended to make it more and more realistic - allows Stone to address some pressing issues about unemployment and over-production. Stone, who has objectives which are essentially practical, is aware that imposing a faster growth rate on the British economy would unavoidably cause problems in the transitional period. In particular, problems could arise if a reallocation of the production factor is required. According to Stone, the model demonstrates that this change would be for the better. In fact he points out that: 'It is an observed fact that the technical processes in Britain and America are often the same but that the number of men behind the processes is much larger here than in America. To the extent that this is true we suffer from disguised unemployment and it is as necessary to convince the trade unions that jobs would be available if they relaxed their restrictive practices as it is to convince the business world that the demand would be forthcoming if they increased the rate at which new techniques are adopted. The model I am describing should help to provide this demonstration because the range of possibilities it opens would be greatly increased if a substantial part of the nominal labour force embodied in it could be released for effective employment' [118, p. 86-87].

082. Some aggregation problems in input-output analysis (in Polish). *Przegląd Statystyczny (Warsaw) IX (1962): 25-28.*

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

From the English Summary:

‘The scope of this short note is to give some generalizing remarks upon an article of T. Czechowski published in *Przegląd Statystyczny* 4/1960, especially when referring to the possibilities of making some aggregation in input-output tables without incurring much loss of information’.

083. Models for seasonal adjustment (in Polish). *Przegląd Statystyczny (Warsaw) IX (1962): 119-134. English version in 137 below.*

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

The problem of seasonal adjustment plays an important role in the development of formal models of the economic system. In this paper Stone examines a strategy for investigating seasonal variation. In Stone’s opinion several useful methodologies for seasonal adjustment have already been developed, but there is a lack of a sound strategy. Therefore, he suggests proceeding first by detecting whether there is a series of data which presents evidence of systematic seasonal variation, then by analysing the significance of this variation and finally by investigating possible causes of the emerging seasonality. Only at the end of this whole process will it be possible to construct a procedure as logical as possible by excluding major exceptional events. The paper provides a detailed exposition of the strategy suggested by Stone and concludes with a numerical example applied to the data series of consumers’ expenditure in Britain from 1948 to 1954. This work constitutes part of the life-long refinement process that Stone dedicated to his model of consumer behaviour, which was part of the broader computational model of economic growth.

084. The housekeeper and the steersman. *L’industria*, no. 4 (1962): 417-426.

[Included in 118]

In this short note Stone proposes a further extension to economic analysis, in relation to the discipline of cybernetics. According to Stone: 'Cybernetics may be described as the study of communication and control in self-regulating systems' [118, p. 33]. The paper highlights a main feature of Stone's vision of economics (already emerging in other works): the economic system is an almost deterministic inter-connection of relationships, basically linking production and consumption through prices. Accurate knowledge of the way the economic system is working is therefore vital in selecting the adjustments that Stone considers necessary to obtain desirable outcomes, such as a more stable or faster growth rate. For instance, realizing that the level of production tends to fluctuate, he points out: 'This raises the question of whether it is possible to introduce automatic stabilizers which would reduce the fluctuations to within pre-assigned limits' [118, p. 34]. In this paper, the goal is achieved by the application of cybernetics to economics. In fact: 'economics and cybernetics are closely related because the search for equilibrium is characteristic of economic systems. Indeed our ability to keep the economy on a chosen course has become nowadays a central political issue' [118, p. 40].

085. *A Computable Model of Economic Growth* (with Alan Brown). No. 1 in *A Programme for Growth*, Chapman and Hall, London, 1962. Czech translation: *The Economico-Mathematical Laboratory of the Czechoslovakian Academy of Sciences, Prague, 1965.*

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

A Computable Model of Economic Growth is the first of a series of twelve volumes, published between 1960 and 1975 by the Department of Applied Economics and known as the 'Green Books'.

The volumes illustrate the results of the extensive research project, directed by Stone and called *A Programme for Growth*, in which the best researchers and scholars of the DEA took part.

A Programme for Growth aims to demonstrate the building of a model to study British economic growth prospects.

It is not a prediction model, but rather a model capable of identifying those structural elements that may prevent the British economy from growing faster.

The complete set of Green Books (first series) includes the following titles:

1. A computable model of economic growth (R. Stone and A. Brown)
2. A social accounting matrix for 1960 (R. Stone)

3. Input-output relationships, 1954-1966 (R. Stone, J. Bates and M. Bacharach)
4. Capital, output and employment, 1948-1960 (R. Stone and G. Pyatt)
5. The model in its environment, a progress report (R. Stone)
6. Exploring 1970: some numerical results (R. Stone and A. Brown)
7. The owners of quoted ordinary shares: a survey for 1963 (R. Stone, J. Revel and J. Moyle)
8. The demand for fuel, 1948-1975 (R. Stone and K. Wigley)
9. Exploring 1972 (R. Stone, T. Barker and R. Lecomber)
10. The determinants of Britain's visible imports, 1949-1966 (R. Stone and T. Barker)
11. The financial Interdependence of the Economy, 1957-1966 (R. Stone and A. Roe)
12. Structural change in the British economy, 1948-1968 (R. Stone and A. Armstrong).

A Computable Model of Economic Growth contains a first formulation of the model and indicates the objectives. Subsequent publications describe the formal evolution of the model and new fields of application.

Although the achievement of a high growth rate is not considered a priority by Stone, he sees valid reasons for trying to improve on Britain's performance in the early 1950s:

'Were we a satisfied country, and were the rest of the world to stand still, we might be content with this small improvement. But we are not satisfied: we strike for higher incomes; we worry about inflation; we grumble about taxes; we want to carry more weight in international affairs; some of us may even want to improve the living conditions of other races. And when we look abroad we find that many countries with whom we habitually compare ourselves did much better than us in the 1950's. Whether we are interested in our own standard of living and that of our descendants, in our ability to help the poorer countries of the world to break the poverty barrier which has always enclosed them, or in the grosser forms of power politics, we cannot be indifferent to Britain's economic growth' [085].

And the way to achieve this goal is outlined by Stone in these terms:

'We should approach the economic system as an engineer approaches a complicated piece of machinery or as a doctor approaches his patient. Any adjustment or treatment depends on a sound diagnosis. Only in this way can we meet the arguments of the reactionary who can say with some plausibility that

things might be worse and that tampering with them will probably make them so, and those of the revolutionary who can say with equal plausibility that things might be better and invites us to follow his particular nostrum. The common link between these very different types is their utter disregard for the economic facts of life, a disregard which they would never think of showing if their car broke down or if they contracted pneumonia. By exaggerating differences in political and social objectives, they obscure the fact that the main reason why we do not have a more successful economic policy is that we do not understand the economic system sufficiently well, and that what we should be doing is to study its anatomy and physiology instead of endlessly debating quack prescriptions either of inaction or of apocalyptic changes.

So let us follow the normal order of action: analysis, diagnosis, prescription, treatment. We shall continue to get nowhere if we continue to shortcircuit the first two stages' [085].

The main task of the *Programme for Growth* is to provide 'indicative planning', that is a series of useful hints and recommendations for the economic development of the country.

From a technical point of view, the project uses two types of models compatible with each other: a steady-state model, in which the main economic variables behave in a uniform way, and a transient model, in which there are elements of economic dynamics, such as the accumulation of capital.

Particular attention is paid to the formal structure of the model and the organization of the data used. The latter is obviously related to the contributions of Stone to the development of national accounts.

Another remarkable aspect is related to the construction and use of input-output tables. Great effort was put into the estimation of input-output coefficients and their possible variation over time. Stone and his colleagues have developed a special method of updating the technical coefficients, known as the RAS method. The acronym indicates that the updating of the coefficients is made by pre-multiplying and post-multiplying the matrix of technical coefficients A by two suitable matrices R and S , respectively.

The problem of variation of technical coefficients was illustrated by Leontief in his early work, but it is Stone who provides a computational technique to be adopted at the international level.

A Programme for Growth is a computational model, equipped with a flexible structure that allows researchers to insert new data and information and to incorporate new functions and applications. Despite its weaknesses and its limitations, the project is one of the most successful attempts to combine

theoretical and empirical research and to provide relevant guidance to economic policy.

086. *A Social Accounting Matrix for 1960 (with Alan Brown and others). No. 2 in A Programme for Growth*, Chapman and Hall, London, 1962.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742773]

A Social Accounting Matrix for 1960 is the second paper of the Programme for Growth series. The first paper outlined the model in terms of a general description of the concepts and processes involved and this paper provides the detailed quantitative framework, which is summarised by a Social Accounting Matrix, 'which we christened SAM' [Stone & Pesaran, 1991, p. 106]. This approach, in Stone's view, permits the combination of Keynes' assumptions contained in his General Theory with Leontief's model of inter-industry relations. As Stone points out: 'Either can be obtained from the more detailed accounting system presented in this paper' [086, p. V]. Therefore, the bulk of the work consists in the disaggregation of the economic system according to the SAM, obtaining a more detailed and complex accounting system which comprises the basis of the growth model developed by Stone at Cambridge.

087. *Behavioural and technical change in economic models (with Alan Brown). Paper presented at the IEA conference, Vienna, 1962. In Problems in Economic Development*, Macmillan, London, 1965.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000748265]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this paper, written with Alan Brown, Stone addresses a fundamental issue in the development of formal quantitative models: the need of 'freeing economic models from their dependence on parameters appropriate to the past' [087, p. 428]. Both in demand theory and national accounts a number of parameters have to take account of their past value. This way of viewing the future 'through the spectacles of the past' is considered by Stone and Brown as inaccurate and misleading, especially in models disaggregated to the sectoral level. Therefore, in this paper, presented at the IEA international conference, Stone and Brown propose two different ways of calculating parameters, one referred to consumer behaviour, and the other relating to input-output analysis. As they state in conclusion, this first attempt, rather than providing a definite solution, aims to

develop traditional theory and statistics 'to a more acceptable degree of realism' [087, p. 438].

[Quotations: offprint]

088. Output and investment for exponential growth in consumption (with Alan Brown). *The Review of Economic Studies* XXIX (1962): 241-245.

[Access the article via JSTOR: <http://www.jstor.org/stable/2295960>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this brief article, written in the context of the Growth Project at Cambridge, Stone and Alan Brown explore a transient model identifying the relationship between the levels of output and investment needed to pursue exponential growth in consumption. The starting point of Stone's investigation is in fact a desired rate of growth in consumption - in this case, an exponential rate - in order to detect 'the output vector needed to sustain [it]' [088, p. 245]. It is interesting to notice Stone's emphasis on consumption: in fact, he considers it as the main objective of economic growth.

089. A post-war expenditure function (with D.A. Rowe). *The Manchester School of Economic and Social Studies* XXX (1962): 187-201.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this brief article, written in collaboration with D.A. Rowe, Stone introduces a refinement of the expenditure function. As the authors note: 'Everyone knows that the highly simplified form of this function as it is usually presented to students and as it appears in simple aggregative models is quite unsatisfactory. Yet, despite innumerable empirical studies, the formulation of a satisfactory expenditure function is still a problem' [089, p. 187]. The original ideas are due to Friedman, who introduced the permanent income hypothesis, and to Modigliani and Brumberg, who stressed the importance of capital as well as income in determining consumption. Stone's main contribution to the construction of the saving function is the formalisation of a distinction between permanent and transient components of income and wealth. Stone's results and ideas on the subject, aiming essentially to improve econometric analysis of consumers' behaviour, were an attempt to contribute to the improvement of Keynes' formulation of the consumption function.

090. A generalisation of the theorem of Frisch and Waugh (in Polish). *Przegląd Statystyczny (Warsaw) IX (1962): 401-403. English version in 137 below.*

[Included in 137]

In this article Stone provides an extension of the theorem of Frisch and Waugh on the method of eliminating trends in time-series. The theorem is applied to regression analysis and Stone's generalization shows that 'time may be replaced by any subset of determining variables' [137, p. 73].

1963

091. Computational analogue of economic growth (in Ukrainian). *Automatika (Kiev) (1963): 39-45.*

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

From the English Summary:

'A description is given of an attempt to develop an analogue of an economic system (on the example on England). The aim of this analogue is the planning of economic growth'.

092. Consistent projections in multi-sector models. Paper presented at the IEA conference, Cambridge, 1963. In *Activity Analysis in the Theory of Growth and Planning*, Macmillan, London 1967.

[Included in 137]

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742298]

This paper outlines and refines the conceptual and philosophical framework of the Cambridge Growth Project. Adopting a plain but rigorous exposition, Stone defines carefully his understanding of 'consistency', related to the development of formal economic models. He sets out a broader boundary for consistency than that usually accepted by social scientists. In particular, Stone outlines seven classes of consistency ranging from traditional constraints of formal modelling to a broad understanding of the problem, including its social and long-term related issues. Stone stresses that this idea of consistency is essential to the purpose of economic models as he understands them: 'Models are an aid to decision-taking,

all the better for being as complete as possible, but they do not take the decisions' [137, p. 44]. Therefore, to help with decision-making, an economic model must satisfy a high degree of consistency, in order to allow the decision-takers to have all the information, 'as detailed and complete as we can make it'. Then, Stone insists, consistency must be achieved by society as well. In fact, once a model provides a projection (i.e. a set of all possible outcomes of the economy), 'before we make predictions we need an agreed plan'. Stone is strongly convinced that the Growth Project is serving a societal purpose, namely the improvement of living standards. This purpose cannot be achieved without wide co-operation between all the social agents involved. In conclusion, Stone says: 'The predictions that we are interested in can be made only after a plan has been accepted' [137, p. 44].

093. Models of the national economy for planning purposes. *Operational Research Quarterly* 14 (1963): 51-59.

[Included in 118]

[Access the article via JSTOR: <http://www.jstor.org/stable/3006924>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This paper presents some considerations on model building, highlighting in particular the features a model should have in order to be actually 'useful', i.e. applicable to the real world. There are two aspects of this aim. The first is mainly methodological and, as in [094], Stone describes the advantages of an appropriate understanding of the environment in developing economic models that should take account of the economic system as a whole. In Stone's words: 'Every model is an abstraction designed to analyse a slice of life with the object of understanding it better and, if it is at all controllable, adapting it better to our wishes. If we want to succeed in our aims we must not only try to build a good model but we must also try to understand how it fits into its environment. If we fail in this second endeavour, an otherwise promising idea may fail to make headway because it does not seem worth taking up and improving to the people who would be affected by it; of these the inventor is only one of many' [093, p. 51]. The second aspect is that the model should be believed to be 'useful'. Stone passionately supports this purpose of economic modelling, and pushes for its wider acceptance inside and outside the academic world. In fact: 'The idea that economic models can be useful is a comparatively new one and is resisted by many people from some vague apprehension that, once accepted, the models would begin to run their lives. Such people do not see the models as tools which would enable them to do their political, administrative or productive job better,

with a consequent increase of satisfaction to themselves as well as to others' [093, p. 58-59]. This final statement re-emphasizes Stone's strong belief that economics must be a 'useful' science, to be used as a tool for helping decision-makers.

[Quotations: Operational Research]

094. Possible worlds. *The Investment Analyst*, no. 6 (1963): 10-14.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this article Stone returns on the core ideas characterizing the Cambridge Growth Project. To clarify his vision of the project, he recalls a work by the biologist J. B. S. Haldane, *Possible Worlds*, a collection of science essays which include an examination of biological limits to size, form and growth in order to explore hypothetical variations in these characteristics. Analogously, the task of the growth project is to ask questions of the kind: 'could we, say, contemplate a rate of economic growth twice or three times as fast as the present one? Could the socio-economic system bear the strain?' [094, p. 10]. Therefore, the need for accuracy of economic modelling serves the purpose of answering such questions. For this reason, in the rest of the paper, Stone presents the main features of the project's framework, in a more synthetic and comprehensive way than he did previously in [075] or [080]. Again, as a practical-minded researcher, Stone stresses the importance of a broad social consensus for the model to be both accurate and useful. In fact, the success of models 'depends on the willingness of people in the practical world to put information into them as well as to take information out of them' [094, p. 14]. In conclusion, Stone recalls the statement he made in [085]: 'The only difference a model can make is to change men's minds as to what is good, sensible, worthwhile or profitable to do. Doing it is up to them' [094, p. 14].

095. Social accounting and standardised national accounts (in Spanish). *Informacion Comercial Española (Madrid)*, no. 356 (1963): 31-39. English version in 137 below.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

Stone has been directly involved in the formulation of an international standard for national accounts, through research projects, under the auspices of the United

Nations and the Organization for European Economic Co-operation, based in Cambridge and related to the broader study-group on economic growth. This paper provides a brief historical background to what has been achieved internationally by the time he is writing. Though appreciative for what has been done by international organisations on the standardisation of national accounts (much of which has in fact been due to Stone's own huge contribution), he points out that a lot is still to be done. In fact: 'If international organisations have not done all we could have wished for in this field, we should recognise their difficulties, be grateful for what they have achieved and continue where they have left off' [137, p. 156]. And this is precisely Stone's aim in writing the paper: proposing to move from national accounts to *social accounts* - more complex models integrating the advances in national accounting, input-output analysis and flow-of-funds analysis in a unique analytical framework. Stone shows that while these individual disciplines have advanced, a fruitful relationship between them is, as yet, incomplete. As a practical man, he calls for intervention by international organisations: 'unless we keep up the pressure for international standardisation, much valuable effort will be wasted. At the moment in national accounting we speak a common language and, if we do not always agree, at least we know what each others are thinking. Ten years from now shall we be able to say the same about social accounting?' [137, p. 162].

096. The *a priori* and the empirical in economics. *L'industria*, no. 4 (1963): 467-486.

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this lecture, held at the Annual Conference of the British Society for the Philosophy of Science, Stone outlines his views about the research methods of economics, stressing the necessary interplay between *a priori* reasoning and empirical facts. Recalling a statement made by Marshall in a letter to Edgeworth in 1902, he stresses the need for a proper combination of these two sides of economics. Stone then goes further, claiming that: 'from a practical point of view it does not matter in the least whether we begin with 'general reasoning' or with a 'study of facts'; all that matters is that we should pass continually from one to the other so as to widen the range of phenomena to which we can give a coherent explanation' [096, p. 115]. The paper continues with an example of iteration adjustment in modelling, in the case of a consumption function which allows for change of preferences. Rather than actually providing an extension of this branch of existing theory, Stone's purpose is to show the potentially fruitful combination of *a priori* reasoning and empirical investigation in model building. He concludes

as follows: 'I have only one conclusion to draw from this short survey of a single economic problem: the *a priori* and the empirical are completely intertwined in the development of the subject. True, there are specialists whose interests are mainly empirical or mainly theoretical. The first work with a rather small input of theory, the second with a rather small input of facts. But this is not the normal, healthy case; indeed, modern developments in economics have come about largely through breaking down barriers between excessive specialisms. I do not think that most of us could separate the contributions of the *a priori* and the empirical in the development of our ideas nor do I think that most of us would wish to deny the essential part played by each' [096, p. 121-122]. As Johansen notably points out: 'Stone himself has followed this recommendation with eminent results throughout the course of his work' [Johansen, 1985, p. 32].

[Quotations: The British Journal for the Philosophy of Science, Vol. 15, No.58 (Aug. 1964), pp. 115-122]

097. The analysis of economic systems. Paper presented at the seventh study week of the Pontifical Academy of Sciences, Rome, 1963. In *Pontificiae Academiae Scientiarum Scripta Varia*, no. 28 (2 vols.), 1965. Also in *The Econometric Approach to Development Planning*, North Holland Publishing Co., Amsterdam, 1965.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747140]

Also in *The Econometric Approach to Development Planning*, North Holland Publishing Co., Amsterdam, 1965.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742296]

This paper is based on previous works by Stone on the philosophy and methodology underlying the development of an economic model, presenting them in a systematic way at the seventh study week of the Pontifical Academy of Sciences in 1963. As in previous work, Stone sets out his view of the way economic modelling should be pursued, essentially by taking into account the complex inter-relations between the economic system and its environment. However, in this paper he is even more explicit on the role he attributes to economic modelling: by recognising the imperfections of the economic system when *laissez-faire* is its ruling principle, the paper aims 'to discuss how economic models might help us to reconcile the advantages of central planning with those of individual initiative' [097, p. 4]. The core issue is the availability of information, the feasibility of decision-making being undermined if it is inadequate or absent. Therefore, since information is costly, a thorough examination of the sources of information should be made, in order to understand when it is possible and

convenient to transfer it to a central authority and when it is not. Once again, Stone's purpose is to present the philosophy underlying his model, stressing its practical scope (as a tool to allow policy-makers to plan the economy accurately) and then proceeding with the illustration of the model itself, which represents the bulk of the work of the Cambridge Growth Project. This presentation offers a broader view of the whole project, since Stone suggests some possible extensions, in the near future, to more complex fields of economic activity, not necessarily directly related to the real side of the national economy. In fact, as Stone argues: 'we believe that the main motive forces of economic growth are to be found in human abilities and attitudes: organising capacity, acceptance of education and training, response to innovation, labour mobility, and so on. However, we could hardly have begun with these indefinite and on the whole badly documented areas of interest; and in any case it would have been useless to do so until we could embody them in a coherent picture of the socio-economic system. So, naturally enough, we decided to build out from the familiar and to use our working experience as the starting point for our work' [097, p. 84].

This paper, then, does not add any new contribution to the model developed by Stone, but it clarifies further his view on the need for balanced intervention by a central authority to control the economy, in order to progress towards socially-agreed objectives.

As the proceedings of the conference reveal, the actual presentation of this paper gave rise to a lively debate during the conference itself. Most of the participants contributing agreed with Stone's philosophy of model-building, demonstrating a common approach to the issue by economists in the 1960s. The most interesting aspect of the discussion relates to the possible application of the model for planning purposes. For this to be possible, as Pasinetti observed, it is essential to understand which relations in the economic system are independent of the institutional set-up and which are not. This point is important in highlighting the danger of a misunderstanding of the background of the economic system of a country, a problem that Stone himself realises.

[Quotations: Pontificiae Academiae]

098. A programme for economic growth (with Alan Brown). *Data Processing 5 (1963): 70-77.*

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This paper is a further presentation of the work being carried out at the Cambridge Department of Applied Economics within the Programme for Economic Growth (PEG). In this case, the main focus is on the computational

features of the model, although a brief introduction to the purposes and structure of the model is provided as well. Along with the summary of the characteristics of the model, the paper highlights the main computer processing requirements for improving the reliability of the implementation of the model. This paper, along with the others in the PEG series, witnesses the huge interdisciplinary achievements of that research group, and the cutting-edge technological and scientific knowledge involved in the process.

099. *Economic Growth and Manpower* (with Alan Brown, Graham Pyatt, and Colin Leicester). Report of the BACIE spring conference, 1963. British Association for Commercial and Industrial Education, London, 1963.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This paper was presented at the British Association for Commercial and Industrial Education (BACIE) and represents the first attempt to introduce demographic variables into the Cambridge Growth Project.

Stone highlights the fact that the ‘work on demographic accounting was prompted by the desire to put education and manpower into the Growth Model’ but, he regrets, ‘this never happened in the way I intended’ [Stone & Pesaran, 1991, p. 109].

1964

100. A framework for economic decisions. *Moorgate and Wall Street*, spring 1964, pp. 5-24; reprinted in *Models for Decision*, English Universities Press, London, 1965.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

The article is a brief and exhaustive presentation of the Programme for Growth. With simple and clear language, Stone illustrates the characteristics and objectives of the model that is taking shape just in those years. ‘The model’, says Stone modestly, ‘has now reached the working stage, but when I say this the reader should think of the aeroplane built by the Wright brothers rather than of a modern jet: it is as yet a prototype which we are engaged in improving’ [100, p. 7].

[Quotations: Moorgate and Wall]

101. British economic balances in 1970: a trial run on Rocket. Paper presented at the sixteenth symposium of the Colston Research Society, Bristol, 1964. In *Econometric Analysis for National Economic Planning*, Butterworths, London, 1964.

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this paper, Stone presents the preliminary results of the computational model of economic growth developed within the Programme for Growth at Cambridge. He illustrates in detail the construction of each table, giving special attention to the explanation of the relationships between production, consumption and accumulation. This model, introduced in 1964, provides the context for the first complete results of the 1970 computations, offering a clear example not only of the mechanics of the model, but also of the philosophy and purpose that drives it. As Stone stresses at the beginning: 'our figures are not forecasts; they are intended to show possibilities and problems' [101, p. 66]. The model does not provide a picture of the immediate future. Therefore: 'The next step is to see what would have to happen during the remainder of 1960's if the initial conditions for realizing the 1970 picture were to be met' [101, p. 66]. In summary, the paper represents the first actual computation using the model as it has been developed, through the very extensive work of Stone and colleagues. Regarding this, Stone remarks: 'Before sitting down to write this paper, I checked up on the writings which have so far emerged from this work. I found that in the two and a half years ending in December 1963 we had prepared twenty-nine booklets, articles and conference papers, most of which have already been published' [101, p. 65]. Arguably the Programme for Growth represents one of the major challenges and achievements of Stone's life.

[Quotations: offprint]

102. Computer models of the economy. *New Scientist* 21 (1964): 604-605; reprinted in *The World of 1984*, vol. 2, Penguin Books, 1965.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This brief article presents the advantages of computer modelling in economics. First, Stone provides a simple description of a 'toy model' of the economic system which summarises in outline the relationships included in the complex model of growth developed by him at Cambridge. Stone's purpose here is to show that, by

knowing with increasing precision a large number of parameters, it would be possible to compute quantitative models that would be 'detailed enough and reliable enough to play an important practical role in government and business planning' [102, p. 604]. The effort made by Stone and his colleagues to construct and develop the computational model was huge, but was made possible (and worthwhile) by the fast growing introduction of digital computers into scientific research. Stone offers an interesting example (with reference to the growth model being developed in Cambridge), which helps to clarify the technological context in which he was working at the time: 'The whole economy is represented by the entries in a set of 253 balancing accounts. Each account shows the incomings and outgoings of some branch or sector of the economy. The numerical inputs (parameters and conditions) needed for a computer-run number between 5000 and 6000. A run involves about 30 million multiplications: on a desk calculator this is equivalent to 60 man-years of work; on the Atlas computer it takes 22 seconds' [102, p. 604]. Clearly the introduction of computers opened possibilities for economic modelling that had been impossible even to imagine only a few years before. The stress on computational devices is driven by Stone's practical-minded approach. In fact, as usual in his work, Stone's aim is to obtain as much 'ready-to-use' information as possible. However, even the most detailed information must be regarded by decision-makers as only a tool for improving decisions. In fact: 'Computers do sums, men take decisions' [102, p. 605].

[Quotations: New Scientist]

103. Mathematics in the social sciences. *Scientific American* 211 (1964): 168-182. Reprinted in *Mathematics in the Modern World*, Freeman, San Francisco and London, 1968. Polish translation: *Matematyka w Swiecie Wspolczesnym*, Polish Scientific Publishers (PWN), Warsaw, 1966.

[Included in 118]

This essay opens with an almost triumphant claim by Stone: 'Except in a few obstinate pockets of resistance, the use of mathematics in the social sciences is now generally accepted' [118, p. 1]. This is a statement of his strong support for the introduction of mathematics into the social sciences, especially economics, which is driven by a deterministic conception of the economic system and consequently a commitment to the possibility of measurement and application of formal analysis. Stone emphasises that the mathematical formulation of complex models allows both for empirical tests and for accurate comparison. Furthermore, he again focuses on the practical applications of economic modelling. As he points out: 'in the social sciences we are interested not only in a description of what happens and of how the different parts of the social system are related, but also

in the rational processes that lie behind effective as opposed to ineffective decisions; to a large extent these processes too can be formulated and analysed mathematically, so that our decisions may eventually come to rest a little more on knowledge and a little less on guesswork than they do at present' [118, p. 1].

104. Private saving in Britain, past, present and future. *The Manchester School of Economic and Social Studies XXXII (1964): 79-112.*

[Included in 118]

As Stone clearly explains: 'This paper is the first fruit of the extension into the financial sphere of the work on British economic growth undertaken by a group of us at the Department of Applied Economics in Cambridge' [118, p. 204]. In fact, the computational model of economic growth focuses essentially on the real economy, while in previous works Stone (in co-operation with D.A. Rowe) had addressed the issue of private savings by developing a formal extension of the demand function which includes capital as well as income [see 089]. Here, the model is applied to several different sets of data, proving successful. In particular, great attention is given to the details of econometrics in order to estimate properly the private saving rate for England. Interestingly, the paper concludes by predicting that if the chosen rate of economic growth in 1970 were to be actually met (as assumed in the computational model of growth): 'personal saving would play a much larger part and company saving a much smaller one than are present in the composition of private saving' [118, p. 219].

105. The changing pattern of consumption. In *Problems of Economic Dynamics and Planning (essays in honour of Michal Kalecki)*, Polish Scientific Publishers (PWN), Warsaw, 1964.

[Included in 118]

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743563]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This essay explores the effects of a dynamic demand function applied to the general computational model of economic growth. The importance of this paper rests on its original contribution to the development of econometrics, as it introduces changing parameters over time in order to allow for changing responses of consumers to income and prices over time. Stone himself remembers this work in these terms: 'Later I worked out a model of the

components of demand which would have fitted into the consumption function described earlier. This was a linear expenditure system with time-varying parameters. I fitted this system to British data for the period 1900-1960 but I did not put the two models together; and having worked out the consumption model for eight groups, I did not go further and subdivide these groups, though up to a point the model lends itself to this kind of elaboration' [Stone & Pesaran, 1991, p. 104]. The heritage of this contribution is widely acknowledged. As Pesaran and Harcourt put it: 'This time-varying specification would in effect introduce lagged consumption expenditures into the utility function, which has recently become popular in the life-cycle literature' [Pesaran & Harcourt, 2000, p. 156].

Talking about the linear expenditure system - LES - Stone says:

'As far as I know the LES was the first complete demand system. It is now a little *passé*, its main weakness being the assumption of additive preferences, as Angus Deaton pointed out in 1974 in the *Economic Journal*. There are now better models, notably that proposed in 1980 by Deaton and Muellbauer in their splendid book *Economics and Consumer Behavior*' [Stone & Pesaran, 1991, p. 104].

106. *The Model in its Environment* (expanded version of no. 97 above). No. 5 in *A Programme for Growth*, Chapman and Hall, London, 1964. Reproduced in part in *Automatica* 4 (1966): 55-71.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000748151]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This paper is a formal presentation of the model developed by Stone at the Department for Applied Economics in Cambridge. It represents an extended and more detailed version of previous presentations, as for instance [085] and [097].

107. Transitional planning. In *On Political Economy and Econometrics* (essays in honour of Oskar Lange), Polish Scientific Publishers (PWN), Warsaw, 1964. Italian translation: *L'industria*, no. 3 (1966): 327-346.

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This essay focuses on the transitional period between the present state of the economy and a target rate of growth, in this case the growth rate of private consumption. The argument recalls the fundamental aim of the model for growth developed at Cambridge by Stone [see 085], namely to provide a tool for political planning in order to achieve faster growth in Britain and consequently faster increase in living standards. After an initial application of the model, Stone asks: 'what changes in economic variables should take place during the transitional period if we are to attain our objective, and do we need to revise our preliminary view either as to the length of this period or as to the level of consumption to be reached at the end of it?' [118, p. 88-89]. This transitional model is essentially focused on capital accumulation, illustrating the different adjustments occurring in different sectors of the economy. As Johansen notes [Johansen, 1985, p. 25], since the implementation of the model requires non-linear programming: 'it could happen that the transient model does not allow for the situation determined as the beginning of the balanced growth path, in which case adjustments have to be made'. This would require iterative adjustments, in line with the principle, established by Stone and his colleagues, that there should be a process of interchange between theory and empirical observations. The purpose of the paper is then essentially practical and reflects Stone's view about the role of quantitative economics in society. Hence, Stone concludes the work by claiming: 'I believe that computable models will come to occupy an essential place in economic adaptation. But the possibility of using them rests on their acceptance by society; it is men who change the course of events, though they do so through ideas. Being an optimist, I believe there are signs that this general point of view is gaining ground in many countries, socialist and capitalist alike. Perhaps in the next generation we shall see some big strides forward in economic organization made possible by developments in political thinking, in economic and statistical science, to which the recipient of this essay has contributed so much, and by the emergence of the computer as a new force in social administration' [118, p. 103].

108. Demand analysis and projections for Britain: 1900-1970: a study in method (with Alan Brown and D.A. Rowe). In *Europe's Future Consumption*, North Holland Publishing Co., Amsterdam, 1964. Reprinted in shortened form in *Consumer Behaviour*, A.S.C. Ehrenberg and F.G. Pyatt (eds.), Penguin Books, Middlesex, 1971.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000094473]

This work represents the second volume of a series developed to analyse European economies quantitatively, both providing reliable calculations and discussing methodological issues concerning the results shown. The paper

presents estimates of demand in Britain on a long-term basis, which are included in the more general model of economic growth developed at the University of Cambridge. The paper illustrates the application of the model when past observations are available. This is only the preliminary stage of the full working model, as it does not include assumptions for the level of British citizens' expenditure for 1970, but rather an extrapolation from historical statistics. However, the paper outlines the formal functions for consumer demand and then provides the estimates for Britain from 1900 to 1970, showing a wide range of decompositions and interactions.

109. The methodology of planning models (with Colin Leicester). Paper presented at the NBER conference, Princeton, 1964. In *National Economic Planning*. National Bureau of Economic Research, New York, 1967. Italian translation: *L'industria*, no. 4 (1968): 409-431.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This brief paper provides an interesting survey of thirty-one computational models being developed in various parts of the world at the time Stone and his colleagues were working on their Growth Project. As he writes: 'When a group of us at the Department of Applied Economics started to work some years ago on a computable model of the British economy, we had only vague ideas about the extent to which large econometric models were being built in other parts of the world. From time to time we felt that we ought to try to improve our knowledge, but for one reason or another nothing got done' [109, p. 15]. Hence the stimulus for the present survey, which covers, essentially, western countries and, in one case, an international organization (the European Economic Community), classifying the work being carried out. The 31 models are very different in style, methods, forms and aims, reflecting a variety of interests and a lack of adequate communication. However, Stone highlights the fact that all the models are intended to be formulated and applied according to computational needs. This fact, along with the unexpectedly large number of models being constructed around the world at that time, emphasises the increasing interest in the late 1960s in the development of quantitative economics for the purpose of economic planning and decision-making. As a final note, it is worthwhile underlining the fact that in 1964 two computational models were being developed in Italy also, within two different programmes led, respectively, by Professor Vera Cao-Pinna (Centro di Studi e Piani Economici, Rome) and Professor Siro Lombardini (Ires, Turin).

[Quotation: National Economic Planning]

110. Models for demand projections. In *Essays on Econometrics and Planning* (in honour of P.C. Mahalanobis), Pergamon Press, Oxford; Statistical Publishing Society, Calcutta, 1964.

[Included in 137]

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742265]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This work, written in honour of P. C. Mahalanobis, focuses on the construction of computable models capable of forecasting projections of future consumption. These models, as stressed in the conclusion: 'are intended to be used in conjunction with a general model of economic growth which deals with such matters as production, accumulation and foreign trade as well as consumption' [110, p. 289]. Stone suggests the inclusion in the model of a full set of potential influences on the pattern of consumption in the long term: income and prices, taste, adaptation, distribution of income. While the first three variables have already been introduced in previous studies, the last one constitutes an interesting original proposal, even though outlined in very general terms. As usual, Stone concludes the paper by presenting an example of an actual application of the model, based on British data for 1960 and 1970. Interestingly and in line with the purpose of the essay, Stone also proposes an application of this model to consumption in India, data for which have been made increasingly available thanks to the work of Mahalanobis.

1965

Since the early 1960s Stone's interest in social and demographic aspects of society has become more and more accentuated. He begins to conceive and develop a system of national accounts which incorporates these factors. It is a system that goes beyond the SNA and broadens the economic analysis to include also the social and demographic dynamics.

Early research in this direction is undertaken at King's Research Centre and will appear later in *Toward a System of Social and Demographic Statistics* published by the United Nations in 1975.

111. A model of the educational system. *Minerva III* (1965): 172-186.

[Included in 118]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In the late 1960s Stone dedicates himself to the inclusion of education and manpower in the Growth Model developed at Cambridge. This paper represents one of the most systematic forays in this direction. From a technical point of view, this paper provides two different original contributions. The first one is the application of input-output analysis to the educational system. The second is the use of Markov chain methods for formalising the hypothesized relationships. The focus is on improvement of the growth model. In fact, as Stone explains: 'The purpose of calculating these activity levels is to enable us to calculate the requirements for economic inputs: teachers, buildings, equipment and supplies' [118, p. 105]. A number of papers along these lines will follow.

112. Modeling economic system (in Russian). *Economics and Mathematical Methods* (Moscow) I, pp. 363-390, and pt. 4, pp. 502-514, 1965.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

Original in Russian

113. The Cambridge Growth Project. *Cambridge Research*, October 1965, pp. 9-15.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This very brief note outlines the up to date position in the Programme for Growth developed by the University of Cambridge in the 1960s. It outlines very clearly the variables involved, both exogenous and endogenous, by providing some examples of actual calculations based on the model. The purpose of the note is essentially internal to the academic circle involved in the project, in order to highlight the strengths and potential shortcomings of the work done so far. Stone focuses on the next step as follows: 'Although I have used the future tense to describe future developments, this does not mean that they are merely good intentions: work is in progress on everything I have mentioned' [113, p. 11].

114. The Social accounts from a consumer's point of view. Paper presented at the IARIW conference, Lom, 1965. *The Review of Income and Wealth, Series 12, no.1 (1966): 1-33.*

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

[abridged version, entitled *Simple financial models based on the new SNA*, included in 137]

In this paper, Stone explores the possibility of including financial transactions within national accounting. This investigation is based on the revised version of the SNA which, as Stone puts it, has corrected a serious imbalance in the development of social accounting concerning the concentration on flows to the exclusion of stocks. Therefore, the inclusion of balance sheets in social accounts offers expanded possibilities for construction of economic models. In the paper, Stone illustrates a few simple examples. As Johansen summarises: 'On the basis of input-output analysis, he extended purely computational methods in an attempt to construct models of financial circulation which could be used in practice. After constructing extreme models with certain fixed proportions derived from the borrowing and lending sides of the markets, respectively, a (hopefully) more realistic model is then established as a compromise between the two' [Johansen, 1985, p. 12].

1966

115. Input-output and demographic accounting: a tool for educational planning. *Minerva IV (1966): 365-380. Russian translation: *Economics and Mathematical Methods III (1967): 355-369.**

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

Near the end of the 1960s Stone's interests are turning towards the social aspects of demographic growth and education. His ambition is to integrate education, training and human resources into the Growth Project, an aim that he will never be able to accomplish fully.

In this article Stone sets the basis for the development of an input-output model to be applied to demography. The paper outlines the strategy adopted by Stone in applying input-output analysis to this less familiar field, i.e. demography. The usual input-output matrices present stages of individuals' lives in rows and columns. The categories, rather than industries and products, are age-groups and

occupations. When input-output analysis is applied to demography, a further difference occurs, as output coefficients, rather than input coefficients, are fixed. In this case, the model is more properly defined as an 'allocation model'. The further development of this model will be pursued in later works [see 127 and 128] aiming for the consolidation of a comprehensive model of socio-economic growth which takes account also of education.

116. Mathematical models in educational planning: a view of the conference. Introduction to the proceedings of a meeting held by the OECD, Paris, 1966. In *Mathematical Models in Educational Planning*, OECD, Paris, 1967.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This brief article is the introduction to the proceedings of an OECD meeting held in Paris in 1966 focusing on educational planning. In the introduction, Stone outlines the main themes which have emerged during the conference, highlighting the theories and models proposed and drawing attention to similarities between them. In general, Stone acknowledges that a large part of the scientific community involved in the study of these topics is moving towards similar objectives, although adopting different techniques. Moreover, Stone stresses the common effort of the participants in the conference to promote 'the formulation and control of educational programmes' [116, p. 20]. Stone continues by adding that: 'They saw a number of new areas where research is urgently needed, and commended these alike to those engaged in research and to those who support research. They expressed the hope that, even at this early stage, the papers presented in this volume would come to the notice of educators, educational administrators and educational planners, without whose understanding and help educational model building could easily become separated from the very activity it was designed to assist' [116, p. 20]. The very practical issues raised by the participants at the conference opened also the debate on planning itself with reference to education, as in this realm individuals' freedom of choice ought to play a fundamental role.

117. Mathematical models of the economy. *Bulletin of the Institute of Mathematics and its Applications* (1966): 77-87.

[Included in 137]

This paper provides a simple example of the use of mathematics in economics, illustrating a 'toy model' of the economic system based on four accounting identities between each of the three main accounts: production, consumption, accumulation. The very simple model provides the conceptual starting point for the more complex Model of Growth developed by Stone at Cambridge. The second and larger part of the paper is therefore dedicated to the outline of the computational model of economic growth, the main features of which are illustrated through a detailed flow chart. This paper is included also in a later collection of essays [137] and as Stone points out in the foreword to that version, at the time [137] was published (1970) the model of growth had been refined by the inclusion of more realistic non-linear functions, especially relating to consumer behaviour. However, the increased complexity did not allow for a graphical representation through a flow chart, hence the original diagram was kept in the book.

118. *Mathematics in the Social Sciences and Other Essays* (containing nos. 54, 68, 69, 70, 71, 77, 78, 81, 84, 93, 96, 101, 104, 105, 106, 107 and 111 above). Chapman and Hall, London 1966. Polish translation, *Matematyka w Naukach Społecznych*, Polish Economic Publishers (PWE), Warsaw, 1970.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000744846]

[Actually the collection includes paper no. 103, not paper no. 106]

Some of Stone's contributions are published in these two volumes of collected essays [118, 137].

The volume *Mathematics in the Social Sciences and Other Essays* [118], published in 1966, is intended to show the analytical and expository power of mathematical tools within social sciences. This particular bee in Stone's bonnet emerges at the very beginning of the Foreword to the book, where he notes with satisfaction: 'That mathematics is an indispensable tool in the study of the social sciences is no longer a very controversial statement. It is now generally agreed that mathematical methods are necessary both at the theoretical level, to formulate models precisely, to draw conclusions from postulates and to gain insight into the workings of complicated process and at the applied level' [118, p. V]. Furthermore, Stone highlights the potentially fruitful co-operation between different disciplines that can arise from the applications of mathematics, suggesting that social sciences should develop interdisciplinary *curricula* in order to 'bring together a variety of techniques at present usually regarded as belonging to separate disciplines' [118, p. V].

119. National income. In *Chambers' Encyclopedia*, fourth edition, 1966.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

Stone contributes to the Encyclopaedia by providing the voice on National Income, a subject on which he probably made his most renowned contribution to economics. The explanation of the concept is presented using simple language - though not lacking in detail - covering a very broad range of related topics (for instance real vs. nominal income, income distribution). The work on the compilation of this section for the Encyclopaedia further bears witness Stone's international standing and reputation for his work on national accounting and related issues.

120. Official statistics: a golden treasury or a working tool? Memorandum submitted to the Sub-Committee on Economic Affairs. In *Fourth Report from the Estimates Committee*, H.M.S.O., London, 1966.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

This very interesting paper constitutes a report submitted by Stone to the British government's Sub-Committee on Economic Affairs. It shows Stone's practical concerns about the role, the needs and the perspectives of statistical analysis as a service to public policy. Stone focuses on the illustration of the progress made in use of statistics, mathematics, econometrics and technology in the previous decades, highlighting the improved possibilities for planning and control of economic activity by government. However, the increasing complexity of society and the economy require more resources to be devoted to statistics, in order to improve the reliability of the models, the collection of data and the calculations and forecasting provided. It is very interesting to read through the minutes of the debate following, where it is apparent that the main concerns of governmental officers relate to resources, whether human or financial. There is a substantial and sincere interest in what has been achieved by Stone at Cambridge, but a sharp scepticism over the need for more investment in the enterprise.

121. Our unstable economy: can planning succeed? Sixth annual lecture of the U.K. Automation Council, December 1966. Reproduced in *Electronics and Power* 13 (1967): 40 *et seq.*, and in *Control* II (1967): 64-66. Italian translation: *L'industria*, no. 3 (1967): 350-361.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747245]

In this paper Stone argues strongly in favour of the possibility of controlling the economic system, notwithstanding widespread increasing pessimism due to failure in controlling instability. However, according to Stone the problem does not arise from the economics being incapable of achieving such a purpose; rather, it stems from the strategy adopted by policy-makers so far. In fact, he argues: 'Before we can design the means of controlling a system, we need to understand how the system works' [137, p. 14]. Therefore, the rest of the paper is dedicated to the illustration of a simple model in which a desired quantity of output can be stabilised by introducing a control device into the model. This device, once confirmed by empirical tests, should be an asset in effective policy-making.

122. Spending and saving in relation to income and wealth. *L'industria*, no. 4 (1966): 471-499.

[Included in 137]

In this paper Stone provides a further application, to the British economy, of the function of consumer behaviour he developed in previous publications [see 89 and 104]. In particular he focuses on four main features of aggregate consumer spending and saving. First, he observes the need for inclusion of a measure of wealth (estimated by saving rates added to a baseline measure of wealth), realising that changes in wealth affect income and saving in a different (actually opposite) way. Secondly, following Friedman, he addresses the problem of distinguishing between transient and permanent components of wealth, as well as of income. Thirdly, Stone is interested in measuring 'how total spending is affected by changes in the different components of different types of income payments' [122, p. 473]. Finally, Stone attempts to include capital gains and losses in his function. The purpose of the paper is mostly practical, as it focuses on econometric issues, mostly concerning measurement. In the final section of the work Stone includes a number of graphical diagrams illustrating the bulk of his results. Again, part of Stone's work is indebted to the advances in IT technology, witnessing the impulse he gave to an increased co-operation between applied

computer science and economic analysis, at least at the Cambridge Applied Economics Department.

1967

123. *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom 1920-1938, Vol. II (with D.A. Rowe). Cambridge University Press, 1966.*

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742412]

The second volume of this huge study (see [056]) contains an extremely detailed investigation on consumer expenditure. It reports in-depth classifications for nine different groups of goods and services, each of which is decomposed into narrow classes of items. This impressive statistical work represents the basis on which the model of growth is actually constructed.

124. Economic and social modelling. Paper presented at a CEIR conference, London, 1967. In *Mathematical Model Building in Economics and Industry*, Griffin, London, 1968.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743561]

In this paper, presented at an international conference in London in 1967, Stone highlights what he considers the most important issues in economic model building, from a very practical perspective. These extend from the size of the research unit to the starting point and scope of the model, and to suggestions of useful advice to enhance co-operation within the academic and governmental networks in order to be able to obtain the huge amount of data needed to implement the model. These observations, assuming the mastery of technical problems demanded of model builders, demonstrate Stone's thorough experience in this pioneer field of economic research. As usual, the final part provides an outline of the progress made by the Cambridge group in developing his model of growth, offering an example of the way computational model building should be pursued in order to be fruitful and effective.

125. The generation, distribution and use of income. Paper presented at the ISI conference, Sidney, 1967. *Review of the International Statistical Institute* 36 (1968): 148-157.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper relates to Stone's work on national social accounting. In particular, as Stone highlights: 'The paper has some bearing on the discussions in progress on the revised system of national accounts (SNA) of the United Nations. Naturally enough, this system contains information on the generation, distribution and use of income, but not in the detail that would be desirable for socio-economic analysis' [125, p. 148]. Therefore, in this paper Stone examines a possible solution to provide a social accounting framework including valuable information about income distribution. Four kinds of income redistribution are considered: current non-tax transfers, direct taxes of income, indirect taxes on goods and services and an implicit redistribution due to inefficiency. As summarised by Stone, current non-tax transfers 'are largely, but not exclusively, transfers made by the central government in the form of national insurance and assistance grants, non-contributory pensions, family allowances, grants to local authorities and so on. The principal gainer from this form of redistribution is the personal sector' [125, p. 151]. With respect to the second form of redistribution, Stone includes direct taxes on income, including national insurance as well as health contributions. As Stone interestingly notes: 'In the British case, the only beneficiaries at this step are the central government' [125, p. 151]. Moving on, 'The third redistribution considered arises from indirect taxes on the goods and services bought by the different sectors either for purposes of consumption or as a net addition to their stocks of tangible assets. A full analysis would require an input-output matrix but, as this is not available in the present case, the calculation has been made with the help of the information given in the Blue Book on the allocation of indirect taxes and subsidies to different types of final expenditure' [125, p. 151]. Finally, Stone considered a fourth type of redistribution which, as he explains, 'arises because in fact the sectors do not act in the way just envisaged. In passing from their command over resources to their actual use of resources it is necessary to deduct net capital transfers and net loans made' [125, p. 153].

126. The use of social accounting matrices in building planning models. Paper presented at the IARIW conference, Maynooth, 1967. In 137 below.

[Included in 137]

This paper, presented at the IARIW conference, Maynooth, in 1967, outlines the possible applications of social accounting matrices, according to the new refinements included in the revised version of the SNA (see [130]). The main advantages of these matrices are practical, as Stone explains in the paper: 'First, it enables the structure of even a complex system to be grasped as a whole and the connections between different bodies of data and different classifications to be traced. Second, it enables the data to be arranged systematically and coherently so that all the simple identities of the system are explicit. [...]. Third, it forces us to think about the connections between the variables we intend to use and the relationships we need to formulate for different kinds of model [...]. Finally, it is helpful in laying out complicated calculations and in establishing efficient methods of estimating parameters' [137, p. 224]. The revised version of the SNA distinguishes between commodities and activities and includes a very detailed sub-set of accounts that provides information on a wide range of economic relationships. Therefore, the use of social accounting matrices can be helpful in analysing - at different levels of detail - production, consumption and saving, generation, distribution and use of income, capital formation, financial stocks and foreign trade. Moreover, it can constitute the basis for the construction of general models, such as the computational model of growth developed in Cambridge, allowing for further estimations and calculations based on the detailed information provided.

127. An example of demographic accounting: the school ages (with Giovanna Stone and Jane Gunton). Paper presented at the IARIW conference, Maynooth, 1967. *Minerva* VI (1968): 185-212.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

As seen also in [115] and [128], in the late 1960s Stone attempts the integration of demographic accounting into a more general socio-economic computational model. In fact, Stone points out that: 'Demographic, educational and manpower statistics are usually treated as three separate subsystems in the statistical universe. Here an effort is made to connect them, and to do it in such a way as to enable us to trace through time the gradual transformation of human stocks and flows' [127, p. 185]. The purpose is mostly practical, in order to provide demography, like economics, with an accounting framework for comparing and organizing information. The starting point is a population matrix in which the units of analysis are characteristics of human individuals. According to Stone, this matrix can be further developed to analyse education, demography or any other social science of interest, to provide more detailed information on the functioning

of the social system. Again, Stone's aim is the possibility of intervention. In fact 'one can try to use this knowledge, in combination with data on costs, educational technology and available resources, to bring about desirable changes in the circumstances' [127, p. 185]. In this paper, as well in [115], the focus is on the education system. In particular, the paper illustrates the formal construction of a population matrix and in the final part it provides an extensive application to school age groups in Britain in 1963-64.

1968

In 1968 the United Nations publishes a new expanded and revised version of the System of National Accounts.

Stone [Stone & Pesaran, 1991] points out that the audit work had started five years before on the initiative of Pat Loftus, who was in charge of statistics at the UN. It had been a more challenging job than in 1953: in 1963 many countries were equipped with a system of national accounts and it was necessary to discuss with them the proposed changes. Thanks to Abe Aidenoff, on the staff of the UN Statistical Office, a final report is published in 1968. The main modifications are a distinction between industries and commodities and the addition of input-output tables, flow-of-funds tables and balance sheets.

128. Demographic input-output: an extension of social accounting. Paper presented at the fourth International Conference on Input-Output Techniques, Geneva, 1968. In *Contributions to Input-Output Analysis*, vol. 1, North-Holland, Amsterdam, 1970.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742262]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper provides an extension of the framework being developed in [115] and [127], with an application to demographic data. In the former papers the focus was on the education system, with the objective of analyzing flows and stocks of human individuals across different stages of education. This paper shows a similar possible application to population flows, such as intra- and inter-national migration. As Stone stresses in the introduction, his purpose is to extend the application of social accounting according to the proper meaning of the concept, as introduced into economics by J.R. Hicks in 1942. In fact, Stone notes that 'Social accounts are still thought of mainly if not exclusively as statements connecting

economic flows and stocks expressed in money terms. [...]. In other words, what we have been doing so far is no more than economic accounting' [128, p. 293]. The paper presents some practical examples of British figures which allow Stone to construct demographic matrices analogous to those presented in [115] and [127]. He then addresses technical issues concerning the development of Markov-chain models for demography in the same way already attempted for education.

129. A comparison of the SNA and the MPS. Paper presented at the Symposium on National Accounts and Balances, Warsaw, 1968. Polish translation in *Bilanse Gospodarki Narodowej*, Warsaw, 1968. English version in 137 below.

[Included in 137]

This work was presented at the Symposium on National Accounts and Balances in Warsaw in 1968 and provides a comparison between different accounting systems. In particular, it compares the SNA to the Material Products System, a different accounting methodology mostly adopted by socialist countries, especially the Soviet Union. As Stone notes, these systems have usually been regarded as irreconcilable, the users of one method being treated with suspicion by the users of the other. In his opinion, knowledge of alternative accounting systems is useful not only to widen the mastery of accounting methodology 'but also in the possibility it provides for understanding different views of economic and social processes' [137, p. 201]. In fact, though the main categories are the same for both accounting systems, their content is different, reflecting different underlying concepts of economic and social activity. The paper provides a detailed technical illustration of the possibility of comparing the two systems, by showing how to implement the necessary adjustments.

130. The revision of the SNA: an outline of the new structure. Paper presented at the Symposium on National Accounts and Balances, Warsaw, 1968. Polish translation in *Bilanse Gospodarki Narodowej*, Warsaw, 1968. English version in 137 below.

[Included in 137]

This paper was also presented at the Symposium on National Accounts and Balances in Warsaw in 1968. It contains a very detailed and exhaustive outline of the proposal for a new structure of the SNA which takes into account most of the refinements that were already suggested as possible improvements to the original version in 1953. Two particular issues are considered. The first one is the

expansion of the number of accounts in order to include a balance sheet for assets and liabilities. The second and more complex one is the expansion of the national accounts into a subset of more detailed accounts in order to capture all the intermediate economic relationships occurring in the country. The result is a very complex and large accounting matrix which offers a comprehensive and detailed picture of the national economy.

131. Input-output projections: consistent prices and quantity structures. *L'industria*, no. 2 (1968): 212-224.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

In the context of his contribution to the improvement of input-output analysis, Stone notes that: 'Input-output projections [...] are often made entirely in terms of quantities without any explicit reference to price movements' [137, p. 45]. Therefore, this paper explores the possibility of making input-output projections which take into account the structure of prices. The discussion is extremely technical and illustrates some possible applications of the traditional method of adjustment (viz. estimation through the method of least squares) to the generation of consistent input-output projections which include the underlying price structure.

132. Control of an economic system. In *Encyclopaedia of Linguistics, Information and Control*, Pergamon Press, 1969.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742409]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This contribution to the *Encyclopaedia* provides an interesting insight into Stone's idea that the economic system could be - and ought to be - 'controlled' in order to perform optimally: 'An economic system can be thought of as a vast human computer into which information is fed continuously, leading to calculations, decisions and actions. For the system to work well, the flow of information should be both full and up to date. Equally important, it should be appropriately distributed among the units responsible for the decisions: insufficient knowledge at one point will not be compensated by an excess of information at another. Given a well-regulated flow of information, it should not be impossible to build into the system a set of controlling devices which would ensure that the ultimate

aim of economic activity, namely making the best possible use of all available resources, is achieved' [132, p. 1]. Stone recognises the economic system as, in principle, self-regulating, but he warns that: 'in the real world a number of forces conspire to diminish the effectiveness of the self-regulating process, and these give rise to a number of policies designated to make it work better' [132, p. 1]. To introduce this issue into the language of control engineering, Stone provides a very simple example of a public policy designed to stabilise employment at a desired level.

[Quotations: offprint]

1969

133. Foreign trade and full employment: an input-output analysis. *L'industria*, no. 4 (1969): 431-443.

[Included in 137]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper focuses on balance of trade, addressing the problem of choosing the best policy in order to change a negative balance into a positive one. The specific problem addressed in the paper is of particular relevance in developed countries (such as Britain), because it concerns the consequences of export expansion and import saving when all the necessary resources in the economy are full employed. The problem, for any country with a negative trade balance, arises as follows: 'Sooner or later the country, like the overwhelming majority of individuals, will have to get its spending in balance with its income. This means that it will have to export more in relation to its imports than its wont; and it can try to this by a mixture of export expansion and import saving' [137, p. 23]. Therefore Stone examines through input-output analysis the consequences of different policy proposals oriented either to export expansion or import saving. In this way, the effects on the whole chain of production can be investigated, detecting losers and winners in order to allow the policy-maker to decide for the best.

134. *Demographic Accounting and Model Building*. OECD, Paris, 1971.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742770]

This report constitutes the first comprehensive publication on demographic accounting, a direction of research which never led to an international standard in the same way as national accounting. The long essay was requested by the OECD to acknowledge Stone's influential and fundamental contribution in developing national accounts. It provides an extensive description of conceptual and practical issues on demographic accounting, highlighting the potential link to economic accounting. The framework presented in the report offers two main advantages, in that it provides a basis for the evolution of an operating accounting system and for testing hypotheses.

135. Economic and demographic accounts and the distribution of income. Paper presented at the Symposium on National Economic Modelling, Novosibirsk, 1970. Russian translation: *Economics and Mathematical Methods VII (1971): 658-666. English version: *Acta Oeconomica 11 (1973): 165-176.**

[Access the article via JSTOR: <http://www.jstor.org/stable/40728215>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

In this paper Stone provides a tentative analysis of the so-called 'demographic-economic system', which consists in the integration of his previously developed models into one more general framework. Relying on a few simple assumptions about consumer preferences over jobs and goods, Stone demonstrates how the main determinants of economic activity - here, essentially, relative prices - affect not only income but also its distribution among the population. The interesting (though preliminary) and potentially controversial results shown in the paper are summarised by Stone as follows: 'It is not the aim of this paper to take up arms for or against a more equal distribution of incomes but only to show that, in a simple example in which neither job preferences nor consumer preferences are constrained by authority, the distribution reached depends entirely on the parameters which control various kind of preferences' [135, p. 175]. However, Stone acknowledges the difficulties inherent in the development of a reliable model for the study of income distribution. In fact: 'as long as the controlling factors in a problem remain parameters, beyond measurement in any but a purely empirical sense, it is difficult to hold strong convictions about how the problem should be solved. However, the parameters of a science may be the variables of another; and it is to that other, if it exists, that economists who wish to claim some rationality for their analysis of the distribution of income should turn' [135, p. 175].

[Quotations: *Acta Oeconomica*]

1970

136. An integrated system of demographic, manpower and social statistics and its links with the system of national economic accounts. Report discussed by an expert group convened by the Statistical Office of the UN, Geneva, 1970. *Sankhyā, Series B* 33 (1971): 1-184.

[Access the article via JSTOR: <http://www.jstor.org/stable/25051744>]

In the late 1960s Stone's work was mainly concerned with social indicators, and how to integrate them into a comprehensive socio-economic model. Beyond academia, this topic attracted the interest of international organizations, with which Stone was already collaborating with a view to developing an international standard of national accounts.

'I was asked' says Stone 'to prepare a report on social and demographic statistics for their Statistical Office. I wrote a first draft for the Committee in 1970 and this was reproduced by my friend and committee member, Prasanta Mahalanobis, in his journal *Sankhya* [136]. Successive drafts went the rounds, like the SNA, in the charge of Aidenoff. The final report was published in 1975 under the title *Towards a System of Social and Demographic Statistics* (SSDS). The report is divided into three main parts: the first deals with the system as a whole; the second with individual sequences and subsystems; and the third with examples and applications. In the last section considerable use is made of models based on absorbing Markov chains' [Stone & Pesaran, 1991, p. 109].

Even if very elaborate and detailed, as in the more renowned works on national accounting, this contribution on social accounting did not achieve great success among economists and policy-makers, as Stone himself admits:

'Although it was made clear that the SSDS was only intended to help countries which were trying to develop socio-demographic statistics and that no country was expected to cover all the topics in the report, the system did not catch on in the way the SNA had. I think I can see the reasons why. Unlike the SNA, it had not been introduced in gradual, easily digestible stages. From the point of view of official statisticians it was long and full of unfamiliar stuff, the taxonomic proposals were very elaborate, and there was a lot of mathematics, which is still apt to turn people off. To my knowledge, the only statistical office that has followed it up is the Central Bureau of Statistics of the Netherlands; their first full-scale report, *Sociaal-demografische Rekeningen*, was published in 1989' [Stone & Pesaran, 1991, p. 109].

137. *Mathematical Models of the Economy and Other Essays* (containing 74, 83, 90, 92, 95, 110, 114, 115, 116, 117, 121, 122, 125, 126, 127, 129, 130, 131 and 133 above). Chapman and Hall, London, 1970.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743083]

[here no. 114 '*Simple financial models based on the new SNA*' is an abridged version of no. 114 'The Social accounts from a consumer's point of view']

This book collects together a number of Stone's papers. As Stone explains in the foreword to the book, the volume can be regarded as a natural sequel to the previous similar collection [118], since all the articles included were actually published after [118] itself. Following the same rationale as in [118], Stone collects the works he considers most relevant to his intention to highlight the importance of mathematical modelling in economics. The papers included essentially fall into two groups: the first group relates to the modelling of specific economic relations and the problems involved; the second group focuses on national and socio-demographic accounting. The very first article [117] can be regarded as a general introduction and contains a general presentation of the Cambridge Growth Model.

138. *Process, capacity and control in an input-output system. L'industria*, no. 1/2 (1973): 3-17.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

Most of Stone's publications have been oriented to practical purposes, as he conceived of economics as a tool for supporting decision-making at a national or international level. In this brief paper he explores an application of input-output analysis at an intra-firm level, introducing processes instead of branches of production. The intention is to explore possible application of input-output analysis to help business decisions. The rather simplified illustration provided in the paper highlights a possible new stream of development for input-output analysis.

139. *The fundamental matrix of the active sequence*. Paper presented at the Fifth International Conference on Input-Output Techniques, Geneva, 1971. In *Input-Output Techniques*, North-Holland, Amsterdam, 1972. French translation: *Cahiers du Séminaire d'Econométrie*, no. 14 (1972): 9-23.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000090785]

This work illustrates the technical issues in the development of socio-demographic accounts. In particular, since Stone has hypothesized a model of demographic accounts based on a sequence of stages of life, this paper focuses on the so-called 'active sequence', i.e. the sequence of life-stages devoted to earning and learning. In order to compile the input-output matrix, Stone models the sequence as a survival process by making use of Markov chain methods to calculate the probabilities of each sub-state (e.g. nursery, pre-school, working age, etc.). The purpose of the resulting matrix is the further extension of the growth model by the inclusion of socio-demographic accounting.

1971

140. A system of social matrices. Paper presented at the IARIW Conference, Ronneby, 1971. *The Review of Income and Wealth*, series 19, no.2, 1973, pp. 143-166. Spanish translation: *Desarrollo Económico* (Buenos Aires) 13 (1973): 169-197.

[Access the article via JSTOR: <http://www.jstor.org/stable/3466247>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper follows the explorations started in [115], [127] and further extensions, focusing on the development of social accounting. As in previous works, attention is mainly given to the construction of the social matrix, illustrating all the methodological issues and difficulties arising. In particular, the presentation provides two possible interpretations of the main analytical tool (which is a set of equations), one relating to input-output analysis, and another related to Markov chain methods. The paper provides some examples of 'life sequences' (in Stone's terminology) to which this analysis could be applied.

141. The evaluation of pollution: balancing gains and losses. *Minerva X* (1972): 412-425.

[Access the article via JSTOR: <http://www.jstor.org/stable/41822162>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper reflects the climate in the late 1960s as regards human development, expressing severe concerns about what we would now refer to as 'environmental

sustainability'. In the opening sentences of the paper, Stone acknowledges that: 'The market system has proved itself to be a practical means of regulating the production and consumption of goods' [141, p. 412]. However, the market system has failed to provide a solution for 'externalities', especially pollution. As Stone notes: 'the goods accounted for in the market system, are intended for sale and expected to yield a profit; but the accompanying evils do not show up in the accounts if the producer can dispose of them without cost to himself. Thus, for instance, a textile mill prospers if it can sell its textiles at a profit, although in producing them it may foul the local river so that the community must either suffer a loss of amenity or spend its own money on cleaning up the mess. In such circumstances the mill-owner has no incentive to adopt less polluting processes or to spend money on waste-purifying equipment. It is therefore difficult, if not impossible, to calculate what the textiles really cost, and the allocation of resources will be distorted as a consequence' [141, p. 412]. As Stone recognizes, the problem is not new in itself, rather in its 'scale, rate of growth and diversity of pollutants' [141, p. 412]. Interestingly, according to Stone a solution can be achieved only through further improvements in science, rather than from a denial of science. In fact: 'The anti-pollution campaign is generally associated with a campaign against science. But the fact is that, in order to control pollution, a great deal of scientific, engineering and economic research will be needed. The back-to-nature movement, which seems to have a certain vogue among modern youth, is acceptable only to affluent people who have no conception of what it entails. Those who live under primitive conditions look with hungry eyes on what they conceive, rightly in my opinion, to be the marvellous scientific and economic achievements of the West. It is cruelly frivolous to deny them the fruits of these achievements' [141, p. 412]. As an economist, Stone provides his contribution to the solution of the problem by suggesting an application of input-output analysis with a view to understanding how to sustain the costs of reducing pollution within the productive process. The paper is indebted to Leontief's previous works on the same topic [W. W. Leontief, *Environmental Repercussions and the Economic Structure: An Input-Output Approach*, in Tsuru, Shigeto (ed.), *A Challenge to Social Scientists*, Tokyo, Asahi, 1970, pp. 114-134; reprinted in *The Review of Economics and Statistics*, LII, 3, 1970, pp. 262-271].

Some time later, Stone will make the following observations:

'The SSDS contains very little that is relevant to the environment but I did write a paper intended to show how far a country should divert resources from the production of regular goods to cleaning up pollution [141]. Meade produced in *L'industria* (1972, pp. 145-1252) a better version of this model, in which it was recognized that the consumer is interested not so much in the amount of cleaning up as in the state of the world after the cleaning up has been carried out. I have always maintained that environmental statistics, along with the national accounts

and socio-demographic statistics, were one of the three pillars on which the study of society should rest' [Stone & Pesaran, 1991, p. 110].

142. A Markovian education models and other examples linking social behaviour to the economy. *Journal of the Royal Statistical Society, Series A (General)* 135 (1972): 511-543.

[Access the article via JSTOR: <http://www.jstor.org/stable/2344680>]

This paper is a follow-up to [140] but focuses on modelling Education. The intention is in line with most of Stone's work in this period, namely modelling based on socio-demographic data as part of a more general socio-economic framework within Cambridge Growth Project. This very detailed work focuses on how to link economic and human flows in the same analytical method. In particular, Stone explores input-output matrices and Markov chain methods. Although not explicitly addressed in the essay, a further and more interesting concern of Stone's about economics is highlighted in the text, i.e.: 'the national economic accounts, and indeed economics in general, make use of a somewhat restricted concept of production. Basically, to an economist production means the bringing into being of goods and services intended for sale at a profit. The definition is stretched to include the services provided by government departments and private non-profit institutions, such as education and health, although in fact they are not sold at a profit. But it is only the saleable goods and services that are explicitly recognized; the unsaleable products, such as pollutants, noise and the destruction of natural amenities, are implicitly accounted for only if they are treated, and are otherwise simply ignored. As a consequence of these limitations, the national economic accounts are useful in econometric model-building and in the analysis of demand management but much less successful, as is generally recognized, in providing measures of human welfare. In my opinion it is necessary to bring together the study of economic phenomena, the study of socio-demographic phenomena and the study of environmental phenomena, since these are the three pillars on which an analysis of society ought to rest' [142, p. 512-13].

143. Transition and admission models in social demography. Paper presented at a Conference on Quantitative Social Theory and the Study of Formal Organisations, Virginia, 1972. *Social Science Research* 2 (1973): 185-230; also in *Social Indicator Models*, Russell Sage Foundation, New York, 1975.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper relates to Stone's interests in the final part of his career. His researches were aiming at developing a unifying framework to extend social accounting to demography and education, in order to obtain a comprehensive model of the national economy. The paper was presented at the Conference on Quantitative Social Theory and the Study of Formal Organizations, held in Virginia in August 1972. In particular, the purpose of the paper is 'to connect data on human stocks and flows', in an 'attempt to unify the analysis of social structure and social change at different levels of generality' [143, p.185].

This aim is pursued through the development of a matrix framework in which the core is the 'C-matrix', i.e. a transition proportions' matrix that allows the production of projections based on survival rates of the population. The framework is given more realism by allowing survival rates to vary according to sex, age-group, educational status and marital status. By combining theoretical and empirical reasoning, Stone shows that the model he develops is more appropriately applied to steady states rather than transient states. Furthermore, Stone shows that the importance of defining the different states is crucial, especially when Markovian probabilities are implemented: in fact, the probabilities of survival are likely to be very different at different age levels, and this variation is not linear (for instance the difference in the probability of survival of new-born babies and 4-year-old children is likely to be larger than the difference in survival rates between, say, 40-year-old and 44-year-old men). These theoretical concerns lead to practical consequences when the model is implemented in a more comprehensive model of the national economy. In particular, Stone illustrates how it would be possible to make projections about the costs of educational programmes based on the estimated demographic transitions. Clearly the reliability of these projections depends strictly on the soundness of the underlying socio-demographic model. The paper suggests possible directions of further research with a view to overcoming the practical and theoretical problems outlined.

144. Demographic growth and the cost of education. In *Population and Growth and Economic Development in the Third World*, 2 vols. International Union for the Scientific Study of Population, Ordina Editions, 1976.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742771]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This study explores the application of descriptive statistics and analytical methods to the provision of possible paths for planning education in developing countries.

The paper adopts the usual framework for social accounting developed previously, and includes several tables providing a large amount of statistical data on population and education in developing countries. Focusing on simple aggregate geographical groups rather than individual countries, Stone offers an interesting descriptive statistical comparison between different groups, highlighting some empirical regularities - such as dependency ratio - which are used to implement the application of the input-output matrices. This work is a further example of Stone's involvement in economic planning for international organizations.

1973

145. Personal spending and saving in postwar Britain. In *Economic Structure and Development* (essays in honour of Jan Tinbergen), North-Holland, Amsterdam, 1973.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742348]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This essay, written in honour of Jan Tinbergen, provides some further developments and refinements of Stone's model of consumption, which constitutes the bulk of the framework developed for the Programme for Growth at Cambridge. In the paper some refinements are provided relating to the codification of net investment and net expenditure and the impact of transient wealth on spending. Moreover, all the calculations are converted to a *per capita* basis. Interestingly, in this paper Stone acknowledges the contribution of several people to the development of his studies concerning consumers' behaviour. In particular, Stone cites Tinbergen as being inspirational for his econometric research, Friedman's contributions on components of income and wealth, some insightful comments received from H.R. Fisher and finally the valuable and long-term collaboration with D.A. Rowe on the development of the functions of consumption and saving. Finally, as Johansen [1985] notes, this study is important because it deals with a number of methodological issues concerning the modelling and measurement of consumption, with particular reference to dynamic features of income, wealth etc.

Stone remembers:

'I continued to write papers on spending and saving functions until the early 1970s [54, 60, 89, 122, 145]. They gradually became more elaborate. I introduced a term in wealth, I divided income into permanent and transient components, I

distinguished wages and transfers from other income, and I introduced a variable to represent government measures to influence consumption. I had two versions of the model; in one, consumption was confined to perishables, and in the other, net investment in durables was added to saving and the consumption of durables was excluded from income and consumption. I also carried out the calculations for 1949-1966 and then added successive years, ending up with 1949-1970 in order to see how much the parameter estimates were affected. The results came out well; they appeared in a paper I wrote in honor of Tinbergen in 1973 [145]. In it I also examined the saving ratio as a function of the growth rate of income and the transient path of the adjustment of consumption to a maintained unit increase in income' [Stone & Pesaran, 1991, p. 102].

146. Statistics (in Italian). In *Enciclopedia del Novecento*, vol. VII, Istituto della Enciclopedia Italiana, 1984.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This essay contains an extensive survey of all the fields of research addressed by Stone during his academic career, providing a clear and simple classification of the applications of statistics in economics. The second part of the work is dedicated to the analysis of common problems arising in econometrics, showing Stone's mastery of the practical work that an applied economist is likely to face.

147. Demographic variables in the economics of education. Paper presented at an International Economic Association Conference held at Valescure, 1973, and published in *Economic Factors in Population Growth*, Macmillan, London, 1976. Hungarian translation of a preliminary version: *Demográfia XVII* (1974): 11-41.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743558]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This study is an analysis, using data for a large number of countries, of the relationship between certain demographic, educational, economic and social variables and an examination of the form of these associations. In particular, in this empirical paper Stone examines 'the association of the proportion of children in the population with the gross reproduction rate and with the growth rate of the population and G.N.P. per head; the association of life expectancy with the G.N.P. per head; the association of the structure of the illiteracy rate with the growth rate and the G.N.P. per head; the association of the structure of educational systems, that is the proportion of total enrolments in the elementary stages of

these systems, with the illiteracy rates and the G.N.P. per head; the association of the coverage of educational systems, that is the proportion of the relevant age-groups enrolled at the primary and secondary levels, with the G.N.P. per head and the urban ratio; and the association of the proportion of the G.N.P. spent on public education with the G.N.P. per head' [147, p. 521-522]. Throughout the paper the different functional forms are tested against actual observations, and there is extensive use of diagrams and graphs. The combined study of economic and social factors constituted an innovative approach that reflected Stone's multi-faceted interest in the complex functioning of the economic system.

1974

148. Random walks through the social sciences. Paper presented at the Sixth International Conference on Input-Output Techniques, Vienna, 1974.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

In this work, Stone addresses the problem of different disciplines within the social sciences, following Marshall's claim that 'a unified Social Science, however desirable, is unattainable' [148, p. 1]. Although Stone substantially agrees with Marshall and is aware that specialisation is unavoidable, especially at the early stages of a new discipline, he is particularly concerned with the risk of an excessive fragmentation of social sciences. However, Stone points out that 'if we look around the social sciences [...] common organizing principles of thought, or taxonomic and analytical methods, are very general' [148, p. 1]. As an example he shows that the approach underlying a particular method widely adopted in economics, namely Markov chains, is shared by a number of different disciplines, ranging from demography to sociology, in so far as 'we are concerned with the question of how the present state of affairs becomes the state of affairs a year hence, a decade hence, a century hence' [148, p. 1]. Stone here sheds some new light on how different branches of social sciences can be actually interconnected. In particular, as Johansen [1985, p. 31] puts it, 'It convincingly demonstrates the effectiveness of matrix techniques in the social sciences'. This compelling survey leads to the following concluding remark by Stone: 'Although there are specific features in all the social sciences, nevertheless definitions and simple, manageable models based on a coherent taxonomy still play an important, one might even say a central, role' [148, p. 18]. Therefore, Stone concludes by calling for a renewed co-operation between social sciences, a task that according to him 'has always been understood by men of broad culture but not by specialists' [148, p. 19].

149. What is wrong with the national accounts? Paper prepared for the Statistical Office of the United Nations for submission to the Statistical Commission.

150. Towards a model of inflation, 1: a survey of some recent findings on the determinants of changes in wages and prices. Unpublished manuscript.

151. Social statistics and social policy. Paper presented at the 40th Session of the International Statistical Institute, Warsaw, 1975. *Bulletin de l'Institut International de Statistique XLVI (1975): 498-510. Reproduced in *Statistical Policy in Less Developed Countries*, IDS Communication 114, 1975. French version: *Economie et Statistique*, no. 75 (1976) 21-26. Hungarian translation: *Demográfia XVIII (1975): 467-478.**

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

In this paper Stone outlines the main features of a system of social accounting, showing some possible applications for policy purposes. In fact, the opening line of the article recalls the efforts made in earlier decades to introduce some form of economic planning and control in Western economic systems, but such intentions require a huge amount of information in order to be reliable and to yield the expected outcomes. This brief, mainly descriptive article shows the latest developments in research on producing a comprehensive system of social and demographic accounts, with potential connection to the widely adopted economic national accounts. The main purpose of the paper is therefore to 'help countries engaged in developing their social and demographic statistics' [151, p. 508] and to increase the international standardisation and comparability of such accounts. This task, in Stone's view, would be pivotal in achieving more effective and efficient economic and social policies.

[Quotations: Bulletin]

152. The expanding frontiers of input-output analysis. Paper presented at the 40th Session of the International Statistical Institute, Warsaw, 1975. *Bulletin de l'Institut International de Statistique XLVI (1975): 306-321.*

[Available at BUL as typescript, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper provides a survey of the recent developments in input-output analysis, covering some selected topics that Stone finds of particular relevance: changing coefficients over time, assumptions about technology, disaggregated models, the distribution of income, finance and the flow of funds, regional and multiregional studies, and finally the relation between resource utilisation and the environment.

153. Modelling the educational system. Paper presented at a Research Planning Conference on the Demography of Educational Organizations, Cambridge, Mass., 1975.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper is part of Stone's approach to the development of a general framework of social and demographic accounting. In particular, this paper focuses on the modelling of human stocks and flows in order to include them in a convenient framework for the educational system. Frameworks for analysing human stocks and flows can actually be 'applied to any aspect of life: everything depends on the definition of states. Accordingly, they can be used to analyse the structure of an educational system and to trace the movements of students and teachers in it' [153, p. 1]. The paper outlines different possible models based both on outflow and inflow coefficients, applying a combined set of different techniques, especially Markov chains and input-output tables. Furthermore, after some illustrative examples, the paper examines possible further refinement of the models and illustrates a few applications to educational performance. Finally, Stone turns to the purpose of the model, which is to describe possible (probable) outcomes of present tendencies. If reliable, the model can be of value to policy-makers in controlling or even changing the pattern they are observing, so as to maximise an ideal social welfare function.

154. Introduction to *Social Accounting Methods for Development Planning: a Case Study of Sri Lanka* by Graham Pyatt, Alan R. Roe, and associates. Cambridge University Press, 1977.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

Stone contributes a foreword to the book by Graham Pyatt and Alan Roe focusing on the application of social accounting in developing countries, and in particular in Sri Lanka. In his foreword, Stone stresses the need for a deep 'knowledge of the people and wealth of a country' as it is 'essential for understanding and good government' [154, p. xvi]. By recalling the works of the Political Arithmeticians, Stone surveys the main development made in the last decades in Britain and Europe in increasing the extent and reliability of national statistics. Then, he outlines the most relevant features of the current system of national accounts that constitute the basis of the descriptive statistics contained in the book. Subsequently, Stone introduces a framework for analysing demographic features of the country, following his previous contributions on the topic (e.g. [153], [154]). In his conclusions, Stone highlights the joint importance of both the main elements of the model. In fact, while the social accounting matrix can be helpful for assessing distributive matters, which are extremely relevant in developing countries, the economic model is essential to understanding how increase in national production is related to distribution.

155. Direct and indirect constraints in the adjustment of observations. In *Nasjonalregnskap, Modeller og Analyse* (essays in honour of Odd Aukrust), Statistisk Sentralbyrå, Oslo, 1975.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747294]

This paper addresses some technical problems related to accounting matrices. In particular, Stone is concerned with a practical problem that, as he says, has bothered him for a long time: 'It is the question of what we can do to improve the economic and social matrices we construct from basic data which in some degree are inevitably incomplete, inaccurate and inconsistent' [155, p. 42]. The essay, written in honour of Odd Aukrust, focuses on this subject mainly in relation to input-output analysis, but also offering a more general illustration of the issue.

1976

156. Major accounting problems for a world model. Paper presented at a working seminar on Global Opportunities and Constraints for Regional Development, Harvard University, Cambridge, Mass., 1976, In *Problems of World Modelling*, Ballinger, Cambridge, Mass., 1977. Hungarian translation: *Demográfia XX (1977): 23-55.*

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

During a conference at Harvard University, Stone addressed the problems of 'world modelling', namely the attempt to formulate a computational and predictable model of particular realms of human experience. The paper presented by Stone incorporates the mature stage of his work at Cambridge in developing the growth model. In fact, the bulk of the contribution is dedicated to a detailed exposition of the construction of socio-demographic accounts, by illustrating all the relationships that link the single components. As a concluding remark, Stone outlines three kinds of problem that arise in modelling. The first is mostly intellectual and concerns the definition and formulation of the concepts that have to be assembled into a coherent whole. The second is essentially practical, and related to data collection and harmonization. Finally, Stone suggests a third kind of problem that he defines as 'emotional', namely related to the arbitrary choice of the model-builder about the sources of data to be considered as relevant to the model. In summary, he feels unsure of the reliability of such model-building at this time. However, as always, he shows optimism about the possibilities of improving world modelling in respect of all three problem areas: intellectual, practical and even emotional.

157. Michael James Farrell (obituary). *Annual Report of the Council of King's College, Cambridge, 1976*, pp. 34-36.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Michael James Farrell worked at the newly established Department of Applied Economics in Cambridge just after his degree in 1949. Stone remembers him as a keen economist, to be regarded, in the word of Frank Hahn's obituary in the *Times* as belonging 'to that small group of people in a subject of whom it can be said that they had written a number of "classical" papers' [157, p. 36]. As a man, Stone remembers him as a lover of freedom, a polite friend and a beloved husband and father.

158. Abraham Aidenoff, 1913-1975 (obituary). *International Statistical Review* 44 (1976): 383-384.

[Access the article via JSTOR: <http://www.jstor.org/stable/1402364>]

Stone writes here on Aidenoff, whom he remembers as an estimable colleague and friend. The greatest contribution of Aidenoff was in the fields of statistics, as he directed the UN Statistical Office for most of his professional life. Along with Stone, Aidenoff contributed to the development of the System of National Accounts and especially their review, set up and refined during the summer of 1968, which Aidenoff spent in Cambridge. As Stone stresses, Aidenoff was very devoted to his work and though his main contribution is in the field of statistics, he also developed other aspects of economics, in particular with reference to the distribution of income. On this topic, Aidenoff guided the drafting of a system of statistics on income distribution, which was eventually included in a broader publication.

1977

159. The evolution of the Cambridge Growth Project. Lecture given at the Institut für Siedlungs-und Wohnungswesen der Westfälischen Wilhelms-Universität Münster. In *Beiträge zur Strukturpolitik, Materialien zum Siedlungs-und Wohnungswesen und zur Raumplanung*, no. 18, Munter, 1977. Hungarian translation: *Statistikai Szemle* 56 (1978): 236-249.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This paper witnesses the widespread academic interest directed towards the Growth Project at the Department of Applied Economics. The lecture given by Stone at the *Institut für Siedlungs-und Wohnungswesen der Westfälischen Wilhelms-Universität Münster* adopts a broad perspective on the project, focusing on research issues, practical matters, such as financing and organization, and publications reporting the results of the work. All the elements constituting the model are analysed in detail, in order to offer an accurate overall view of the Growth Project.

160. Introduction to *Inland Revenue Report on National Income, 1929*, Department of Applied Economics, University of Cambridge, 1977

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

In the last part of his academic career, Richard Stone dedicated himself to the study of the origins of quantitative economics. This brief paper serves as a presentation of a reprinted facsimile version of a confidential report on the Inland Revenue prepared for the Chancellor of the Exchequer in 1929. As Stone points out, this document constitutes the first attempt to gather systematic estimates of Britain's national income, based on inland revenue data. It precedes the White Paper prepared in 1941, usually dubbed as the first official estimate of British national income, and therefore its historical importance is relevant to economics. In this introduction, Stone outlines the main features of the 1929 report.

161. Introduction to *Econometric Contributions to Public Policy*, the proceedings of a conference held by the International Economic Association, Urbino, 1976. Macmillan, London, 1978.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000748260]

[Also available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Stone (along with William Peterson) edited the proceedings of an international conference held by the International Economic Association, in Urbino in 1976, on the contribution of econometrics to public policy. The topic was of particular interest to Stone since in his view, recalling a famous phrase by Marshall, proper economics is only an equilibrated mix of theory and application, and the same is true for econometrics, which should help economics to achieve its ends better. In the introduction, Stone praises the contributions, as well stressing the need for a more courageous effort to improve econometrics as an applied, rather than a purely theoretical, science.

It is worth recalling the contribution of Professor Lombardini on regional and urban planning, providing a model suitable for practical application to public policy.

162. Harry Gordon Johnson (obituary). *Annual Report of the Council of King's College, Cambridge*, 1977, pp. 24-26.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This obituary is a tribute to Harry Gordon Johnson, a man that Stone describes as having great energy, being hard-working and passionate, as well as 'a great talker and joker,' although 'On serious matters of opinion he was blunt and

uncompromising, giving in argument as good as he got or better' [162, p. 24]. Interestingly, Stone recalls the disappointments and frictions that Gordon Johnson encountered in the economics environment at Cambridge. However, Stone likes to report that 'he seems to have kept a soft spot for King's' [162, p. 26].

163. Discussion of Professor Abramovitz's paper on rapid growth potential and its realisation: the experience of capitalist economies in the postwar period. Presented at the Fifth World Congress of the International Economic Association, Tokyo, 1977. In *Economic Growth and Resources, Vol. 1, The Major Issues*. Macmillan, 1979, pp. 34-44.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000744834]

This contribution discusses Abramovitz's paper on growth potential and its realisation. In this comment, wide-ranging and detailed, Stone points out two considerations regarding the trends of rapid growth that occurred among industrialised countries after the end of World War II. First, by comparing Abramovitz's data with other sources he shows that the phenomenon was a general, widespread phenomenon, rather than an exceptional feature of industrialized countries. Secondly, there is a time dimension to this general pattern. In fact, not only did growth rates, as measured by output per worker, rise across countries after World War II, but they also increased in an unprecedented way with respect to past realisations of per capita output growth rates. Therefore, Stone stresses the need for a more contextualised analysis of growth trends, capable of incorporating general underlying phenomena, geographical and temporal

1978

164. Introduction to *Towards a Methodology for Projecting Rates of Literacy and Educational Attainment*. UNESCO, Paris, 1978.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Stone was asked to introduce this report on literacy and educational attainment, prepared for UNESCO in 1978. After assessing the importance of understanding and measuring literacy levels and educational attainment, Stone outlines the main methodological issues in producing reliable work on the topic. In particular, Stone

focuses on possible ways to overcome the lack of data availability and stresses the importance of producing consistent definitions and classifications.

165. The disaggregation of the household sector in the national accounts. Paper presented to the World Bank SAM Conference, Cambridge, England, 1978. In *Social Accounting Matrices: a Basis for Planning*, G. Pyatt and J.I. Round (eds.), The World Bank, Washington, D.C., 1985.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Stone's contributions to the development of a System of National Accounts in the early years of his career is certainly well known. However, his later work on national accounting led him to explore possible further disaggregation in order to obtain a more realistic picture of the national economy. The revised version of the national accounts, released by the UN in 1968, incorporated some changes derived partly from Stone's work. In particular, as Stone himself remembers in his interview with Pesaran: 'The principal changes were a distinction between industries and commodities and the introduction of input-output and flow-of-funds tables and of balance sheets. At the time I do not think we could have done more than we did. But looking back I think it was a pity that we did not complete our disaggregation of the domestic sectors by disaggregating households (the consumption account) and discuss the analyses that this would make possible. The UN Statistical Office did take up this question and I returned to it in a paper on the disaggregation of the household sector in the national accounts which I wrote for a World Bank conference in 1978 [165]' [Stone & Pesaran, 1991, p. 95]. This work, mentioned by Stone in his interview, explores the possibilities of further disaggregating the household sector, in order to obtain a more accurate picture of income distribution. The paper, included as Chapter 8 in *Social Accounting Matrices: a Basis for Planning*, by G. Pyatt and J.I. Round (eds.), deals with technical issues concerning the disaggregation of the household sector, developing an appropriate accounting matrix and showing a numerical example.

166. Multipliers for Quesnay's tableau. In *Social Accounting Matrices: a Basis for Planning*, G. Pyatt and J.I. Round (eds.), The World Bank, Washington, D.C., 1985.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This is the Appendix to *Social Accounting Matrices: a Basis for Planning*, by G. Pyatt and J.I. Round (eds.) [165]. It constitutes a follow-up to previous work by

Phillips (1955) and Barna (1975) developing social accounting matrices from Quesnay's original *Tableau*. In particular, Stone illustrates the algebra of the multipliers to be implemented in former models based on Quesnay's *Tableau*, briefly analysing the effect of different stimuli on different accounts.

167. Keynes, political arithmetic and econometrics. Keynes Lecture in Economics, 1978. In *Proceedings of the British Academy*, vol. LXIII, 1980, and separately.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

From the interview of Richard Stone with M. H. Pesaran:

'Given the deep involvement of Keynes in the establishment of the DAE (with the idea of promoting research in the areas of measurement of savings and investment), how do you explain Keynes's adverse reactions to Tinbergen's macroeconomic work on business cycles?'

This is a difficult question to answer. I discussed it at some length in my Keynes lecture to the British Academy in 1978 [167] and perhaps the best thing I can do is to quote from that. Up to a point the explanation may lie in Keynes's state of health. In 1937 he had had a severe heart attack; and the summer of 1938, when he received Tinbergen's proofs, must have been a particularly bad moment for him to be faced with an approach to economics so very different from anything he was accustomed to. But this does not justify the virulence of his remarks. While not pretending to know the full answer to the puzzle, I have three suggestions to offer.

First, Keynes suffered from an irresistible urge to overstate. He recognizes it himself in *A Treatise on Probability* where he says:

In writing a book of this kind the author must, if he is to put his point of view clearly, pretend sometimes to a little more conviction than he feels. He must give his own argument a chance, so to speak, nor be too ready to depress its vitality with a wet cloud of doubt. It is a heavy task to write on these problems; and the reader will perhaps excuse me if I have sometimes pressed on a little faster than the difficulties were overcome, and with decidedly more confidence than I have always felt.

This *caveat* should always be kept in mind when reading Keynes, even though he himself may have forgotten it. Both by temperament and by training he was heir to the great rhetoricians of the nineteenth century. This style has its splendours and its fun, but it also has its dangers, and Keynes seems to me to fall very often

into the trap of overstatement, that it works up the feelings of the writer quite as much as those of the reader.

Second, by the thirties Keynes's mathematics had become pretty rusty. Although he introduced some algebra into *The General Theory*, he did not do it in a way that added much to the argument. And in the Tinbergen review we come across the following passage:

Is it possible that there could be a cyclical fluctuation in a system, all the ultimate independent determinants of which had fixed regression coefficients and were in linear correlation with their consequences, except in the case where one of the ultimate determinants is itself a periodic function of time (*e.g.*, sun-spots)? Where and how does the element of *reversal* come in?

He had forgotten the equation describing the motion of a simple pendulum which, as Jeremy Bray has pointed out, appeared in part I of the mathematical tripos examination for 1905. In fact, Keynes never seems to have relied much on his mathematics and when it came to econometrics he can hardly be said to have been conscious of doing any. As a consequence, the subject was one on which his judgment seems to have been uncertain and he tilted at knights and windmills alike with the gusto of a Don Quixote.

Third, in my experience, Keynes' reaction to anything new was to look for the weak spots and shoot them full of holes. This was not the end of the matter but only a way of gaining time, as he usually thought things over and either came up with some really good arguments or changed his mind. In the latter case he seldom said so in so many words, but one discovered that the insuperable objections to the frightful rot one had been talking the other day had somehow melted away and were never mentioned again.

It is my belief that in the end his views had changed considerably. I remember him saying to me towards the end of the war *à propos* of something I had submitted to *The Economic Journal* that he had touched up the text a bit but left my nefarious econometrics alone. But by then this was a joke which no one could possibly have resented.

I think, in fact, that by then he had become clearer in his mind about his own position *vis-à-vis* econometrics. In the middle of 1943 Alfred Cowles wrote to him expressing the wish of the Council of the Econometric Society that he would accept the presidency. Keynes was evidently pleased to be asked but a little hesitant, since under wartime conditions he did not think there would be very much that he could do and, as he continued in his reply, "whilst I am interested in econometric work and have done something at it at different times in my life, I have not recently written anything significant or important along these lines, which would make me feel a little bit of an impostor." However, he did accept the

presidency and held it through 1944 and 1945, by which time all his asperity toward econometrics seems to have evaporated. In his last letter to Cowles, dated 23 July 1945, he recounts his extreme satisfaction at renewing contact with Tinbergen, who had been visiting England and whom he had entertained in Cambridge. "I felt once more," he writes, "as I had felt before, that there is no-one more gifted or delightful or for whose work one could be more anxious to give every possible scope and opportunity." This sounds to me like the authentic Keynes and deserves to be remembered more than the incident of 1939' [Stone & Pesaran, 1991, pp. 97-99].

168. Input-output analysis and economic planning: a survey. Paper presented at the International Symposium on Mathematical Programming and Its Economic Applications, Venice, 1978. In *Mathematical Programming and Its Economic Applications*, Angeli, Milan, 1981.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742768]

This paper was presented at the *International Symposium on Mathematical Programming and Its Economic Applications* held in Venice in 1978. The purpose of the conference, promoted by the Faculty of Economics of the University of Venice and supported by several Italian academic and non-academic institutions, was to favour the circulation of new ideas to further the development of mathematical programming within economics. Stone was invited as a lecturer to outline the recent developments in input-output analysis with special emphasis on economic planning applications. Stemming from his deep knowledge and mastery of input-output techniques and from the practical application to the development of the Growth Model at Cambridge, this paper provides a detailed illustration of the strategy needed to construct an economic model for economic planning. In this strategy, the role of input-output analysis is pivotal, as it permits identification and analysis of the impact of different parameters on the changes occurring in the economic relationships summarised by the model. The presentation starts from the Social Account Matrix, which constitutes the basis of the whole model. Then it illustrates in detail the relationships to be analysed in the model and technical problems of calculation and estimation. There is also a thorough survey of existing applications outside Britain, highlighting the original specific contribution of each different model. The survey focuses mostly on contributions to input-output analysis but it also represents a further summary of the work done by Stone and colleagues at Cambridge within the Project of Growth.

169. Jacob Marschak, 1898-1977 (obituary). *Journal of the Royal Statistical Society, Series A (General)* **142 (1979): 80-81.**

[Access the article via JSTOR: <http://www.jstor.org/stable/2344674>]

Stone writes here on Marschak, an Ukranian-born eclectic economist. The first part of his career was dedicated to the study in the field of economics with a strong interest in statistics and econometrics. After the outbreak of World War II he began to move towards different areas of interest, especially in the fields of organization theory and choice under uncertainty. Therefore, Stone sums him up as 'one of the great behavioural scientists of his time' [169, p. 80].

170. Tribute to Luigi Solari. Address presented to the European Meeting of the Econometric Society, Geneva, 1978. In *Qualitative and Quantitative Mathematical Economics*, J.H.P. Paelinck (ed.), Nijhoff, The Hague, 1982.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742377]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This brief essay is a tribute to Luigi Solari who, all of a sudden, died (he was 45) less than a year before the European Meeting of the Econometric Society was held in Geneva in 1978. He was expected to be in the chair for the conference programme, so Stone delivers a brief but warm address in honour of his friend.

Luigi Solari is remembered by Stone as a brilliant scholar. He received his graduate education from several universities across Europe: Munich, Geneva and Paris, where he learnt econometrics from René Roy and Edmond Malinvaud. In 1963 he was appointed professor of econometrics in Geneva, 'the first chair in the subject in Switzerland' [170, p. 3] as Stone underlines. Solari was also involved in other research centres: the Research Centre of the Faculty of Economic and Social Sciences at Geneva (from 1958) and the Econometric Centre at the same university which he founded in 1966 and directed until it was incorporated into the university department in 1968. Solari's intensive research as well as his widespread interpersonal network helped to increase the reputation of the university, and in 1968 he became vice-dean and eventually, in 1971, dean of his Faculty. His contribution at the University is elegantly summarised by Stone as follows: 'As a teacher and researcher Solari was characterized by his broad interests, his great knowledge, which he was always seeking to extend, and his inspiring personal example. If he expected much from others it was clear that he expected much from himself. He had a passion for economics and for making it a

reliable, practical tool. He wanted his students and assistants to see his vision, discuss it with him and help in the task of improving and advancing it' [170, p. 4].

The core of the tribute is dedicated by Stone to the brief review of three books by Solari that Stone believes illustrate the wide breadth of his research interests. The books are: *Modèles et décisions économiques: sur les fondements de l'économie pure*; *Théorie des choix et fonctions de consommation semi-agrégées: modèles statiques*; *De l'économie qualitative à l'économie quantitative: pour une méthodologie de l'approche formalisée en science économique*. Stone describes Solari as a great econometrician but cannot avoid a note of disappointment: 'It is a matter of great surprise and regret to me that Solari never became a fellow of our Society. When I consider all he did for econometrics, both through his writings and through his establishment of the centre at the University of Geneva, I can only think that there must be something defective in our methods of election. It is not that he was never proposed: I proposed him myself in 1970 and eventually his name was put forward by the nominating committee. But there the matter ended' [170, p. 6-7]. The importance of Solari's contribution was eventually acknowledged by the French government which, a short time before he died, awarded him the title of *Chevalier dans l'Ordre des Palmes académiques*. In his concluding note, Stone likes to remember Luigi Solari as 'a warm-hearted man, a passionate scholar and a good friend' [170, p. 7].

[Quotations: offprint]

171. Can matrix multipliers be decomposed in the general case? Unpublished manuscript.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

172. Where are we now? A short account of the development of input-output studies and their present trends. Paper presented at the Seventh International Conference on Input-Output Techniques, Innsbruck, 1979. In *Proceedings of the Seventh International Conference on Input-Output Techniques* (ed. UNIDO), UN, New York, 1984. Russian translation: *Economics and Mathematical Methods XV (1979): 1094-1109*. Hungarian translation: *Statisztikai Szemle 63 (1985): 555-570*.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This paper is a further survey of the developments in input-output analysis, following [152] and [168]. The survey covers the basic conceptual issues and technical problems, the relevant literature being analysed in detail. The survey

addresses also the issue of income distribution, not of concern to many scholars at the time but of great interest to Stone.

173. Sigmoids. Opening address to the Royal Statistical Society Conference Oxford, 1979. *Bulletin in Applied Statistics (B.I.A.S.)* 7 (1980): 59-119.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

In this work, Stone reviews the use of sigmoids, particularly useful functional forms appropriate to proxy 'relationships in which the dependent variable is confined between lower and upper bounds and commonly moves monotonically from one to the other as the independent variable ranges from indefinitely low to indefinitely high values' [173, p. 59]. The paper deals with the forms of the most common types of sigmoid (i.e logistic) and the methods of estimation, and finally provides some examples of possible applications taken from different branches of science.

174. *Aspects of Economic and Social Modelling*. Lectures delivered at the University of Geneva, 1979. Droz, Geneva, 1981.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000100237]

The book contains a series of 16 lectures given by Richard Stone in the summer of 1979 at the University of Geneva. That same year, the Department of Econometrics, University of Geneva, launched the 'Conférences Luigi Solari', in honour of the first professor of econometrics to teach this discipline in Switzerland.

The conferences, held every year without interruption since 1987, have seen the participation, as guest speakers, of many famous economists and econometricians.

In 1987 Richard Stone himself, who had dedicated to his friend the 'Tribute to Luigi Solari' on the occasion of his premature death, was invited to give a lecture at the conference entitled 'Some seventeenth century econometrics : consumers' expenditure'.

As the title of the volume suggests, the book is not intended to be a comprehensive and systematic treatise on econometric models, but rather a set of ideas, notes and suggestions from the experience of the author.

The first 8 lectures are devoted to the classical econometric models, including the input-output model.

The following two lectures introduce the Cambridge Growth Project in its static (chapter 9) and dynamic (chapter 10) versions. Subsequent lectures cover some technical problems and the crucial issue of introducing social, demographic and environmental factors into economic models.

The last lecture is dedicated to sigmoid curves, where the dependent variable moves in a regular manner within precise limits. According to Stone, sigmoid curves, as well as presenting elegant formal properties, find their major use in the field of economic analysis.

1980

175. A simple growth process tending to stationarity. *The Economic Journal* 90 (1980): 593-597.

[Access the article via JSTOR: <http://www.jstor.org/stable/2231929>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

The paper describes a simple growth model which leads, contrary to the multiplier-accelerator model, to a stationary state.

Stone gives credit to Solow [R. M. Solow, A contribution to the theory of economic growth, *Quarterly Journal of Economics*, Vol. 70, No. 1, 1956, pp. 65-94] for his contribution in this field:

‘An essential step in this direction was taken many years ago in Solow [1956] which set out a model with a bounded capital-labour ratio. This result depended on an endlessly growing labour force, and so capital, output and the other economic variables also grew endlessly. I shall now give the eight equations of a simple growth model and derive a version of Solow’s result from them before developing the fully stable solution’ [175, p. 593].

176. The relationship of demographic accounts to national income and product accounts. Paper presented to the SSRC Workshop on Social Accounting Systems, Washington, D.C. 1980. In *Social Accounting Systems: Essays on the State of the Art*, F. Thomas Juster and Kenneth C. Land (eds.), Academic Press, New York, 1981.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742285]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Stone remembers the invitation to SSRC Workshop on Social Accounting Systems, Washington, as one of the few occasions in which his efforts to develop a system of social and demographic statistics (SSDS) were considered by international academics. The paper provides a thorough, detailed illustration of the SSDS, explaining both conceptual and methodological aspects of the model.

Stone remembers:

‘In academic circles, the SSDS was well received by a group of American sociologists who knew of my earlier work in this field, and earned me an invitation to a very interesting conference in Washington [176]. But with this and a few other exceptions it was ignored. I think it fell between three stools, that is, between the three specialisms of economics, demography, and sociology’ [Stone & Pesaran, 1991, p. 109].

177. The adjustment of observations. Unpublished manuscript.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

178. Whittling away at the residual: some thoughts on Denison’s growth accounting. A review article. *Journal of Economic Literature* XVIII (1980): 1539-1543.

[Access the article via JSTOR: <http://www.jstor.org/stable/2724061>]

This article reviews Denison’s book on growth accounting. The review focuses on the main claim Denison makes, namely that there is a possibility of ‘whittling away’ the residual from growth accounting estimation. The residual in growth accounting has given rise to an intense and wide discussion in economic literature. Stone supports Denison’s view but believes that it needs refinement: the residual in growth accounting must be estimated, as analogously happens in national accounting.

179. Political economy, economics and beyond. Royal Economic Society, Presidential Address, 1980. *The Economic Journal* 90 (1980): 719-736.

[Access the article via JSTOR: <http://www.jstor.org/stable/2231739>]

In this essay Stone gives an overview of the development of economics during the past hundred years. Rather than providing a mere historical reconstruction, Stone offers a critical review of the most influential contributions in the field of applied economics, also known in the past as Political Economy. Stone's purpose is both positive and normative. On the one hand he aims to rediscover the original definition of Political Economy as the study of economic phenomena in relation to all other aspects of social life; on the other hand, the progress in this field ought to be an aid to improvement of social life itself. Notwithstanding a widespread pessimism on the usefulness and effectiveness of economics, Stone shows open optimism since, in his opinion, economic science has improved impressively in the last decades. In fact he notes: 'The vast amount of research in economic theory, in econometric and statistical methods and in all branches of applied economics has borne fruit: the younger generations of economists are technically streets ahead of mine, the gap between the a priori and the empirical seems to me to have narrowed considerably, and the tools on offer to the policy-maker are getting more and more sophisticated' [179, p. 732].

180. A marital status transition matrix: England and Wales, 1972, males. Unpublished manuscript.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

181. Model design and simulation. *Economic Modelling* 1 (1984): 3-23.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This paper explores the advantages of simulation for 'solving the equations of large econometric models' [181, p. 3]. Given the increasing complexity of model-building, since more and more sophisticated equations are included to increase realism, a solution cannot be expressed in the traditional way, in terms of an elementary 'snapshot' function. The extensive use of simulation, strongly encouraged by Stone in the paper, allows exploration of several different solutions, expanding the possible interpretation of the models. These techniques

require a mastery of econometrics and availability of a powerful digital computer, both being increasingly common among economists in the early 1980s.

182. Random shocks in a simple growth model. *Economic Modelling* 1 (1984): 277-280.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

In this brief paper the variables utilised in [181] are further explored. In particular, attention is given to the inclusion of random shocks into the models.

1981

183. Balancing the national accounts: the adjustment of initial estimates – a neglected stage in measurement. In *Demand, Equilibrium and Trade*, A. Ingham and A.M. Ulph (eds.), Macmillan, London, 1984.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000745333]

In this work Stone addresses the problem of accuracy of measurement. Notwithstanding a great improvement in data collection by statistical offices, as Stone points out, ‘national accounts contain statistical discrepancies, residual errors, unidentified items and other balancing entries, evidence of the difficulties arising from the fact that the information available is in some degree incomplete, inconsistent and unreliable’ [183, p. 191]. After reviewing some previous attempts made by himself and his colleagues at Cambridge to deal with adjustment, Stone outlines some possible methodologies and illustrates an application to a set of 14 accounts for Britain over the period 1969-1979. As Stone recalls in the interview with Pesaran, ‘Although these [accounts] were balanced one year at a time and not as a single operation, the results were reasonably satisfactory’ [Stone & Pesaran, 1991, p. 110].

184. The international harmonisation of national income accounts. *Accounting and Business Research* 12 (1981): 67-79.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This paper contains an historical reconstruction of the development of an international standard in national income accounts, one of the most renowned consequences of Stone's work as an economist. The paper explains in a straightforward style the way international accounts are constructed, providing examples and tables and highlighting the most important achievements in the field as well as possible future extensions and further refinement.

185. Life profiles and transition matrices in organizing sociodemographic data (appendix to "Active life profiles for different social groups" by Dudley Seers). In *Economic Structure and Performance*, Academic Press, San Diego, 1984.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

This brief and intensively technical contribution constitutes the Appendix to a collection of essays on the modelling of economic structure. The Appendix shows the technical procedures necessary to organize socio-demographic data for national accounting, in which the careers of residents are taken into account (with reference to their educational and work attainment). In particular, Stone outlines a technical procedure to relate the two main methods for organizing socio-demographic data, i.e. 'life profiles' and 'transition matrices', and provides a numerical example in order to assess the actual equivalence of the two methods.

186. Working with what we have: how can existing data be used in the construction and analysis of socio-demographic matrices? *The Review of Income and Wealth*, series 28, no. 3 (1982), 291-303.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747299]

Stone's last professional efforts were dedicated to the development of the System of Social and Demographic Statistics (SSDS), an analogue of the national account system which includes data about population, education, health and environment. One of the most common objections to this framework was the enormous amount of data required to construct it. As Stone puts it: 'It is often said that the System of Social and Demographic Statistics (UNSO, 1975), and similar proposals for organizing socio-demographic data require an inordinate amount of statistical information, in particular information about human flows, and so cannot be implemented except where data have been specially collected for the purpose' [186, p. 291]. Therefore, the paper outlines a possible solution which includes the estimation of the initial values of the variables and a test of the reliability of these estimates. The strategy considers an adjustment process once

the estimates are implemented. However, Stone himself realises that practical problems arise as regards the best way to apply the adjustment procedures, 'because of the difficulties of stating exactly what we think we know **and** do not know about the direct estimates' [186, p. 303].

1982

187. How accurate are the British national accounts? In *Specification Analysis in the Linear Model*, Maxwell L. King and David E.A. Giles (eds.), Routledge and Kegan Paul, London, 1987.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742303]

This work represents a further extension of [183]. In the first part, Stone outlines the main features of his former work on adjustment procedures for social accounts. Then the rest of the work is dedicated to the illustration of the techniques to assess the reliability and accuracy of the adjustments made. In particular, following Stone's rationale, the work does not focus on abstract theoretical problems; rather it provides an evaluation of the British national accounts which he developed in [183]. Essentially, the main technique is based on applying the least-squares method to estimate current (or future) values from past observations.

1983

188. Accounting matrices in economics and demography. In *Mathematical Methods in Economics*, F. van der Ploeg (ed.), Wiley, New York, 1984.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000743521]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This essay provides a didactic illustration of accounting matrices for economics, to be applied both to economic and demographic data. The dissertation is built upon Stone's life-long work on the topic and reveals his mastery of input-output analysis as well as his ability to provide simple and detailed explanations about it.

1984

Sir Richard Stone was awarded the Nobel Memorial Prize for Economics in 1984 for 'having made fundamental contributions to the development of national accounts and hence greatly improved the basis for empirical economic analysis'.

189. Two populations and their economies (with M. Weale). Paper presented at the Annual Conference of the Regional Science Association, Canterbury, 1984. In *Integrated Analysis of Regional Systems*, P.W.J. Batey and M. Madden (eds.), London Papers in Regional Science 15. Pion, London, 1986.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This work, written together with M. Weale, is an attempt to develop an input-output model which incorporates both demographic and economic variables. The model represents one of the most sophisticated outcomes of research that dates back to the development of the growth model at Cambridge. As distinct from most of Stone's previous work, this contribution is essentially theoretical and presents, as an example, an application implemented with artificial and arbitrary data. The main purpose of the framework is to account simultaneously for different kinds of variables within a unique complex system of economic and demographic transactions.

190. Robert Malthus. Address to Conference of the British Society for Population Studies, Cambridge, 1984. In *The State of Population Theory*, D. Coleman and R. Schofield (eds.), Blackwell, Oxford, 1986.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000742284]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This essay contains Stone's tribute in honour of Malthus, who he assesses as a person and as an economist. This address was read at the Conference of the British Society for Population Studies in Cambridge.

191. The accounts of society. Nobel Memorial Prize Lecture, 1984. In *Les Prix Nobel 1984*, Almquist and Wicksell International, Stockholm, 1985, reprinted in *Journal of Applied Econometrics* 1 (1986): 5-28.

[Access the article via JSTOR: <http://www.jstor.org/stable/2096535>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

In this lecture for the Nobel Memorial Prize in 1984 Stone recalls his work on accounting. He describes the conceptual and philosophical foundations of his work, the whole framework of his analysis and the process of its construction. This framework results in a complex set of interrelations that he has thoroughly analysed during his professional life. Stone's view of economics as a science that should guide policy-making comes through clearly. At the beginning of the lecture, Stone outlines the core features of his analysis of society, enunciating what he calls the pillars (see [142]): 'the studies of economic, socio-demographic and environmental phenomena' [191, p. 5]. Although the last of these is only briefly mentioned in Stone's late works, and he did not succeed in convincing international academics about the usefulness of the second, it is his contribution to the first one which constitutes Stone's greatest achievement and which won him the Nobel Prize in 1984.

[Quotation: *Journal of Applied Econometrics*]

192. Richard Stone (an autobiographical sketch). In *Les Prix Nobel 1984*, Almquist and Wicksell International, Stockholm, 1985.

http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1984/stone-bio.html

[Also in [198], pp. 429-439]

1985

193. Foreword to *Materials for a Balance of the Soviet National Economy, 1928-1930* (transl. and eds. S.G. Wheatcroft and R.W. Davies). Cambridge University Press, 1985.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

Asked to write the foreword to *Materials for a Balance of the Soviet National Economy, 1928-1930*, Stone highlights the great interest of the publication for at least two reasons: from a historical perspective, 'it shows the kind of information

available as a basis for planning during an important period which saw the unfolding of the first Five-Years Plan, the intensification of the drive towards industrialisation and the introduction of collective farming'; from an economic perspective 'it shows the progress made in Russia during the 1920s towards the construction of national accounts' [193, p. ix]. Stone seems to admit being fascinated by the huge effort made by Russian officials at the time to gather the statistical information contained in the book. His foreword is a tribute to this effort, which he sees as part of the progress from ideas developed first by the Political Arithmeticians, then Quesnay, Karl Marx and finally organised according to modern criteria within the System of National Accounts in the 1950s. In particular, Stone recalls the main contributions of each of them: 'with the political arithmeticians the idea of national economic balances was first conceived [...]. With Quesnay we have an explicit recognition of the interdependence of economic flows and a rudimentary planning scheme [...]. With Marx we have a working dynamic model' [193, pp. xvii-xviii]. Finally, acknowledging the outstanding contributions of Leontief and Clark to the development of the SNA, Stone concludes with a concise comparison of the SNA and the Material Production System (MPS) developed by Russian officials, keenly underlining the main conceptual differences, rooted in different visions and concepts of the economic system.

194. James Alan Calvert Brown: an appreciation. *Oxford Bulletin of Economics and Statistics* 47 (1985): 191-197.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This tribute to James Alan Calvert Brown contains a detailed survey of his main field of research and a mention of the most important biographical events in his life. Interestingly, Brown spent a long time at the Department of Applied Economics in Cambridge, an opportunity which led him to switch to an academic career and to co-operate with Stone in the development and the refinement of the socio-economic model, especially on the issue concerning consumers' behaviour.

195. Entries on: the Matrix Multiplier; R.G.D. Allen; A.L. Bowley; R.C. Geary; M.G. Kendall; E. Rothbarth; and J.C. Stamp. In *The New Palgrave*, Macmillan, London 1987.

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000073884]

These entries in *The New Palgrave* follow the contributions in *Chambers' Encyclopaedia* [119] and *Encyclopaedia of Linguistics, Information and Control* [132]. The style, as usual, is precise and concise.

1986

196. Social accounting: the state of play. *The Scandinavian Journal of Economics* 88 (1986): 453-472.

[Access the article via JSTOR: <http://www.jstor.org/stable/3440380>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

As Stone himself states at the beginning, the paper is a continuation of [191], but here the focus is on 'some of the important problems which are likely to occupy the attention of social accountants in the coming generation' [196, p. 453]. Much attention is devoted to the questions of data collection and availability, procedures of adjustment, changes in the classification of the output, disaggregation of the household sector, issues concerning capital accounting, and discussion about the inclusion of pollution and socio-demographic variables in current Social National Accounting.

197. Progress in balancing the national accounts. In *National Income and Economic Progress*, D. Ironmonger, J. Perkins and Tran Van Hoa (eds.), Macmillan, London, 1988.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This brief essay in honour of Colin Clark, who was Stone's teacher at Cambridge, outlines the progress made by statistics and econometrics in providing techniques to solve the problem of adjustment of national accounts. The paper is intended to honour the memory of Colin Clark, who, according to Stone, provided the foundations for tackling the issue. Therefore, Stone's exposition is mainly bibliographical and, after demonstrating what has been achieved, he draws attention to remaining issues, rather than providing or suggesting possible solutions.

198. Some British empiricists in the social sciences. Mattioli Lectures, 1986. To be published in expanded form by the Banca Commerciale, Milan.

[Different quotation:

198. *Some British Empiricists in the Social Sciences 1650-1900*. Mattioli Lectures, delivered by Richard Stone at the Università Commerciale Luigi Bocconi, Milano, October 1986. Edited by A. M. Cardani and G. Stone, and published posthumously. Cambridge University Press, Cambridge, 1997.]

[Available at BUL, see: http://lumen.sbu.usi.ch/bul:bul_aleph000745354]

Richard Stone has always been interested in the history of economic thought, more specifically in the pioneering works of the political arithmeticians.

Pasinetti [1992, p. 118] recalls how this volume has taken shape:

‘In October 1986 he was invited to Milan to deliver the Mattioli Lectures on history of economic thought. He seized this opportunity for collecting all his notes, remarks, reflections and speculations on the subject. The lectures carried the title ‘Some British Empiricists in the Social Sciences’, and represented a remarkably wide review, ranging from the seventeenth century to the beginning of the twentieth, of the contributions to political arithmetic, economic statistics, demography and quantitative social studies, of a well-chosen set of British empiricists. They took the form of beautiful vignettes concerning in succession: William Petty, Gregory King, Charles Davenant, William Fleetwood, Arthur Young, Patrick Colquhoun, John Graunt, Edmond Halley, William Farr, Fredric Morton Eden, Florence Nightingale, Charles Booth.

These lectures – of which a written text was available at the time they were delivered – have remained unpublished. They were to be expanded, each chapter being devoted to one of his twelve characters, and in his last years Stone worked at this task as hard as his failing health permitted. At the time of his death the first nine chapters were already at proof stage; the last three were almost finished. Giovanna Stone tells me (and I gratefully acknowledge all the information and suggestions she has kindly given me) that she is doing the final work necessary to complete them for publication. When they appear I am sure the world community of economists, econometricians and social scientists will be extremely grateful to her’.

Giovanna Stone anticipates the contents of the volume in a communication sent to the International Conference in Memory of Sir Richard Stone held in the Certosa di Pontignano, Siena, Italy, October 17-20, 1993:

‘The idea of actually writing a book about it arose from an invitation he received from the Banca Commerciale Italiana to deliver the 1986 Mattioli Lectures and

subsequently expand them into a book. The underlying theme of these lectures, which are an annual event, is the history of economic thought, and my husband chose as his topic twelve pioneers of economic, demographic and social statistics in England from the seventeenth century to the end of the nineteenth. They are a very diverse and in some cases surprising lot. I shall list them in order of appearance.

William Petty, a typical representative of what was perhaps the most exciting period in the history of English science: physician, surveyor, cartographer, writer on economic and demographic matters, naval engineer, founding Fellow of the Royal Society and, above all, originator of the national accounts.

Gregory King, officially a herald, unofficially a one-man central statistical office; besides his well-known *Natural and Political Observation of England*, the mass of economic and demographic statistics that fill his one surviving notebook, dated 1695, is staggering.

Charles Davenant, publicist and Member of Parliament, who made a special study of public finance; his other claim to fame is that he may have been a grandson of Shakespeare, his father William D'Avenant, the playwright, being rumoured to have been an illegitimate son of the poet.

William Fleetwood, a liberally minded and politically active bishop of the Church of England, who in 1707 devised the first index-number of prices.

Arthur Young, one of the principal protagonists of the English agricultural revolution of the eighteenth century, who constructed the first production accounts based on value added.

Patrick Colquhoun, cotton merchant, magistrate, writer on poverty and crime, who drew up the accounts of the British Empire at the end of the Napoleonic Wars.

John Graunt, a London draper, whose *Observations upon the Bills of Mortality*, published in 1662, is recognised as the foundation of demographic statistics.

Edmond Halley, the astronomer, who calculated the first scientifically-based life table to oblige a friend.

William Farr, a doctor turned statistician, who in his long career at the General Register Office brought vital statistics to a high degree of excellence; he was a vigorous campaigner for public hygiene, and one of his campaigns resulted in the disappearance of cholera from England.

Frederick Eden, a humanitarian nobleman, who carried out the first large-scale quantitative survey of poverty in England.

Florence Nightingale, a reluctant member of what might be called the Victorian jet set, who transformed not only the civilian hospital service but also the living conditions of the British soldier in war and in peace.

And finally Charles Booth, a Liverpool shipping magnate, whose seventeen-volume survey of the London poor marked an important step towards the Welfare State.

In the book each of these characters has a chapter to him or herself. Each chapter opens with a pen portrait, followed by an account of the protagonist's contributions to statistics illustrated by a number of tables. When my husband died he had finished the first nine chapters, in fact they were already in proof. The last three were unfinished, but he had carried them far enough for me to think I could complete them. I had followed his work closely and knew his intentions. The substantive parts, including the tables, were all there, and all I had to do was to provide some of the connecting links. This I have done, and the last three chapters are now with the printers. The book, which is entitled *Some British Empiricists in the Social Sciences*, is part of a series published by the Banca Commerciale under the imprint of the Cambridge University Press and is due to appear, with luck, next year'.

1987

199. When will the war end? *Cambridge Journal of Economics* 12 (1988): 193-201.

[Access the article via JSTOR: <http://www.jstor.org/stable/23597105>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This brief essay focuses on war finance, in very practical terms, as it is based on the personal experience of Stone in helping James Meade to produce economic tables when he was serving in the War Cabinet in 1940. The essay includes an interesting historical comparison between the analysis by Stone and Meade and Gregory King's study compiled for the years 1688 and 1695. Stone recalls this brief essay in his interview with Pesaran:

'In 1987 James Meade had his eightieth birthday and in the course of the celebrations I gave a talk about the finance of the War of the League of Augsburg as estimated by Gregory King in 1695 [199]; not so odd a subject as it may sound, since it was the problems of war finance that had brought James and me together in 1940. I ended with a comparison of war finance and expenditure in England

over the periods 1689-1698 and 1939-1945. It turned out that King's war, had it lasted to 1698 (it actually ended in 1697), would have cost, reckoned at 1938 prices, £ 2.29 per head per annum, or about *one-tenth* of the corresponding national income per head; whereas our war cost £ 47.07 per head per annum, or over *one-third* of the corresponding national income per head' [Stone & Pesaran, 1991, p. 111].

200. Some seventeenth century econometrics: consumers' expenditure. Solari Lecture, 1987. *Revue européenne des sciences sociales XXVI (1988): 19-41.*

[Access the article via JSTOR: <http://www.jstor.org/stable/40369768>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This paper, prepared for a lecture in honour of Luigi Solari, who shared with Stone interest in consumer behaviour modelling, gives Engel curves for ten groups of consumers' expenditure at the end of the seventeenth century. Data are taken from Gregory King's notebook. Through this historical exercise Stone intends to show how far back in the past the roots of econometrics can be traced.

1988

201. Some seventeenth century econometrics: public finance. Lecture for the Ninth Centenary Celebrations of the University of Bologna. *Revue européenne des sciences sociales XXVII (1989): 5-32.*

[Access the article via JSTOR: <http://www.jstor.org/stable/40369799>]

[Also available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This short essay illustrates an historical analysis of public finance for the Seventeenth Century in England. Stone uses data from Petty, King, and Davenant, highlighting some different aspects of public finance. As in [200], Stone shows that quantitative economics is not a 20th century invention, rather an idea which goes back about three hundred years.

202. Adjusting the national accounts. Lecture presented at the Central Institute of Statistics, Rome, September 1988. To be published.

[Available at BUL as offprint, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This manuscript, presented at a statistical conference in Rome, addresses a particular practical problem related to the construction and actual calculation of national accounts. As emerges in most of his works on national accounting, Stone was very concerned with the issue of reliability of national statistics. In fact, the reliability of computational models and related accounts depends on accurate measurement of input variables. However, notwithstanding the notable progress made in the field by the early 1980s, Stone argues that incompleteness, partial inaccuracy, inconsistency and unreliability of statistical information cannot be totally eliminated. Therefore, it is necessary to improve the methods of adjustment in order to increase reliability in developing national accounts. In this paper, Stone presents an application to adjustment using the least squares method, first developed in the 19th century, but only in recent times applied to the field of economic statistics. Interestingly, Stone chooses to address the issue in Rome, at the Central Institute of Statistics which he will later on praise for the advanced and - according to Stone - accurate techniques of adjustment it implemented for Italian national accounts.

203. The national accounts today and tomorrow. *Rivista di Politica Economica* LXXIX (1989): 3-38.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

This paper was originally presented by Stone at a conference held at Banco di Sicilia on 3rd October 1988, by invitation of Professor Giannone. It addresses the state of the art on national accounting, providing insights into possible future developments. The paper covers the revised SNA as well as the further revision process on-going from 1975. Stone highlights the great progress made in national accounting by most developed countries. Some problems remain partially unsolved, in particular relating to data reliability and consistency. He suggests some possible solutions and interestingly he praises the Italian statistical bureau, ISTAT, for being the only organisation at that time adopting the method he considers the most reliable for adjusting and correcting data based on preliminary estimates. However, the core issue, according to Stone, is the ability to extend national accounting to all the three pillars of the complete system: economic, socio-demographic and environmental accounts. Economic accounts are arguably the most developed and widespread and the challenge for the future is the

eventual harmonisation between different systems of accounting being used by countries and international organisations. Socio-demographic accounts are improving but still remain unapplied on a regular and comprehensive basis. Finally, Stone appears disappointed by the fact that, notwithstanding increasing pollution as well as consciousness of the problems it causes, environmental accounts are not developed at all, and only a few embryonic applications can be found at the United Nations Statistical Office. These final conclusions lead Stone to claim that a lot of work has still to be done to improve statistics in the field of national accounting.

1989

204. The theory of games revisited. To be published in the centenary volume of the Royal Economic Society.

[Different quotation:

204. The theory of games revisited. Published in *Economic Journal* Special Issue Centenary Volume of the Royal Economic Society (1990).]

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

One of Stone's very last works, focused on Game Theory, surveying the origin of the concepts and ideas (dating back to Von Neumann and Morgensten in 1947), and illustrating their main functioning and providing examples of applications in a broad set of branches of economics. This work, organised as an introductory handbook to game theory, highlights the increasing importance of this methodology in social sciences, and praises it especially for having 'raised the discussion on what is "rational" from after dinner conversation to something that serious people can take seriously' [204, p. 226].

205. Professor Sir John Hicks (obituary). *The Caius: The Annual Record of Gonville and Caius College, Cambridge*, November 1989, pp. 100-105.

[Available at BUL as photocopy, see: http://lumen.sbu.usi.ch/bul:bul_aleph000747303]

The contributions of John Hicks to economics have undoubtedly been huge. Therefore, in this obituary, Stone surveys his major works concisely, recalling the time he spent at Caius (Stone's college also), as the first economics fellow to be appointed there. Some years later Hicks was appointed to a lectureship in

Cambridge, at a time when the debate around Keynes' ideas was particularly harsh. With regard to this, Stone subtly notes that 'As a newly-married man I like to think he was also happy in spite of being caught up in the quarrels between the Keynesians and the anti-Keynesians which had already begun. He had come to Cambridge with the support of Pigou and Dennis Robertson and was consequently assigned to the anti-camp' [205, p. 101]. This led to his famous work *Mr Keynes and the classics* (1937), notwithstanding which, Stone notes, 'Keynes himself wrote that he found it interesting and really had nothing to say by way of criticism' [205, p. 102]. Having surveyed the rest of Hicks's noteworthy career, Stone concludes by recalling his major awards (including the Noble Prize in 1972), and remembering him as a modest and friendly man, talented, with wide cultural interests, fond of poetry (especially Dante Alighieri) and with a strong character.

1990

[Not included:

206. Public economic policy: Adam Smith on what the state and other public institutions should and should not do. Paper presented at the Conference for the bicentenary of Adam Smith's death, Edinburgh, July 1990. Published in *Adam Smith's Legacy*, Routledge, London, New York (1992).]

[Available at BUL]

This is Sir Richard Stone's last presentation of a paper, and it was published after his death. The occasion arose at the conference for the bicentenary of Adam Smith's death, which caused a number of Nobel prize-winners to gather in Edinburgh to discuss the legacy of the Scottish philosopher to the development of modern economics. Stone's contribution concerns public policy and Smith's idea of the role of government in the economic system. Showing lucid and deep understanding of Smith's work, Stone highlights his central ideas on taxation and expenditure by relating them to the more general conceptual framework of the philosopher.

1991

Richard Stone died in Cambridge on 6 December 1991.

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Appendix to Year 1962 – The History of the Cambridge Growth Project

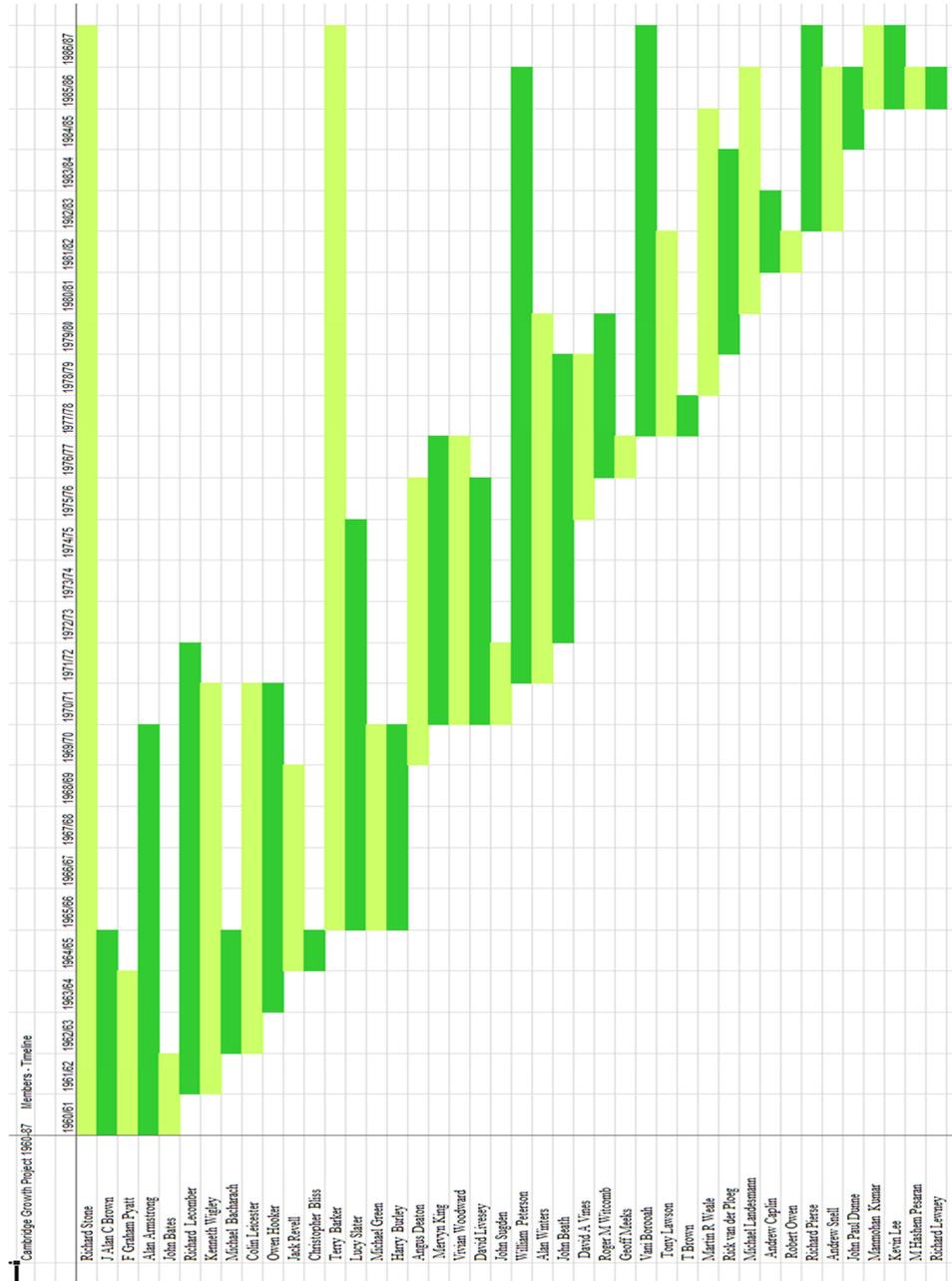
[source: the Cambridge Growth Project (CGP) Catalogue in The Marshall Library, University of Cambridge]

CGP publications/papers statistics (1960-87)

	Books	Journal Articles	Book Selections	Conference papers	Unpublished papers	Totals
Richard Stone	32	45	40	31	44	192
Alan Brown	1	2			45	48
F Graham Pyatt	1				14	15
Alan Armstrong	1	1	1		20	23
John Bates					36	36
Richard Lecomber	3	1	1	1	34	40
Kenneth Wigley	1	2	2	1	18	24
Michael Bacharach	1				12	13
Colin Leicester	2				13	15
Owen Hooker					47	47
Jack Revell	1	1			3	5
Christopher Bliss					3	3
Terry Barker	3	61	29	50	102	245
Lucy Slater	7				26	33
Michael Green					18	18
Harry Burley					1	1
Angus Deaton	3	11	4	5		23
Mervyn King	3	7	3	7	9	29
Vivian Woodward		1	1		36	38
David Livesey	1	7	3	5	15	31
John Sugden					4	4
William Peterson	1	4	10	19	70	104
Alan Winters		3	9	7	21	40
John Beath			1	5	23	29
David A Vines		1		1	7	9
Roger M Witcomb				1	3	4
Geoff Meeks		2	2			4
Vani Borooah	1	11	9	15	23	59
Tony Lawson		7	2	6	10	25
Martin R Weale		9	7	9	34	59
Rick van der Ploeg	1	14	4	6	21	46
Michael Landesmann				6	8	14
Andrew Caplin					3	3
Robert Owen		1		1		2
Richard Pierse		2	1	4	2	9
Andrew Snell			1	2	8	11
John Paul Dunne		2	1	1	2	6
Manmohan Kumar		3		2		5
Kevin Lee		1	1			2
M Hashem Pesaran	2	5	3		2	12
Totals	65	204	135	185	737	1326

Appendix to Year 1962 – The History of the Cambridge Growth Project

[source: the Cambridge Growth Project (CGP) Catalogue in The Marshall Library, University of Cambridge]



Sir John Richard Nicholas Stone**Salient moments of his life**

1913	Born 30 August, London
1919-1925	At Cliveden Place Preparatory School
1926-1930	At Westminster School
1931-1935	At Gonville & Caius College
1935	B.A. Economics
from 1935	Member of the Royal Statistical Society
from 1936	Member of the Royal Economic Society
1936-1939	With C.E. Heath & Co., Lloyds Brokers
1936-1940	He marries Winifred Jenkins in 1936, but the marriage is dissolved in 1940
1937-1939	Working at <i>Trends</i>
1938	M.A. Economics
from 1938	Member of the Econometric Society
1939-1940	Ministry of Economic Warfare
1940-1945	Offices of the War Cabinet, Central Statistical Office
1941-1945	The White Papers attached to annual Budgets
1941-1956	In 1941 he marries Feodora Leontinoff, who dies in 1956, leaving a daughter, Caroline
1944-1977	The Blue Books on <i>National Income and Expenditure</i>
from 1945	Fellow of King's College, Cambridge
1945-1955	Director of the Department of Applied Economics from 1 July
1946	Commander of the British Empire
from 1948	Member of the International Statistical Institute
1949-1951	Director of National Accounts Research Unit of OEEC

1954&1966	Two Red Books - The Measurement of Consumers' Expenditure
1955-1980	P.D. Leake Professor of Finance and Accounting at Cambridge University
1955	President of the Econometric Society
1956	He is elected FBA (Fellow of the British Academy)
1957	Sc. D. Economics
1959-1976	Director of The Cambridge Growth Project
1960-1991	He marries Giovanna Croft-Murray née Saffi
1962-1974	Twelve Green Books - A Programme for Growth
1970-1972	Chairman of the Economics Faculty
from 1976	Honorary Fellow of Gonville and Caius College
1976-1983	Co-Director of The Cambridge Growth Project
1978	Created Knight Bachelor
1978-1980	President of the Royal Economic Society
from 1980	Emeritus Professor of Economics, Cambridge University
1984	Nobel Memorial Prize for Economics
1987	Foreign Member Accademia dei Lincei - Rome
1991	Died 6 December, Cambridge