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THE CANADIAN QUARTERLY NATIONAL ACCOUNTS—A CRITICAL APPRAISAL

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INTRODUCTION[1]

A CRITICAL appraisal of a country's national accounts could easily entail examination of the whole structure of economic statistics, because the quality of the estimates in the accounts are to a large extent determined by the quality of the underlying data on which they are based. When attention is focused on the quarterly accounts certain methodological issues, such as seasonal adjustment, must also be considered. The ensuing task is potentially overwhelming and important choices must be made at the outset in order to accommodate the confines of a single paper. Choices, no less difficult, must also be made regarding the manner of manipulation and presentation of supporting evidence, particularly if the treatment is quantitative, as well as qualitative, as in this paper.

Probably no two people, working independently, would select precisely the same material and form of presentation, but a unifying and guiding influence in the evolution of our theme – the usefulness and reliability of the quarterly national accounts – is the reminder that the main purpose of the quarterly accounts is to facilitate making appraisals of emerging developments in the economy; and that the need for making such appraisals is not a matter of choice but a matter of necessity. Judgements regarding what the economic situation is, or is becoming, must be made – in fact, are made – whether or not information is available in the required form, accuracy, detail, or timeliness.

[1] All views expressed in this paper are the personal responsibility of the authors; none of the statements made should be attributed to the Dominion Bureau of Statistics. We wish to acknowledge gratefully the generous assistance provided by our colleagues in the Dominion Bureau of Statistics, particularly those involved in the production of the national accounts. Valuable comments which served to improve several sections of the paper were also received from a number of our colleagues in other Government departments, in particular R. B. Crozier, D. J. Daly and D. A. White. The statistical processing work was carried out under the supervision of Barbara Clift and C. Freedman. Schedule 1 (page 12) was prepared by Betty Emery. Most of all we are indebted to F. T. Denton, who set up the statistical procedures employed in the paper and provided useful advice throughout. We also wish to thank Mrs. Jean Short for typing several drafts of the paper, and L. Tessier for preparing the charts.

In the first instance, therefore, it is not entirely to the point to ask whether the estimates are as good as they should be, but rather two other questions: first, whether better judgements regarding the current economic situation are likely to be made if quarterly accounts are available; and, second, if so, whether the judgements are sufficiently better to justify the expense and time involved in their preparation.

Questions of this sort are easy to ask, but not to answer in any direct fashion. If there is truth in the saying, 'Handsome is as handsome does', an explicit answer is perhaps superfluous. The very act of publishing quarterly accounts regularly represents the most eloquent affirmative reply; and failure to publish perhaps a negative one. Over and above this, a specific assertion may be ventured at this stage, as a first approximation. If there are enough basic statistics in a country to be employed as important props in the regular public assessment of the current economic situation, then there is at least a presumption that construction and publication of current accounts is worthwhile. The fact is, it can be argued, that in such assessment the available information is inevitably supplemented by certain other things which are implicitly dubbed in, and, to some extent at least, the accounts merely make these things explicit.

This line of reasoning is, however, likely to appeal more to the users than the producers of the estimates. The latter may feel that it has the effect of simply passing on to them, from the users, the unpalatable job of, in the words of Sir Harry Campion, 'papering over the vacuums of knowledge';[1] they would prefer to wait until enough basic information becomes available to convert the estimation procedure to a substantially objective and relatively stable basis. Just when this stage is reached is essentially a matter of judgement and we comment on this matter later with reference to Canada.

Inevitably the question of whether the accounts are as accurate as they should be must be faced. It is customary to say that a statistical series should be as accurate as is required by the uses to which they are put – no more and no less! This is perfectly true, but not entirely helpful. Seldom do users provide effective guides as to how accurate statistical series should be. Their exhortations are usually to the effect that 'the estimates

[1] 'Recent Developments in Economic Statistics', *Journal of the Royal Statistical Society*, Series A (General), Vol. 121, Part 1, 1958, p. 9.

should be more accurate than they are'; and, the opposite, that 'any figure, even a very inaccurate one, is better than no figure'; and that 'a highly approximate figure in time is better than a perfect figure late'. In the last analysis the producer of the estimates is on his own in grappling with this question, although he tries to make appraisals against a background of general knowledge, supported by intuition and coaxed by pressures, of what users' requirements are.

As already indicated, questions such as those raised above will be handled somewhat obliquely in this paper, but it should be pointed out here that there are really two, more or less, distinct aspects to which they can be directed. The first deals mainly with the quarterly accounts as a system of organizing current data – the arranging of available economic statistics into a balancing set of income and expenditure accounts employing conventions that have become generally acceptable during the last twenty years. Data problems aside, the situation in regard to quarterlies is identical to that of the annual estimates, except that the matter of seasonal adjustment necessarily enters in and that there is more room for argument on some conceptual issues. The quarterly estimates may be regarded, as far as this aspect is concerned, as a (retrospective) breaking out of the annual data into the four calendar quarters. Data problems cannot, in fact, be left aside for very long even here, but they are of particular concern when the second aspect is considered – the estimation of quarterlies currently *before* annual data have become available. It is useful to keep these two aspects in mind even though an explicit distinction between the two is not made at all points in this paper.

The paper is divided into five parts. Part I is devoted to a description of the development of quarterly accounts in Canada. This is followed, in Part II, by a discussion of the usefulness of the accounts and their reliability. The discussion on reliability is cast in general terms and is designed to place the question in perspective – in relation to the main uses the accounts are expected to serve and the character of the underlying raw material on which the 'end-products' included in the accounts are necessarily structured. Attention is then turned to the question of how reliable the accounts have been thus far in Canada. The record of their performance is viewed in broad terms here – in relation to their use in assessing the general contours of the

evolving economic situation and the nature of available alternatives for making such assessment. The theme of reliability is taken up again in Part III, which is intended to provide a detailed quantitative impression of the extent to which the statistician has had to change his mind, as it were, in the light of hindsight, that is to say, the extent to which initial estimates have had to be revised later. The treatment here is entirely descriptive and is designed, in part, to provide a general background for Part IV, which is devoted to a further elaboration of the character of the estimates and the main factors responsible for the revisions. The discussion here, which, of necessity, deals mainly with the figures prior to adjustment for seasonal variation, attempts to sift out the factors which are no longer present from those still at play. Brief comment is also made regarding the lines along which future research and development could usefully be undertaken. Part V contains some concluding remarks.

An appendix contains a number of tables showing summary figures for the annual estimates corresponding to those shown in Part III for the quarterly estimates.

PART I

THE EVOLUTION OF QUARTERLY ACCOUNTS IN CANADA

Historical background

Not much time had passed after the appearance of the first set of annual income and expenditure data[1] before it became apparent that the full potential for economic analysis of a system of national accounts could only be realized with publication of quarterly figures. Such a set of data would reveal more quickly movements taking place in the economy and, in addition, pinpoint the emergence of events that the annual data by their very nature tend to hide or attenuate. The calendar year

[1] The first annual estimates of a balancing set of National Income and Expenditure Accounts were published in November 1945 in a reference book for the Dominion-Provincial Conference on Reconstruction. Revised figures, going back to 1938, were published in *National Accounts – Income and Expenditure* (Dominion Bureau of Statistics, Ottawa, April 1946). For an up-to-date version of the annual national accounts see *National Accounts, Income and Expenditure, 1926–1956* (Queen's Printer, Ottawa, 1958). For a brief historical review see Simon A. Goldberg, 'The Development of National Accounts in Canada', *The Canadian Journal of Economics and Political Science*, February 1949, pp. 34–52.

is, after all, a convention to suit man's convenience and there is no compelling reason why economic laws should respect it. The cyclical upward and downward movements, as well as the troughs and peaks, of economic activity may occur at any time during the calendar year and an up-to-date record of these movements as they take place is of great importance, even though it is particularly difficult to measure them in a country with strong seasonal swings and highly irregular fluctuations, as is the case in Canada. A recession or recovery may have set in and indeed be in full swing while the annual average, aside from being late in coming, might show an unduly pessimistic or optimistic picture, possibly clashing with available current data. Since these latter are incomplete and, frequently, heterogeneous in their conception, it is extremely difficult for the perplexed user to decide what weight to attach to them. By contrast, the erection of a set of current income and expenditure accounts necessarily involves the reconstruction of much of the available data into a consistent conceptual pattern and, in addition, tends to exert a unifying influence on related current information in conjunction with which the totals and components of the accounts are used for economic analysis.

This latter property of the national accounts – that of constituting a powerful force for the integration of the whole range of economic statistics – had already made itself felt strongly throughout the Dominion Bureau of Statistics in the course of developing the annual data. Its application to current economic statistics had irresistible appeal. At any rate, the worksheets of rather important components of the annual accounts, in particular labour income and consumer expenditure on goods, had been set up on a monthly basis from the very outset in order to facilitate early publication of estimates of the most recent year. In many cases these early preliminary annual estimates were based on a comparison of ten or eleven months' data (or at times the sum of three quarters) of the most recent year with corresponding information of the previous year. It seemed a natural step to combine these monthly data into calendar quarters. Further, the fact that the United States Department of Commerce was releasing regularly quarterly income and expenditure figures was a telling factor, firmly establishing beyond reasonable doubt that the objective of publishing quarterly estimates on a regular basis is a realistic one. It appeared prudent for Canada's central

statistical agency to prepare the ground for regular publication of quarterly national accounts somewhat in advance of the strong, widespread demand that was anticipated as coming, as, in fact, it did.

Accordingly, in 1948, while developmental work on the annual data was still proceeding, a study was undertaken to establish the feasibility of constructing, for regular publication, quarterly income and expenditure estimates. This study took the form of actually estimating quarterly figures of the four main tables – gross national product, gross national expenditure, personal income and the disposition of personal income. The previous impression that there was available a great deal of current information for the purpose of calculating quarterly accounts was confirmed. At the same time, some glaring gaps in the basic information came to the surface. It was concluded that the most important of these gaps would have to be filled before regular publication could be undertaken.

Meanwhile, it was considered worth while to prepare quarterly a set of estimates of the four tables mentioned above on the basis of available data for confidential circulation within the government. This decision, which was implemented in 1949, turned out to be a very fruitful one in that it provided valuable experience to the staff; emphasized that it was essential to adjust the data for seasonal movements in order to facilitate analysis; highlighted the arbitrary and unreliable nature of certain procedures that had been developed to compensate for the absence of basic information; and last, but not least, helped to gain influential support for securing resources to develop additional basic information.

The two most important gaps which were filled were those of quarterly corporation profits and quarterly revenue and expenditure of the provincial governments, but improvements were also introduced in inventory and other data. The estimates of seasonal patterns drew heavily on pre-war experience wherever consistent postwar data of sufficient duration were not available. Further, constant dollar estimates of the expenditure components were developed successfully. There was, however, one issue that presented intractable problems – the measurement and seasonal adjustment of farm inventories. This issue, to be discussed later, has not been resolved successfully to date.

As the time for readying the estimates for actual publication

was closing in, there was increasing concern to develop additional cross-checks of the quarterly movements. This took the form, initially, of mobilizing into coherent form all available related economic data – employment, indexes of production, commodity flow data, and so on – on a quarterly basis. It was soon transformed into an independent project of major proportions, that of extending the index of industrial production to cover the whole economy – thus providing not only a check on the quarterly constant dollar gross national expenditure estimates but valuable information on the industrial composition of output. This extension had already been made for the annual figures and the task of attempting it also for the quarterlies appeared eminently worthwhile.[1]

Although the most dramatic innovations in basic information and methodology took place before the estimates made their public début in the fall of 1953, significant improvements have taken place since. In addition, the tabular composition and analytical content of the quarterly accounts were expanded substantially. The first publication of the quarterly accounts contained tables on gross national product and expenditure and personal income and expenditure unadjusted as well as seasonally adjusted. A table of gross national expenditure in constant dollars was also included, but only in unadjusted form. Subsequently these figures were deseasonalized and, in addition, tables of government revenue and expenditure and gross national saving and investment were added, containing data both in unadjusted and seasonally adjusted form. An increasingly comprehensive review was added which, though based, in the main, on the national accounts, has drawn fairly generously on other relevant economic indicators. Charts and supplementary tables – designed to highlight the main economic events of the most recent quarter – round out the quarterly reports.

The satisfaction that can be drawn from the improvements incorporated in the quarterly accounts and the cumulation of experience facilitating a more effective handling of the data is rather quickly subdued by an assessment of the overall state of the estimates such as is presented in this paper. Known data gaps persist, new survey information has not always lived up to initial expectations, and the struggle to explore and weed out

[1] See *Indexes of Real Domestic Product, by Industry of Origin, 1935–1961* (Dominion Bureau of Statistics, Ottawa, 1963), Catalogue No. 61–505.

inconsistencies has been slowed by staff turnover and shortages. Furthermore, there are a variety of statistical and conceptual problems that are not amenable to easy solution. It should be noted, too, that reliance on personal judgement at various points and the study of the statistical series for reasonableness, and the adjustment of the results in the light of this study, is nearly as much an essential part of the estimation procedure now as it was ten years ago. There is a subtle line beyond which these procedures may yield essentially 'subjective' rather than 'objective' estimates, although this line is probably pushed farther back with the cumulation of basic information.

The problems just alluded to are discussed further later on, and it may suffice to suggest here, before turning to a consideration of the vitally important matters of timeliness and revision policy, that these problems, while real, can be exaggerated. Undue preoccupation with them can be conducive to rather unprofitable perfectionist tendencies which may take the form of either 'throwing out the baby with the bath water' or the opposite 'spending so much time preparing the baby for the water that the latter gets cold and cannot be used'.

Timeliness, nature of source material and revision policy

Timeliness is probably the major attraction that the quarterlies possess for most users. However, the objective of producing timely statistics comes into conflict with the desire to maintain adequate accuracy in them. Resort is inevitably made to so-called preliminary estimates which go through various stages of revision as additional information becomes available. Despite repeated efforts to quicken the flow of primary information for the quarterly accounts, it has not proven possible to reduce significantly the two and a half month interval, after the reference quarter, that it has taken to publish the estimates of a new quarter since their inception. Only a massive effort involving considerable additional resources and substantial mechanization of the procedures could succeed in reducing this time interval by several weeks. The alternative of releasing a month earlier estimates made on the basis of two rather than three months' primary information has been considered from time to time. Aside from projecting the third month for many items, estimates of questionable validity would be involved to fill in information that is collected quarterly only, including corporation profits,

depreciation, provincial government revenue and expenditure and a variety of items in the balance of payments. Such estimates have actually been prepared for internal study for some time, but have not been published because it is considered that too large a portion has to be based on the estimator's judgement.

The estimator's judgement is, of course, also involved, necessarily, in constructing the figures actually published, as already mentioned. There is no hard and fast rule that can be used to decide just when the stage has been reached where the underlying data play a central role, and personal judgement a marginal one[1] in constructing the estimates. The decision just when the quarterly accounts are ready for regular publication is to a considerable extent an arbitrary one; and aside from accuracy other considerations may enter in, such as, whether making the data available publicly, by establishing their importance, will gain support for provision of resources to strengthen the flow of the underlying primary statistics. Be that as it may, a large portion of the first preliminary estimates of the Canadian quarterly accounts is, in fact, based on a wide range of quarterly and monthly survey data or their equivalent; a substantial portion is based on related information of varying quality; the remainder, which is based on assumptions of uncertain validity, is still considerable, as indicated in Schedule 1.

It should be emphasized that Schedule 1 is designed to convey a general impression of the nature of the *source* material on which the estimates are based; some of the estimates based on direct survey data may not be as accurate as some of the series based on related information. Furthermore, both the survey data as well as the related basic information are to a considerable extent incomplete when the first preliminary estimates are prepared. There are various reasons for this, the most important being tardiness in arrival of returns and changes made by respondents in data supplied in the preceding month or quarter. Revisions have to be made to incorporate the more complete and up-to-date information. More important, however, are revisions arising from changes in the annual data to which the quarterlies are tied.

Under the present revision policy, during the current year,

[1] It will be seen later that personal judgement does, in fact, play a particularly important role in the seasonally adjusted estimates, especially the first preliminary estimates.

SCHEDULE 1

Nature of source material for Canadian quarterly accounts

	Preliminary estimates, third quarter 1958	Based on survey data or their equivalent	Based on related data	Based on tenuous assumptions or judgements
	million dollars		per cent	
Wages, salaries and supplementary labour income	4,171	45	35	20
Military pay and allowances	125	100	—	—
Corporation profits before taxes and before dividends paid abroad	771	95	—	5
Divdends paid abroad	−109	100	—	—
Rent, interest and miscellaneous investment income	643	30	10	60
Accrued net income of farm operators from farm production	917	15	50	35
Net income of non-farm unincorporated business	553	—	30	70
Indirect taxes less subsidies	961	60	30	10
Capital consumption allowances and miscellaneous valuation adjustments	928	55	20	25
Total inventory valuation adjustment (excluding the residual error of estimate and G.N.P.)	8,960	50	35	15
Personal expenditure on consumer goods and services	4,970	60	25	15
Government expenditure on goods and services	1,727	55	—	45
Business gross fixed capital formation	1,983	—	100	—
Value of physical change in inventories		75	10	15
Non-farm[1]	−54	5	90	5
Farm	658	80	15	5
Exports of goods and services	1,658	75	15	10
Imports of goods and services	−1,833			
Total G.N.E. (excluding the residual error of estimate)	9,109	45	40	15

[1] The percentages are based on *book values* of non-farm business inventories. The contribution of industries to the *change* in inventories may show extreme variation from quarter to quarter, so that, in some quarters, an industry whose estimates are based on tenuous assumptions may account for most or very little of the quarterly change in aggregate inventories.

the first, second and third quarters are subject to revision at the time when the second, third and fourth quarters are prepared. When the fourth quarter is estimated independent estimates for the year as a whole become available for several components and the quarterly estimates of the year just passed are tied to them. At the same time, more complete annual information becomes available for the preceding years and the quarters for these years are also revised at that time. Because the national accounts are based on a vast range of time series, and because some of these series become firm after one year, some after two years, and some not for three years, it is usually necessary to revise three years at the time the fourth quarter estimates are prepared. A schematic presentation, starting with year I and tracing all revision to year IV is appended (Schedule 2) and may help to clarify the above description. In addition to this regular annual revision programme the data are subject to change every ten years in order to incorporate the information from the decennial population, merchandizing and other censuses.

The aim of keeping revisions to a minimum, both in order to economize scarce resources and to simplify the use of publications, comes into conflict with the desire to incorporate in each report the most up-to-date and reliable information; and with the need to reduce to a minimum conflicting information purporting to reflect identical events, as would be the case if the accounts were not revised to include up-to-date series, relating to individual components, reasonably soon after they are published elsewhere. A central statistical agency is probably particularly sensitive about such lack of synchronization of related material. It is clearly not a simple matter to maintain an optimum revision policy in the face of conflicting considerations affecting not only the national accounts but the whole range of economic statistics on which they are based.

SCHEDULE 2

Revisions schedule

Publication date Year	Quarter	Each publication may contain: P – denoting estimate published for first time; R – denoting revision of estimate published previously; NC – denoting no change in figure published previously.															
		I_1	I_2	I_3	I_4	II_1	II_2	II_3	II_4	III_1	III_2	III_3	III_4	IV_1	IV_2	IV_3	IV_4
I	1	P															
I	2	R	P														
I	3	R	R	P													
I	4	R	R	R	P												
II	1	NC	NC	NC	NC	P											
II	2					R	P										
II	3					R	R	P									
II	4	R	R	R	R	R	R	R	P								
III	1	NC	NC	NC	NC	NC	NC	NC	NC	P							
III	2									R	P						
III	3									R	R	P					
III	4	R	R	R	R	R	R	R	R	R	R	R	P				
IV	1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	P			
IV	2													R	P		
IV	3													R	R	P	
IV	4	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	P

Note: This schedule is designed to show the occasions when revisions *may* take place; this does not mean, however, that revisions are actually made on each such occasion for all components.

PART II

THE USEFULNESS AND RELIABILITY OF THE ACCOUNTS IN PERSPECTIVE

Introduction

Just as the annual national accounts have been hailed as a liberating force in economic analysis and in the study of structural characteristics and changes in the economy, so may it be claimed that the quarterly accounts are a most valuable medium for the study of the current economic situation and the analysis of emerging and historical cyclical developments. It is not likely that this statement will invoke opposition; indeed, most observers would regard it as rather obvious. The only question at issue, it may be claimed, is whether the quarterly figures are, or can be, accurate enough to permit them to fulfil their important role.

We should emphasize at the outset the view that the quarterly estimates cannot be as accurate as their annual counterparts. The (fairly obvious) reasons for this are detailed later on. A related question is also discussed later: how accurate *should* the quarterly estimates be? In addition, the question of how accurate, or reliable, the quarterlies have been in the light of the record of their past performance is reviewed.

Before dealing with these questions we turn to a discussion of how useful the quarterlies have, in fact, been so far in Canada, taking their accuracy as given. Implicit in this procedure is the assumption that the quarterly national accounts can be useful even if they are not very accurate.

Usefulness of quarterly accounts in Canada

It goes without saying that statistics are for use, but, aside from statistics which are employed directly for administrative purposes, it is frequently difficult to specify exactly how the data are or have been used. This is particularly true of general-purpose statistics, such as the national accounts. Even if it is established that they are used widely in economic analysis – an assertion which no one familiar with the Canadian scene will be inclined to challenge – the question still remains open as to their influence on actual policy formulation by government, business, labour and others. Here again the evidence, though indirect, is strongly in the affirmative.

A complex range of political, economic and accidental forces, not to mention the strong impact of personalities, usually combine and interact to fashion policies, particularly in the short run. But the ease with which policies are implemented, as well as much of their content, is often influenced deeply by the prevailing climate, and it is our impression that the quarterly accounts have been conducive to developing an awareness and interest in current economic events and a more orderly approach to the diagnosis of the emerging economic situation. A perusal of the daily press, business periodicals and published reports of parliamentary debates will, we believe, confirm this impression, as will discussion with business, labour and government officials and economists.

Secondly, it is, we believe, a fair statement to make that the quarterly national accounts have rendered all available current economic statistics more valuable. This is clearly true of the series that are actually used in constructing the accounts. In most cases these series are useful in their own right, for example, inventories, corporation profits and retail sales; their utilization in the erection of the quarterly accounting system doubles, as it were, their value. This is just as true for series such as new orders, employment and financial statistics in conjunction with which the accounting estimates are often used in analysis of the economic situation. Even detailed commodity and regional statistics are rendered more valuable by the availability of the quarterly national accounts, because the aggregates and components of the latter provide some perspective for the detailed study of markets and other current developments.

The quarterly accounts have added a new dimension to the process of current economic analysis. Like the annual accounts, they force the serious user to develop a habit of mind that studies economic developments in terms of the interrelationships of the various expenditure and income flows, yielding a more penetrating and consistent picture of the current and evolving situation. In this process all relevant available information and a variety of seasonally adjusted indicators are sifted and weighted systematically to piece together a meaningful pattern of up-to-date economic events.

Even when the annual, rather than the quarterly, accounts are used as the major framework for short-term forecasting, as is still the case, for example, in the Canadian Department of Trade

and Commerce, the quarterly accounts play an important role, as the following description of forecasting procedures by an official of the Department indicates:

'Forecasts of national income and expenditure are usually drawn up in terms of annual averages only. Analysis of quarterly and monthly trends plays an important part in the calculations and in the textual comment, but quarterly forecasts are not usually explicitly set out. Trend projections which make use of the movement of quarterly seasonally-adjusted national accounts components play an important part in the estimation of many of the calendar year averages – and in checking the "reasonableness" of annual estimates derived independently. This is because quarterly estimates which measure the position as at the final quarter of the year provide a much more "up-to-date" base for projection than annual averages; and because quarterly projections can more readily take account of information concerning the stage of the business cycle which would be lost to view in the annual averages. In addition, it is often fairly easy to form a judgement about the reasonableness of quarterly rates of change which are implied in annual averages, moving from the final quarter of the current year through to the end of the forecast period; if these fall outside of the range of normal experience, a second look at the annual estimate is called for. The quarterly national accounts therefore play a vital role in preparing and checking forecasts, even although the forecasts themselves are not explicitly presented in quarterly terms.'[1]

A fortiori, the quarterly accounts are essential when forward-looking appraisals are made by individual quarters, as indeed

[1] To avoid misunderstanding it should perhaps be noted that, while the forecasts are presented in terms of annual averages, the economic situation is studied currently as monthly and quarterly data become available. Considerable attention is given to the pace of activity within the calendar year. Further, the approach in Canada to forecasting is eclectic in nature. The approach used in the Canadian Department of Trade and Commerce has been described as follows: 'The final product represents a fusion of several approaches. Quantitative analysis goes hand-in-hand with "informed judgement" of subject matter experts. Surveys of spending plans or intentions play an important part in the procedures. Knowledge accumulated on the behaviour of business cycles in Canada and in the United States is used in conjunction with the indicator approach, to judge the timing and composition of cyclical swings in economic activity and to check on the "reasonableness" of the forecast. Aggregative projections based on cyclical trends are supported and checked by reconciliations at the commodity, industry, or market level. An econometric model, given the assumptions of the forecast, provides a test of its consistency with respect to underlying relationships. To a considerable extent each one of these approaches serves as a check upon the other; where different conclusions are suggested, the forecaster is forced to enquire into the reasons.'

they are in Canada, though in a more informal way. The importance of the quarterly accounts in the construction and use of quarterly econometric models is self-evident. Developmental work on quarterly models is proceeding in the Department of Trade and Commerce.

The quarterly accounts have been instrumental in improving and adding to the stock of current economic statistics. Like the annual accounts, they provide an effective conceptual and definitional framework for the collection of new data and adjustment of existing statistics and, in addition, they help to direct the spotlight on gaps and areas requiring improvement or more intensive analysis. Reference has already been made to the institution of the quarterly surveys of corporation profits and depreciation and provincial government revenue and expenditure. At the time of writing, a quarterly sample survey of municipal government revenue and expenditure is being instituted, mainly to fill a serious gap in the quarterly accounts. The collection of statistics of current employment by governments is being stimulated by the quarterly accounts. To meet the requirements of the quarterly accounts special information is being collected to permit estimation of current inventories held by independent retailers and wholesalers. The importance of adjusting the quarterly figures for seasonal variation was recognized from the very beginning, but the full significance of seasonally adjusted data for economic analysis was brought home to users as they began working with them. This in turn led to the demand, both within the government and outside, for more and more current economic indicators on a seasonally adjusted basis, culminating in a fairly comprehensive programme of regular publication of seasonally adjusted data.[1]

It will be clear, too, that the quarterly accounts provide an effective framework for future systematic development of current economic statistics; and they fulfil this function not only for particular series to strengthen the individual components of the estimates or to provide auxiliary data for joint analysis but also

[1] 'The present seasonal program derived its initial impetus from the early work which was done on the seasonal adjustment of the quarterly national accounts, and the related monthly indicators which were used in the accounts in following the course of current economic developments.' R. B. Crozier, 'Some Observations on Canadian Administrative Experience with a Program of Seasonal Adjustment', *Seasonal Adjustment on Electronic Computers*, Proceedings of an International Conference held in Paris, November 1960, Organisation for Economic Cooperation and Development, p. 314.

for the evolution of related systems of data on a consistent basis. It has already been mentioned that the project to develop quarterly indexes of industry output in constant dollars has arisen directly to serve the needs of the quarterly income and expenditure accounts. Though closely related to the latter, this project has an existence of its own and has drawn attention to serious data gaps and inconsistencies in certain areas of current output statistics that will be dealt with as soon as resources are made available. Similarly, the work on the quarterly income and expenditure accounts has sharpened the awareness of the need for strengthening certain components of investment income and for securing information to facilitate estimating personal saving directly, not just residually as at present. The development of related data on financial flows in Canada to satisfy the requirements ultimately of a full-fledged money flows system of tables was conceived in quarterly rather than annual terms since an early date, not only because of an awareness that changes in financial practices can take place rapidly but also because the availability of quarterly income and expenditure accounts made this natural and convenient.[1]

How accurate should the quarterly accounts be?

The need for accuracy has to be appraised in the light of the uses of the quarterly accounts just referred to. To the extent that the quarterly accounts continue to be instrumental in strengthening the range of current data on which they are based their accuracy is improved.

Of the various purposes to which the quarterly accounts are put, their usefulness as a framework for a systematic up-to-date assessment of the current economic situation with a view to forming judgements about prospective developments is unquestionably the most important, and the adequacy of the accounts is best appraised in this light. It should be emphasized here that the assessment made in this paper, particularly Parts III and IV, leaves no room for comfort; many areas urgently require strengthening and, even if adequate financial support is forthcoming, it will take many years before all the components

[1] For a comprehensive description of a financial flows system as conceived to date in Canada see Wm. C. Hood, *Financing Economic Activity in Canada*, Royal Commission on Canada's Economic Prospects (Ottawa, 1958), Part IV. For a brief description of the present programme of financial statistics see *Canadian Statistical Review*, November 1960.

of the accounts are as accurate as they should be. At the same time, it is important to be on guard that the desire to obtain a high degree of accuracy does not lead to the pursuit of unobtainable or impractical ends.

In a discussion of accuracy it appears appropriate to distinguish between the unadjusted and seasonally adjusted estimates. The compromises involved in fixing the production boundary and setting up the conventions for the measurement of the total product and components of the unadjusted estimates expressed in current dollars need not be repeated here. However, once these are agreed upon, reliance is placed on the market for converting otherwise non-additive things to a conventionally acceptable common denominator – dollars are added to dollars. As long, therefore, as one endeavours to measure only the 'facts', as the market process reveals them, imperfections of measurement, other than those present in the market itself and in the accepted conventions, can be overcome, at least theoretically. When one goes farther, however, and endeavours to separate value data into their constituent price and volume components and, more particularly, when one tries to decompose time series into trend, cyclical, seasonal and irregular components, *accurate* measurement becomes a rather more intangible matter. These attempts to unscramble the economic omelette are merely mathematical expressions that try to approach the real world by making certain simplified assumptions of the *ceteris paribus* variety. Since in the real world the *cetera* do not remain *paria* for very long, the most that may be expected from such 'abstract' statistics is to approximate and to reflect, rather than measure precisely, the basic underlying factors in any given economic situation.

On the other hand, it bears emphasis that certain inaccuracies which the unadjusted data contain need not be damaging to the adjusted series; to the extent that the inaccuracies reappear with some sort of regularity in the quarterly data they should be eliminated, to some extent at least, in the process of seasonal adjustment, together with other regular intra-annual fluctuations.

While the unadjusted data, as far as they go, are more clear-cut in their conception than the seasonally adjusted series, the latter are much more useful; that is to say, one is undoubtedly more likely to come closer to a true picture of current economic

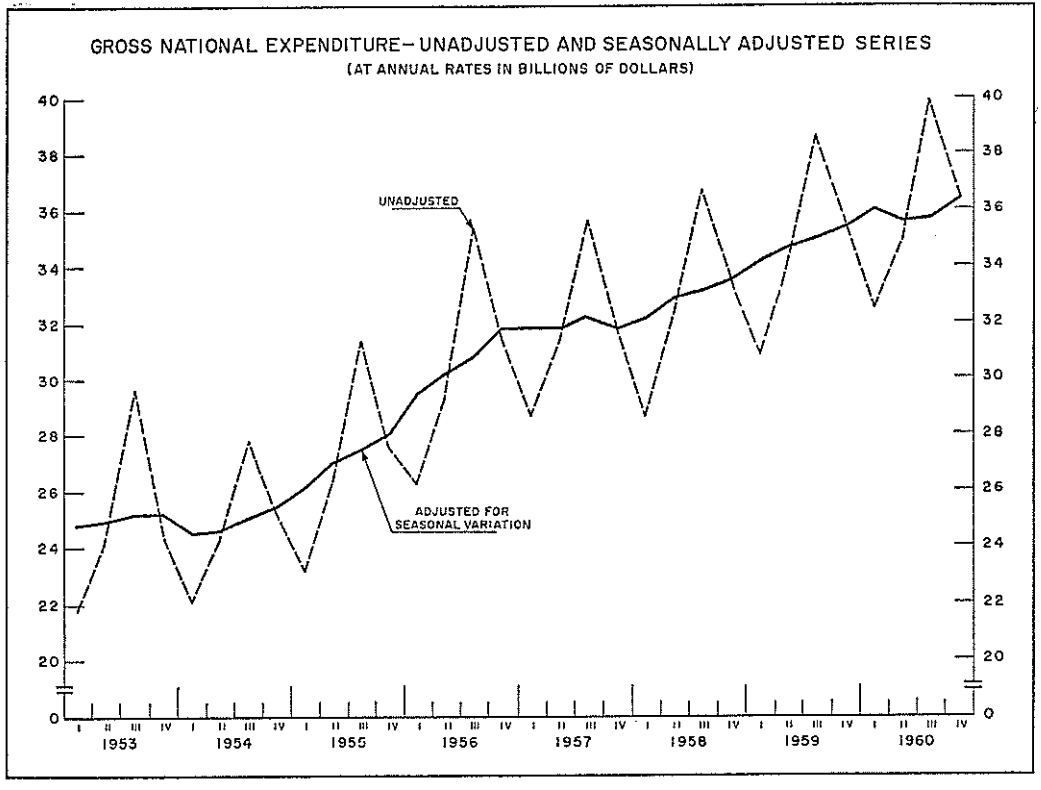
development by relying on the seasonally adjusted estimates.[1] This is particularly true for a country such as Canada with strong seasonal swings which can easily be confounded with cyclical and irregular movements. The importance of seasonality is illustrated in Chart 1 showing the gross national expenditure in unadjusted and seasonally adjusted form; the seasonal swings are, of course, more pronounced for some series such as corporation profits and less for others such as military pay. The superiority of seasonal adjustment to other devices, such as comparisons of a particular quarter with the same quarter a year ago, need not be laboured here.[2]

To the extent that the main use of the unadjusted data is to provide raw material for the seasonally adjusted 'end-product' they need to be no more accurate than is required to render the 'end-product', particularly its quarter-to-quarter changes, as reliable as is desired. As intimated above, the danger that the unadjusted components of the accounts are more accurate than necessary is far from imminent, but it is conducive to balance

[1] We are not concerned here with any particular method of seasonal adjustment. The points made appear relevant no matter which procedures underlie the seasonal adjustment series. It can be argued, of course, that the producer's main responsibility is to prepare accurate unadjusted estimates, leaving the matter of allowing for seasonal variation to the users, including model builders. However, in view of the widespread expectation, indeed insistence, that the statistical agency should publish seasonally adjusted series, it is reasonable to regard the statistical product unfinished until it has been adjusted for seasonal variation, as we do here. Canadian practice has been to publish both the unadjusted and the seasonally adjusted series, providing users with a choice, as well as an opportunity to check the seasonally adjusted figures if they so desire. Most users are not, in fact, in a position to adjust the figures for seasonal variation; but even if they were, it is clearly much more economical, and conducive to consistency in the data, if the central statistical agency carries out this function as a regular part of its responsibilities. The bringing into use of a wide range of seasonally adjusted economic statistics, including the quarterly national accounts, has had a strong influence on economic studies in Canada and strengthened considerably the statistical basis of current forecasting work in recent years. For a comprehensive report on work in Canada on seasonal adjustment see R. B. Crozier and W. Darcovich, 'Time Series Analysis by Electronic Computers', *The Canadian Journal of Economics and Political Science*, February 1962.

[2] See, in particular, Julius Shiskin, *Electronic Computers and Business Indicators*, National Bureau of Economic Research, Occasional Paper 57; Donald J. Daly, 'Seasonal Variations and Business Expectations', *The Journal of Business*, July 1959. 'No government, economics group or individual who is interested in the current economic situation can afford to be without seasonal adjustments for those series that are of general interest. It is correct and usually persuasive to say that with seasonal adjustment one can know what is going on in the economy six months earlier than those using unadjusted data. The use of computers has reduced the overall costs and the resources of clerical and professional time in this important process.' D. J. Daly, 'Canadian Experience with Seasonal Adjustment', *Seasonal Adjustment on Electronic Computers*, Report and Proceedings of an International Conference held in Paris, November 1960, Organisation for Economic Cooperation and Development, p. 176.

CHART 1


GROSS NATIONAL EXPENDITURE– UNADJUSTED AND SEASONALLY ADJUSTED SERIES
(AT ANNUAL RATES IN BILLIONS OF DOLLARS)
UNADJUSTED
ADJUSTED FOR SEASONAL VARIATION
40
38
36
34
32
30
28
26
24
22
20
0
I II III IV
1953
1954
1955
1956
1957
1958
1959
1960

in the evolution of statistical programmes to keep in mind that imperfections in the unadjusted data contribute a portion only, albeit an important one, to the total deficiency in the (changes of the) seasonally adjusted estimates. Thus if the unadjusted data contribute 50 per cent to the total 'deficiency' (however defined) of the seasonally adjusted estimates, a reduction of the error in the unadjusted data by one-half will reduce the 'deficiency' by one-quarter only. Whether such a reduction in the deficiency of the end-product justifies the expenditure involved has to be decided on the basis of an appraisal of the merits of each individual case, keeping in mind, however, that many of the constituent unadjusted series may be required for other purposes, not just to serve the needs of the quarterly accounts in deseasonalized form.

This highly pragmatic approach to the question of accuracy is further supported by the fact, already mentioned, that in practice judgements regarding the economic situation are ultimately formed after intensive probing of a broad range of statistical data and a variety of clues; and the extent to which these data and clues tend to reinforce one another. Furthermore, such judgements, even when arrived at after the most painstaking study, are frequently held with some reserve until data for the next quarter or two become available and confirm them. For such purposes exact magnitudes are not essential and even highly approximate estimates are very useful.

It is fortunate that this is so, because certain characteristics, to which we now turn, detract considerably from the accuracy of the quarterly accounts.

How accurate can the quarterly accounts be? A qualitative comparison with the annual accounts

There are various reasons why the quarterly accounts cannot be as accurate as the annual, aside from the matter of seasonal adjustment, which is discussed further in Part IV. In the first place the imperfections contained in the annual estimates necessarily spill over into the quarterlies, since, for many components, each successive annual estimate forms a benchmark to which the current quarterly estimates are tied; the latter are adjusted retrospectively as the annual figures are revised. The impact of these procedures on the level of the quarterly

figures is perhaps self-evident, but they also affect the quarter-to-quarter changes.

Secondly, even if the primary data for the quarterlies were as plentiful and comprehensive as for the annual – which, of course, is not the case – a variety of problems detract from the accuracy of the quarterly estimates in comparison with the annual. A review of a number of these will serve as a reminder.

The seemingly intractable problem of measuring farm production[1] quarterly is dealt with first. The difficulties in the measurement of farm production are associated mainly with the estimation of volume and the application of prices to growing inventories. In the non-farm sector, production for inventories is measured by the cost of inputs as the inventory accumulates: the change in 'goods in process', for example, appearing in gross national expenditure is evaluated at current average purchase prices (i.e. cost) and matched on the gross national product side of the accounts by factor costs and other costs.

It would appear desirable to follow the same procedure in the farm sector, although the case is less clear that growing farm inventories should be measured at cost (of inputs) rather than assumed market values (of outputs). Whichever method of valuation is used, the procedure would aim to allocate agricultural production to the quarter in which it has actually occurred. Such a procedure would simply recognize the fact that, for example, the harvesting of a grain crop in the fall of the year represents the culmination of productive activity of preceding periods and, therefore, the value of this production is 'accrued' throughout the ploughing, seeding, growing and harvesting periods. Productive activity of the fourth, first and second quarters would be measured by the cost of inputs (expenses) incurred during the various preparations to ensure a good harvest and would be reflected in the accounts by a corresponding addition to 'inventories'.[2]

However, in the case of grains, information is lacking at the

[1] More specifically, changes in farm inventories and net income of farm operators from farm production.

[2] If an output-market price valuation rather than input-cost valuation is preferred, the latter could be adjusted retrospectively, or in some arbitrary manner in the period in question. It should be noted, however, that imputing a market value to the growing crop would credit net income (return to capital and entrepreneurship) in the quarter before the sale of the product had actually taken place, i.e. (estimated) unrealized profits would be included.

present time to permit such quarterly accounting of inventories: *total* estimated expenses of farm operators are now deducted from gross farm income in each quarter and the portion incurred in preparation for the harvest (that is the 'inventory' accruing to the quarter) is not added back to income. As a consequence, inventories (and therefore production and income) in the first, second and fourth quarters are understated, and those of the third (harvest) quarter are overstated by an equivalent amount.[1]

While the problems of valuing farm production and counting it in the quarter in which it has actually taken place is most acute in the case of grains, it is also present, though to a lesser degree, for livestock.[2]

It should be added, in passing, that the decision in the present Canadian accounts to treat the crop as production only when it is harvested in marketable form accentuates a difficult problem of seasonal adjustment. Because crop production is characterized by a concentration of output in the third quarter of the year and by large and erratic fluctuations about any average which may be constructed, the ordinary procedures for deseasonalization (based as they are on assumptions of regularity in the past) give rise to results which may create misleading impressions of the movement of the gross national product. To date, a simple expedient has been employed of dividing the annual value of grain-crop production into four equal parts to

[1] If 'additions' to farm inventories were counted in the other quarters the change in inventories on the expenditure side of the accounts, in these quarters, would be a smaller negative value than at present; the change in inventories in the third quarter would be a smaller positive value.

[2] Currently, the quarterly change in the value of livestock inventories is computed by broad classes of animals; and is obtained by multiplying the change in numbers (representing physical change) by the average unit value (representing average prices at the farm). This procedure values changes in livestock inventories at (farm) market prices rather than (farm) costs and is therefore inconsistent with the valuation of non-farm inventories. Much more serious, however, are the deficiencies present in the statistical data.

Physical inventories and unit values of livestock are estimated quarterly on the basis of semi-annual surveys. However, the unit values are applicable to the *whole* stock and not necessarily to the *change* in the stock. A further problem springs from the fact that physical inventory data are available only in terms of numbers (rather than in terms of weight of animals) and, since the physical weight composition of the livestock changes from period to period, the numbers do not necessarily provide an accurate accounting of the real physical inventories and changes in them. The livestock inventory estimates used at present are, in addition, inconsistent with the farm cash income figures which are used as a starting-point for estimating net farm income. The cash income from livestock marketings represents a figure of depletions (or weighted numbers) and prices of marketings (not the whole stock).

represent seasonally adjusted data. In going into a new year, before the crop is known, production is estimated on the basis of average yields of preceding years, estimated acreage and initial prices. This preliminary first-quarter estimate is revised later in the year as the actual data become available. The 'annual-divided-by-four' technique is used for grain crops only; data for livestock and other items are deseasonalized by standard techniques.

The following illustrates further the kind of inconsistencies which arise in the quarterly accounts to a greater extent than the annual. Since the national accounts constitute a balancing system of statistics, all its component parts should, theoretically, refer to exactly the same time period. In actual practice, however, there are various reasons why this cannot be accomplished in a precise way: data flowing from administrative records may be determined by the administrative process rather than the time when the transactions to which they relate have taken place; the time of effective sales and transfers may be reported differently by the seller and buyer; goods and payments may be in transit and their precise status indeterminate; and payment may precede or follow, by a considerable time interval, work carried out. Such leads, lags and floats loom much larger in the quarterlies than in the annual data, because short time spans are usually involved and are therefore less important on an annual basis; and secondly, as the major emphasis in business accounting is still concentrated on the year, respondents themselves pay greater attention to the precise timing of annual data.

Our knowledge of these lags and flows varies from case to case: some of them have been identified and corrected, albeit approximately; some are known to exist, but so far they have not been adjusted for, either because they have not proved amenable to explicit adjustment or for other reasons; and some are merely suspected to exist in a general way. It should be noted, however, that many of these leads and lags are probably stable over time and, as a consequence, affect less the quarter-to-quarter changes than the level of the estimates. Furthermore, as indicated above, some, at least, probably cancel out in the process of adjusting the data for seasonal variation.

An example of a timing adjustment which is presently made, albeit very approximately, is that which attempts to convert

government cash outlays for capital goods as entered in the public accounts to a figure representing the value of work done or the actual purchases of equipment, to be referred to later. An illustration of a different type of timing problem is provided by monthly merchandise exports and imports data which are generally based on copies of customs documents actually received by the statistical agency. The receipt of these documents may not coincide in time with the actual movement of the goods or money flows in question and special procedures and adjustment may be necessary in order to approximate the latter. An important illustration of this is wheat. Although all movement abroad of wheat is supposed to be accompanied by more or less simultaneous customs documentation, in fact, some movement precedes such documentation by a considerable interval of time. Accordingly, the wheat export figures included in the balance of payments are based on an independent estimate of the value of wheat exported. Again, certain bulk orders abroad such as aircraft may be financed on a 'progress payment' basis. The progress payments are included as they are made in the balance of payment figures. When the aircraft are moved across the border they are included in the customs documents and care has to be taken to exclude them from the latter in order to avoid counting them twice. Through such special procedures and adjustment the inadequacies of the estimates based on customs documents are kept to a minimum, but whatever deficiency remains is relatively more important in the quarterly than the annual figures, as the latter permit a degree of cancellation of error between quarters.

Even when customs documents are matched exactly by corresponding flows of goods a certain amount of imbalance may arise in the accounts because the imports of goods may not be fully matched by, for example, inventories, in the same quarter in which they have been entered in the balance of payments. Another example of imbalance is that between indirect taxes and profits and net income. Thus profits and net income are reported after deduction of indirect taxes, but receipt of such taxes by the government (and hence their inclusion in the gross national product) may not be recorded until a subsequent time period, either because business accounting accrues these taxes even before they are actually paid, or because some time may elapse until the receipts of such monies are included in the accounting

records of government. In many instances this sort of discrepancy cannot be adjusted for.[1]

In addition to the imperfections arising from accounting practice and administrative records discrepancies result from inconsistent statistical practice. An example of this is the so-called aggregate versus rate method of estimation. The most important series affected at the moment are labour income and consumer expenditure. Current labour income data, which have been designed to serve a variety of users, are estimated on a monthly rate basis, that is, labour income is measured as to what would be paid and received in a month of standard length with an equal number of pay days, rather than as the actual amount paid or received; the latter will, of course, vary from month to month depending on how many pay days fall into a particular calendar constellation. Consumer expenditure, on the other hand, is the estimated sum of expenditures actually made by consumers. Since labour income and consumer expenditure are the largest components of G.N.P. and G.N.E., the imbalance arising from the rate versus aggregate problem is probably largest in this area. It is intended to remove the inconsistency arising from this source at some future date, but it should be noted that it applies mainly to the seasonally unadjusted series. Since the seasonal adjustment process converts all data to a rate basis, it removes a portion at least of the inconsistency caused by these different methods of estimation.

Finally, a problem which is of peculiar importance to the quarterly estimates arises when a series is first projected by means of quarterly indicators and later adjusted to be consistent with independent annual data; the fourth- and first-quarter relationship, in particular, is changed from that indicated by the quarterly projectors or interpolators, unless by chance the projected quarterly data coincide exactly with the annual figures. Over the years considerable experimentation has been carried out to correct this situation, but for various reasons a final decision regarding the general practice that should be adopted has not been made. At the moment labour income and a large proportion of consumer expenditure are adjusted regularly to take account of this factor, but not the other components as

[1] In the case of corporation profit taxes a special adjustment to place government receipts on an accrual basis is made in the Canadian national accounts. However, since for certain analytical needs the cash flow into the government sector may be a relevant item, cash receipts are also shown.

yet. It is hoped that eventually the basic information can be improved sufficiently to reduce to a minimum the need for such adjustments.[1]

Perhaps as important as the imperfections illustrated above, if not more so, are the weaknesses arising from the relative paucity of primary data: a larger proportion of the annual estimates are based on comprehensive survey material, or projections that lean on fairly solid related information, than the quarterly. We shall return to a consideration of the quality of the data underlying the quarterly estimates later, but now turn to an appraisal of the performance of the first preliminary quarterly estimates in the light of the more complete and up-to-date information available at the time of writing.

How accurate have the quarterly accounts been? A general appraisal

It can be claimed, we believe, that in general the first preliminary estimates of the quarterly accounts have portrayed faithfully the overall strengths and weaknesses of the economy, as revealed subsequently by the 'final' estimates. Revisions of a number of components have been much too large for comfort, but the broad, unfolding picture of the economic situation as a whole has emerged despite imperfections in the data. The downswings of economic activity in Canada since 1947 were periods of hesitation and pause rather than of sharp, decisive changes in direction. The first estimates of the accounts have not invariably portrayed these relatively moderate swings with immediate and unambiguous precision, but, on the whole, the changes revealed in them were such as to serve as an effective medium for determining, in conjunction with other current information, whether something was going awry in the economy or whether things were improving.[2] In general, the accounts

[1] The conventional methods employed to make this adjustment (which would affect not only the first-fourth quarter relationship but also the preceding quarters as well as the most current ones) are the ones developed by V. Lewis Bassie, or variants of his methods. For a description of the procedures used to adjust the labour income data see *Labour Income 1926–1958* (Dominion Bureau of Statistics, Ottawa, 1960), p. 43.

[2] It should be noted that reference is made here to the *accuracy* of the first preliminary estimates of the accounts. It can, of course, be argued that even the most accurate and timely quarterly accounts by themselves could not pinpoint turning-points as early as a range of seasonally adjusted monthly indicators. Some users feel that the quarterly accounts tend to be sluggish at turning-points, 'partly because of the lags in price changes and partly because of their very comprehensiveness'. However, even these users regard the quarterly accounts as essential for current analysis and forecasting.

have served as an indispensable framework for determining, in a systematic fashion, the nature of the factors at play over the course of the business cycle, especially if users did not confine the analysis to isolated quarters.

The statements just made are based on experience in working with the figures and discussions with experienced users. Further, they are supported by an examination of the summary reviews appearing in the introductory portion of the quarterly publications from 1953 to 1960. These reviews, which are, of course, based on the first preliminary estimates, were studied in the light of the now known 'final' data. The examination was restricted, in general, to the part of the reviews that deals with the general economic situation as revealed by the aggregate gross national expenditure and product and major components; they were studied in conjunction with Chart 2, which shows the percentage changes from one quarter to the next in (*a*) the first preliminary estimates and (*b*) the 'final' estimates available at the time of writing.[1]

The following is a summary of the impressions derived from the study: In general, the 'final' data would not change the tone of the reviews or the broad picture that they present,[2] although in many quarters considerably different percentage changes would have been inserted, and some reassessment of individual components would be necessary. The statements based on preliminary estimates of gross national expenditure portrayed clearly, and in general with precision, the movements which were eventually established by the 'final' estimates.

The movement of the estimates of government expenditure switched direction in a large number of quarters, in part reflecting the introduction of a timing adjustment discussed in Part IV. But even where there has been no difference in the direction of movement there has been a noticeable see-saw in the magnitudes of change between the preliminary and 'final' estimates for a number of quarters; in other words, in one quarter the preliminary has shown a small change and the 'final' a large one, and in the subsequent quarter the preliminary showed a large change

[1] The limitations of this procedure, that assumes that the 'final' estimates are the 'true' figures, are discussed in Part III. In the case of inventories and personal saving, the changes in Chart 2 are expressed in dollars rather than percentages.

[2] To some extent at least, judgements of this sort, made retrospectively, are necessarily subjective. It is clearly impossible to say with assurance, long after the event, how a person confronted with different percentage changes in the current period would have reacted.

and the 'final' a small one (so that, incidentally, when the two quarters are considered together the difference in movement between them is smaller). For the years 1953 and 1954 the divergence in the pattern of movement was also pronounced for business fixed capital formation.

The portion of the reviews dealing with the first estimates of most other components has been adequate in light of the final

CHART 2

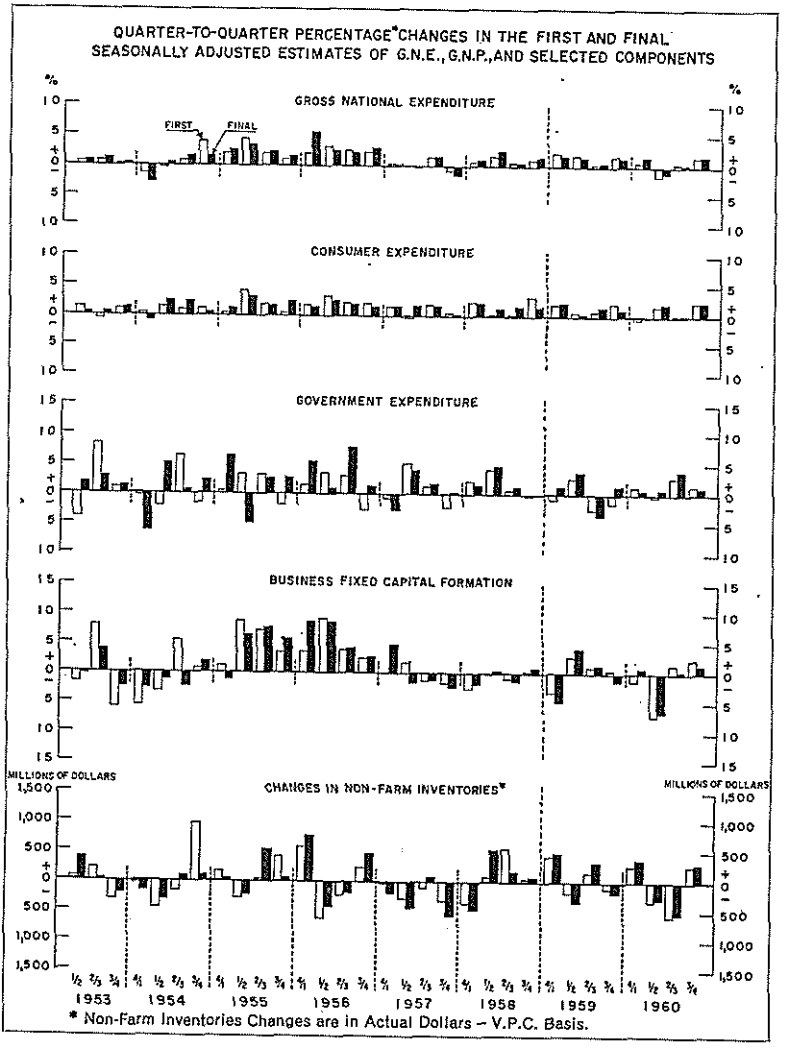
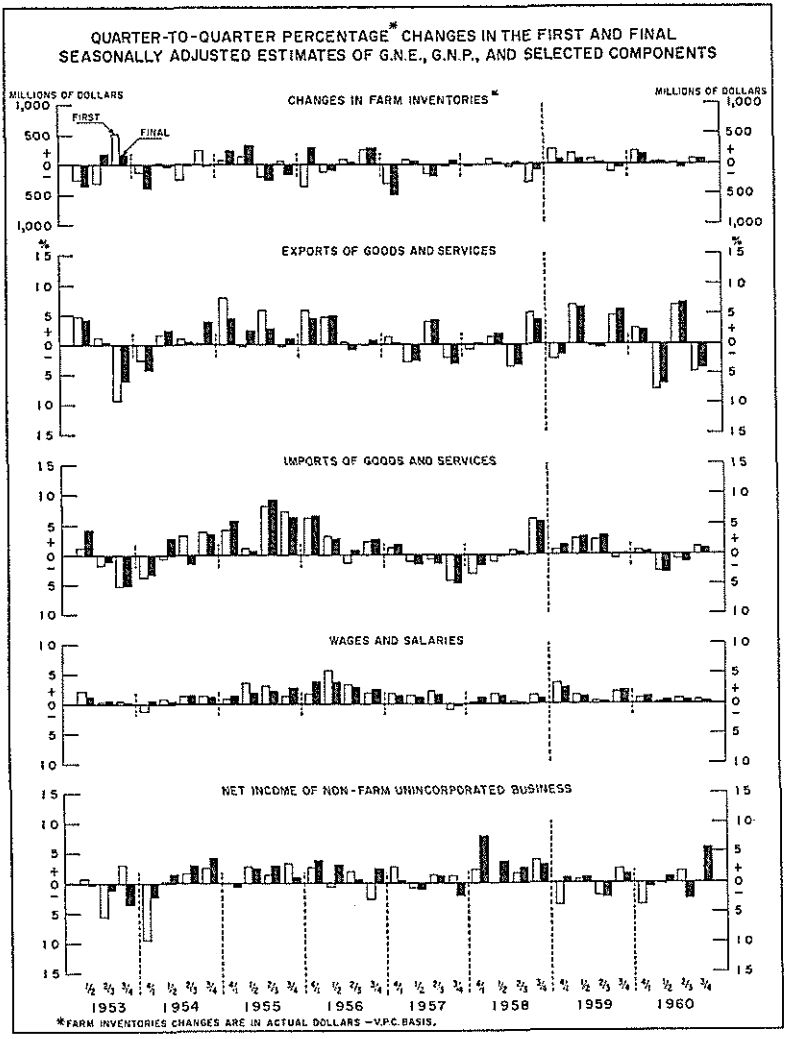


CHART 2 - Continued

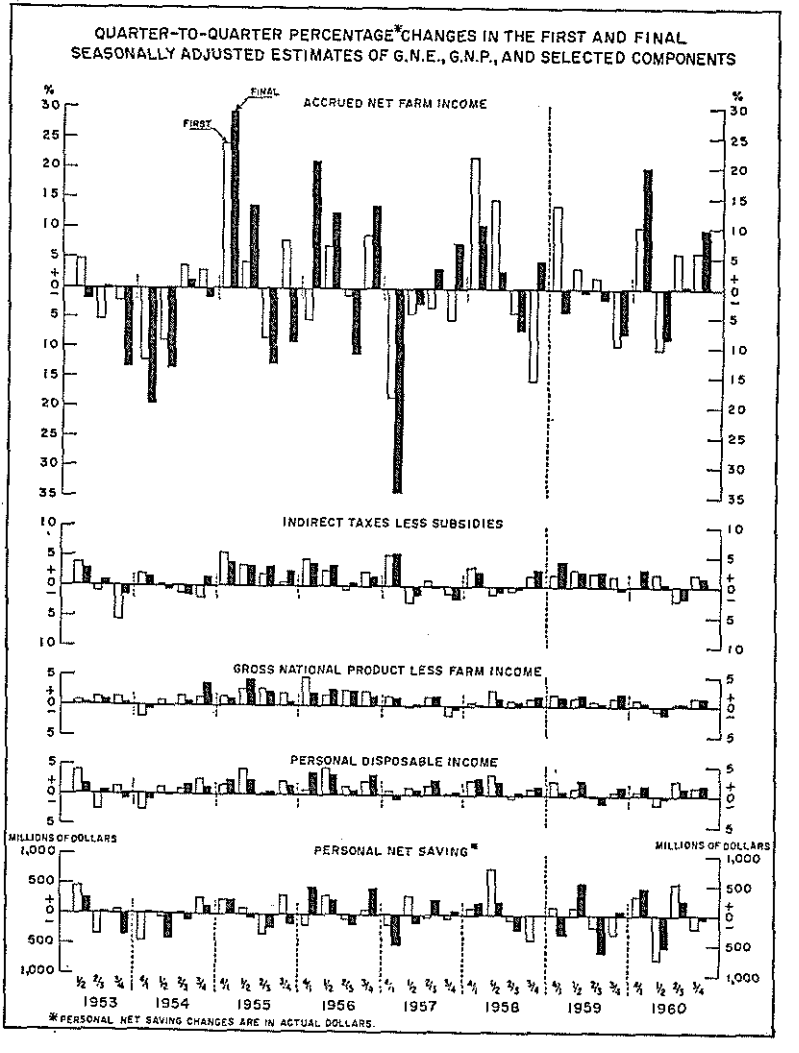


record; even in quarters where there were changes in direction of movement, these were frequently small and were described by comments such as 'stable', 'relatively unchanged', or 'showed little movement'. It is interesting to note that in a number of quarters comment in the published text seems to have been inhibited on components which subsequently were revised

sharply, reflecting, no doubt, an awareness on the part of the estimators of the uncertain nature of the estimates of these components in the quarter in question.

In the last few years changes in personal income were featured somewhat more than previously and a number of statements with respect to this aggregate would have to be rewritten in the

CHART 2 – Concluded



light of the 'final' estimates. This is even more true of personal saving, the changes of which, however, were not featured in the part of the reviews dealt with here.

Other indicators of economic change

The preceding comments and the review of the revisions contained in Parts III and IV of this paper should be considered in the light of alternative ways of appraising quantitatively the current and prospective economic situation.

It is probably true that, in general, the aggregate gross national expenditure and product are more accurate than most of their components and this is suggested by the record of revisions discussed later, though not without some exceptions. The reasons why the aggregates may be expected to be more accurate are fairly obvious: the 'law' of cancelling errors does not work to the same extent on the components which, in addition, cannot be subject to the same number of consistency checks.

The statistical limitations of the components *vis-à-vis* the comprehensive aggregates apply, in more or less the same way, to the alternative series available for appraising the current economic situation. Most economic indicators such as indexes of production, employment data, retail sales, shipments and new orders, and so on, would probably show a record of revisions not unlike that described below for the components of the accounts. In contrast with the quarterly accounts, where a fairly solid aggregate serves as a frame of reference for analysing components (and related data) of varying degree of accuracy, in a systematic and interrelated way, the available partial indicators, while indispensable, are more difficult to integrate into an overall systematic framework. The analyst would have to use his own judgement as to what weights to attach to the various partial measures, in contrast with the market-oriented and internally consistent weights embodied in the quarterly accounts.

One could, of course, utilize available monthly (and quarterly) time series for constructing a variety of synthetic indicators of the barometric type for gauging the course of current economic developments, in particular the leading, lagging and coincident indicators and diffusion indexes developed by the National Bureau of Economic Research.[1] In recent years, interest in this

[1] See *Business Cycle Indicators*, edited by Geoffrey H. Moore, National Bureau of Economic Research (Princeton, 1961), especially Chapter 7; Julius

type of analysis has increased considerably in Canada as a result, in large part, of studies carried out in the Canadian Department of Trade and Commerce (which in turn have been stimulated by the work of the National Bureau and the U.S. Bureau of the Census).[1] In the experience of a number of practitioners this approach to the study of cyclical developments and, in particular, the various analytical devices associated with it (including the dating of reference-cycle turning-points, the use of cycle-on-cycle comparisons, techniques for gauging the probable duration and amplitude of cyclical swings and so on) have served as useful aids in the quest for early detection of economic changes and for forming views regarding the reasonableness of forecasts in the light of past experience.[2]

Whatever one's degree of acceptance of these tools for analysis and short-term forecasting it should be noted, first, that the underlying data on which they are based are probably no better than those of the quarterly national accounts; and secondly, that they, as well as other techniques, are available to be used as complementary to, and need not be regarded as in competition with, current appraisals and short-term forecasts based on the national accounting framework.[3] As already indicated,

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Shiskin, *Signals of Recession and Recovery; An Experiment with Monthly Reporting*, Occasional Paper 77, National Bureau of Economic Research (New York, 1961); and *Business Cycle Developments*, a monthly report issued by the Bureau of the Census, U.S. Department of Commerce. See also the useful, brief review of the above by D. J. Daly, *Canadian Journal of Economics and Political Science*, August 1961, pp. 456–7.

[1] See W. A. Beckett, 'Indicators of Cyclical Recessions and Revivals in Canada', *Business Cycle Indicators*, Chapter 10; and Edward J. Chambers, 'Canadian Business Cycles since 1919; a Progress Report', *Canadian Journal of Economics and Political Science*, May 1958.

[2] The following quotation by an official from the Department of Trade and Commerce is of interest: 'It should be emphasized that the business cycle indicator approach is not, in general, used in a direct way to forecast the precise time-paths of the variables, or the exact date of turning-points in advance of the event. But knowledge of the current stage of the business cycle provides a cross-check on the reasonableness of estimates derived independently; it forces the forecaster to allow for the impact of probable cyclical developments on the magnitudes being predicted. And, in addition, cycle-on-cycle comparisons impose the requirement that the estimate be reasonable from the perspective of the normal cyclical behaviour of the variable. This process thus subjects the forecast estimates to two important constraints which aid the forecaster in reaching a judgement.'

[3] See R. A. Gordon, 'Alternative Approaches to Forecasting; the Recent Work of the National Bureau', *The Review of Economics and Statistics*, August 1962, pp. 284–99, and John P. Lewis, 'Short-Term General Business Conditions Forecasting: Some Comments on Method', *The Journal of Business*, October 1962, pp. 343–56.

successful early diagnosis and prognosis of economic developments (being an extremely complex matter in which the talents of the artist are applicable as well as the skills and experience of the scientist) must utilize a variety of approaches and requires a well-rounded programme of current statistical information.

In such a programme seasonally adjusted monthly, as well as quarterly, economic time series play a central role. Aside from their use in the construction of various analytical indicators, many of the seasonally adjusted monthly time series are well suited as projectors of components of the quarterly accounts, and have been used for this purpose since an early date. Such projections, which can be adjusted as more monthly data become available, though rough, are probably a more useful approach to an advance intimation of quarterly change of the national accounts than purely mechanical projections.[1] As indicated in Part I, considerable experimental work has been carried out during the last few years in Canada in an attempt to anticipate, on the basis of two months' information, estimates of the latest quarter. The results to date suggest that the aggregate gross national expenditure arrived at in this way comes practically as close to the final quarterly estimate as the first preliminary estimate, but not the components.

PART III

A QUANTITATIVE APPRAISAL OF 'RELIABILITY' AS REFLECTED IN REVISIONS

Introduction

It has been suggested in the preceding section that the quarterly accounts as a whole have been sufficiently reliable to serve as a useful, indeed indispensable, framework for current economic analysis in the light of available alternatives. The chances are that some users would feel that way even if the accounts were

[1]Such projections can be constructed on various assumptions; for example, that there was no change from the preceding quarter. The table in Part III showing the number of times the revisions exceeded the actual change in the final estimates in effect indicates whether this assumption would provide as good or better an indication of the actual change (as reflected in the final estimates) than the preliminary figures. There is, of course, the possibility that a 'sophisticated' model of how the economy works in the short-term could be developed which would yield better and quicker indications of change, as reflected in the 'final' quarterly estimates, than the first preliminary figures now available, at least for some components.

somewhat less reliable than they are believed to be, particularly if their release could be quickened. Nevertheless the question arises whether a more precise quantitative portrayal of the reliability of the aggregates and various components of the accounts than already made could be provided.

It is generally recognized that the techniques of assessing error which are applicable to statistical data derived from probability samples cannot, as a rule, be applied to economic time series such as the components of the accounts, encompassing as these components do a vast complex of data from a large variety of sources ranging from complete censuses and specially designed sample surveys, to administrative records, projections based on piecemeal, scattered and indirect information and, in some instances, near-guesses. Further, the fusing of this information into coherent categories involves adjustments which, while usually based on scrupulous study for internal consistency and consistency with external data, may at times be made on a rather intuitive basis. In this context, it does not appear feasible to measure purely statistical errors, in the sense of independent chance components attached to each observation.

In recognition of this, attempts have been made at various times to give quantitative expression of the degree of deficiency that the estimators themselves attribute to their statistical results. This subjective appraisal of 'error' in numerical terms has been employed, for example, by Simon Kuznets in his pioneering study, *National Income and Its Composition, 1919–1938*, volume II.

We have decided against using this approach here. Aside from being subjective, it does not lend itself to a systematic appraisal of error in the quarter-to-quarter changes in which major interest lies. However, if we were to use this approach it is likely that the general picture conveyed in Schedule 1 would be duplicated; that is to say, nearly one-half of the estimates would be classified as good, a third as fair and the remainder as poor. These three categories could then be described further by attaching to them appropriate (successively larger) orders of magnitude, preceded by the signs plus and minus.

A less subjective quantitative appraisal of error is applicable when the two sides of the accounts are estimated, more or less, independently. The difference between the two sides may then

be regarded as a broad indication of error in the overall aggregates. In the Canadian national accounts one-half of this difference is added to or subtracted from, as the case may be, the income and expenditure sides, and shown separately in the published figures under the perhaps misleading title of 'residual error of estimate'.[1] Thus the gross national expenditure is defined as the sum of expenditure components plus or minus the 'residual error' and, *mutatis mutandis*, the same is true for the gross national product.

This procedure – of estimating independently the two sides of the accounts and then allocating one-half the difference to each – has proven extremely useful and may have added considerably to the overall reliability of the accounts, in part in virtue of the disciplined investigation which is frequently generated by it. The characteristics of the 'residual error' are not discussed in this paper, but it bears emphasizing here that its apparent objectivity may be illusory to a significant degree. When the residual error is 'larger than usual' a re-examination of worksheets is undertaken. Occasionally, this examination may throw up some mechanical error or logical flaw in the estimation procedure that has been missed in the regular analysis of the statistical components for consistency and reasonableness. But even when no such error or flaw is discovered, some fairly arbitrary adjustment may on occasion be made. The fact that in a number of components adequate basic information is lacking leaves more leeway for rationalizing such adjustments.

Revisions as indicators of 'reliability'

Another quantitative approach, applicable to the components as well as the total, assumes that the last available estimate for any particular quarter is the more reliable figure than an earlier estimate for the same quarter, so that the difference between the two provides a measure of deficiency of the earlier figure.[2] This assumption, which underlies the discussion in the

[1] 'Residual difference' or 'residual discrepancy' might be more appropriate terms.

[2] This approach was used in a study of the U.S. National Accounts by Arnold Zellner. See his 'Statistical Analysis of Provisional Estimates of the G.N.P. and its Components, of Selected National Income Components and of Personal Saving', *Journal of the American Statistical Association*, March 1958, pp. 54–65. See also Statistical Evaluation Reports, Report No. 2, *Revisions of First Estimates of Quarter to Quarter Movement in Selected National Income Series 1947–1958* (seasonally adjusted data), Office of Statistical Standards, Bureau of the Budget, Washington, D.C., February 1960.

last section of Part II, is, of course, a reasonable one, the latest figures for a quarter being based usually on more complete and up-to-date information. The approach has, however, several major weaknesses.[1] First, it sheds no light on the extent to which the last available estimate may itself be faulty. Secondly, the approach may give a misleading impression of strength or weakness of the earlier estimates. Basically, it measures the degree to which revisions have taken place over a period of time. If a particular series has not undergone any revision because, say, no new data have become available during the period in question, then the preliminary series will appear strong even though it may, in fact, be very weak. At the same time, another preliminary series, intrinsically more reliable, may have been revised substantially as a result of improvements introduced during the period and consequently will appear weak.[2]

It has been deemed worth while, nevertheless, to carry out a detailed study utilizing this approach. Attempts to strengthen a component of the accounts are made by procuring additional information and improving concepts and methodology. To the extent that this has taken place the resulting revisions are indeed a reflection of improvement of the earlier estimates as well as a measure of their weakness at the starting-point. Secondly, this approach opens up questions regarding the factors responsible for observed revisions, and an investigation of these factors, along the lines described later. Such investigations themselves provide insights into the character and reliability of the various estimates. Thirdly, the approach lends itself not only to an assessment of deficiency in the level of the preliminary estimates but in the quarter-to-quarter changes as well, and since major interest lies in the latter this is a very important consideration.

Before proceeding to a quantitative description of the revisions, certain additional features and limitations of the procedures used require elaboration.

To summarize, at any particular quarter we have a time series of quarterly estimates based on latest available information and best judgements. The estimates of the successive quarters in this

[1] See also page 30.

[2] It should be noted, too, that when revisions are, on average, of constant magnitude over time, this does not mean that the preliminary estimates are not getting better; it may simply reflect the fact that both the preliminary and final estimates have improved at the same rate. Similarly, revisions of increasing size may not necessarily reflect that the preliminary data have deteriorated, but rather that the final ones have improved.

series are not, however, entirely alike, some having been based on more complete and up-to-date information than others. As we go back in time the estimates are relatively stronger, those for the most recent quarters being based on least complete data. However, major interest centres around the most recent quarters as indicators of emerging developments in the economy. Two related questions arise: How adequate a representation of quarter-to-quarter change of the ultimate estimates are the most recent estimates of quarter-to-quarter change? How adequate a representation of the level of the ultimate estimate is the level of the most recent estimate?

These questions may be asked of each most recent quarterly estimate as it becomes available, to be referred to henceforth in this paper as the 'first' estimate of a quarter. They may also be asked of the subsequent estimates of the same quarter until it has reached the status of 'ultimate', to be referred to henceforth as the 'final' estimate of the quarter. Thus, in between the 'first' estimate of a quarter and its 'final' estimate there are a number of intermediate estimates of the same quarter. Just how many of these there are depends on the revision practice.

Considerations of time did not permit adequate study of the intermediate estimates, and in what follows attention is confined to the differences between the first and final estimates only. These differences are referred to as 'revisions' in the remainder of this paper.

Although the Canadian quarterly accounts go back to 1947, it has not been considered appropriate to use the whole time series in the present review. The estimates from 1947 to 1952 were made retrospectively in 1953, when the annual data for these years were already available. The first estimates for these years are, therefore, of a different order from those of the subsequent years when the estimates were made contemporaneously. For opposite reasons the year 1961 has not been used; at the time the calculations for the present project were being carried out, during 1962, only limited revisions had been made to the estimates of the preceding year. Accordingly, the review below is confined to the eight-year period from 1953 to 1960.

A further complication arises from the fact that the first six years of this relatively short time series (1953–8) differ from the last two years (1959–60) in two important respects. First, the round of revisions for the period from 1953 to 1958 is complete

in the sense that no further changes are anticipated until the material from the 1961 decennial census is built into the estimates. By contrast, although the estimates of the two subsequent years have undergone considerable revision, it is expected that further changes will have to be made to a number of the components before the census material becomes available. Accordingly, for these components, the latest available estimates for the years 1959 and 1960 are not quite as 'final' as those of the preceding years.

Secondly, a revised volume of the quarterly national accounts was issued early in 1959 incorporating certain changes in concepts and methods as well as 1951 decennial and other new information.[1] The figures in this volume superseded all previous estimates from 1947 on. Accordingly the first estimates for quarters beginning with (approximately) 1959[2] are on a somewhat different basis than first estimates of the preceding quarters.

In recognition of the fact that the two periods are not homogeneous, separate summary measures have been calculated for the years 1953–58 and 1959–60. It should be noted, however, that even so it is rather difficult to interpret the summary measures shown below. In particular, the years from 1953 to 1958 represent a period of statistical consolidation, especially as far as changes in concept and methods are concerned. One would expect increasing stability in the estimates as experience is gained, as data gaps get filled, and as the concepts and methods used settle down. In fact, various new forces come into play, disrupting potential stability. Whether, overall, these forces will give rise to changes in the future that are as large as in the past is not something that, we believe, can be appraised through a probability calculus.

Be that as it may, the summary measures are presented below merely as a quantitative impression of the extent to which the first published estimates have been amended. This is of considerable interest in itself as an indication of the extent to which the

[1] *National Accounts, Income and Expenditure, by Quarters, 1947–1957*, Dominion Bureau of Statistics, Catalogue No. 13–511 (Ottawa, 1959). This monograph contains a description of concepts, sources and methods used. An up-to-date version will be found in *National Accounts, Income and Expenditure, by Quarters, 1947–1961*, Dominion Bureau of Statistics, Catalogue No. 13–519 (Ottawa, 1962).

[2] It is extremely difficult to determine the exact period that this discontinuity in concept and methods has taken place because some of the contemplated changes were, in fact, linked into the preliminary estimates in 1958 or even earlier.

statistician has had to change his mind in the light of hindsight, as it were. In addition, as already indicated, the calculations have served as an occasion for sifting out systematically the major factors that have been responsible for revisions. The results of this sifting are described later, but it should be noted here that, in many instances, it has been extremely difficult to determine precisely the causes of the revisions, in part because the available records have not been kept in a form to facilitate such analysis. Indeed, one of the lessons of the present study has been to highlight the usefulness of maintaining such records for future analysis.

The summary measures employed are elementary. The final estimate of each quarter was subtracted from the first estimate of the same quarter; these differences were then summed and divided by the number of observations, that is, the number of quarters. Two types of averages were calculated: the one ignoring the sign in summation, to be referred to henceforth as the *absolute mean*; the other taking the sign into account, to be referred to henceforth as the *algebraic mean.*

The absolute mean is the more relevant measure in that it indicates the extent to which, on average, the first estimate has failed to represent the final estimate, irrespective of whether the former was larger or smaller than the latter. The algebraic mean, on the other hand, indicates the extent to which the first estimate tended to be biased in a particular direction, that is to say, whether, on average, it was smaller or larger than the final estimate for the period under consideration.

The same summary measures were calculated for the revisions in quarter-to-quarter changes and the revisions in the level of the estimates.[1] The absolute means of the revisions have been expressed as a percentage of the final estimates of quarterly change and level, respectively. Expressed in this form the sum-

[1] It should be noted that the first estimate of quarter-to-quarter change is the difference between the *first* estimate (of level) of a particular quarter and the *second* estimate (of level) of the preceding quarter. This is because when the first estimate of a particular quarter is published it is frequently accompanied by a revised (second) estimate of the preceding quarter, and it is the difference between this latter and the first estimate of the current quarter that users calculate to determine quarter-to-quarter change. For example, the first estimate of the first quarter of 1958 of the gross national expenditure was $31,676 million (seasonally adjusted at annual rates). When the first estimate of the second quarter of 1958, amounting to $32,248 million, was published, the figure of the preceding quarter had been revised to $31,684 million. The change between the first and second quarter of 1958 was calculated by subtracting $31,684 million (not $31,676 million) from $32,248 million.

mary measures provide a convenient bird's-eye view of the relative importance of the revisions. Another comparison of interest is the extent to which the movements of the first and final estimates were in a different direction; and the number of times the revisions were larger than the quarter-to-quarter movements of the final estimates. This information is shown in a separate table.

The series summarized include all those forming the expenditure side of the accounts, major components of the income side, and several aggregates. The notes that follow are designed to guide the reader through the tabular material, more detailed explanatory comment being reserved for Part IV, which, however, deals mainly with the seasonally unadjusted series.

Quantitative description of revisions

It may be well to begin with a note on terminology to avoid confusion: the quarterly estimates, unadjusted for seasonal variation, will be referred to henceforth as the 'unadjusted series'; those which have been adjusted for seasonality will be referred to as the 'adjusted series'. Thus reference will be made to the first and final estimates of the unadjusted series, and similarly for the adjusted series. It should be clear from the text when reference is made to characteristics of the underlying series in contradistinction to the revisions of the first estimates.[1]

It should be noted, too, that while the averages shown below are a convenient shorthand method of conveying the character of the revisions, and are believed to be of considerable interest and significance, they can be misleading, in a degree. In actual economic analysis the quarterly figures are used as a time series, and individual quarters are studied, in sequence, in relation to the preceding and following quarters; the import of the revisions

[1] If X_p^t represents the first estimate of a quarter and X_f^t the final estimate of the same quarter, the revision, in level, of a quarter as defined in this paper equals $X_p^t - X_f^t$. If N represents the number of observations for which the revisions were calculated, then the absolute mean of the revisions in level equals

$$\frac{\Sigma[X_p^t - X_f^t]}{N}$$

If X_p^{t-1} represents the estimate of the previous quarter published at the same time as X_p^t, the first estimate of quarter-to-quarter change equals $X_p^t - X_p^{t-1}$. If the final series is expressed similarly only with subscript 'f', the final estimate of quarter-to-quarter change equals $X_f^t - X_f^{t-1}$ and the absolute mean of the revisions in quarter-to-quarter change equals

$$\frac{\Sigma[(X_p^t - X_p^{t-1}) - (X_f^t - X_f^{t-1})]}{N}$$

may be considerably different when they are viewed in this context. This matter is considered further in the summary at the end of this section.[1]

Unadjusted series

The unadjusted series are dealt with first, because: they are the foundation on which the adjusted series are based; they facilitate making comparisons later with certain characteristics of the adjusted series; and, of necessity, the discussion in Part IV deals mainly with them.

Table I deals with the final quarterly series, not with revisions. The average movements from quarter to quarter of the final estimates, expressed in percentages, are shown to provide perspective.

TABLE I

Absolute and algebraic means of final estimates of quarter-to-quarter percentage change, unadjusted series

Item	1953–58		1959–60	
	Absolute Mean (1)	Algebraic Mean (2)	Absolute Mean (1)	Algebraic Mean (2)
Gross national expenditure	12·10	2·67	9·91	1·46
Consumer expenditure	9·08	2·68	8·38	1·55
Government expenditure	11·07	2·50	11·24	1·84
Business fixed capital formation	15·05	3·97	16·18	1·33
Changes in non-farm inventories	*	*	*	*
Changes in farm inventories	*	*	*	*
Exports of goods and services	10·94	2·39	11·59	1·76
Imports of goods and services	9·05	2·19	8·68	1·20
Wages and salaries	3·59	1·70	3·12	1·18
Corporation profits	14·35	2·84	14·38	−0·81
Net income of non-farm unincorporated business	14·44	3·96	17·42	2·75
Accrued net farm income	*	*	*	*
Indirect taxes less subsidies	2·28	1·61	2·62	1·68
Gross national product less farm income	5·35	2·05	5·18	1·21
Personal disposable income	12·59	2·95	8·67	1·48
Personal net saving	*	*	*	*

Note: The percentage change of each quarter from the preceding quarter was calculated; these percentage changes were summed and divided by the number of quarters, ignoring sign in the summation to arrive at the absolute mean, and taking sign into account to arrive at the algebraic mean.

* The quarter-to-quarter percentage changes of these items are difficult to interpret.

[1] See pages 60–65 inclusive.

It will be seen that for most components the absolute mean (that is, ignoring sign) of the quarter-to-quarter percentage changes has been substantial.[1] By contrast, the algebraic mean has been much smaller.

This combination of large absolute means and small algebraic ones is primarily a reflection of the wide seasonal swings in economic activity in Canada, but the significant aspect for our present purposes is the fact that the large quarterly swings, embodied in the absolute means, provide a sizeable 'target' at which the first estimate of change can aim. On this account *alone* one might expect the first estimates of change to come relatively close to the 'target', as represented by the final estimates of change. In fact, numerous other factors enter into the picture which, together with the size of the target, determine the extent to which it is missed by the first estimates.[2] This can be inferred from an examination of Table II.

The main question that Table II is designed to answer is: How does the size of the revision in quarterly change compare with the size of the final estimates of quarterly change? Column (1) of the table shows the average quarterly change (in dollar amounts) of the final estimates and corresponds to column (1) of Table I. Column (2) of Table II shows the size of the average revisions, that is, the difference between the first estimates of quarterly change and the final estimates of quarterly change. Column (3) of the table is perhaps the most revealing one in that it indicates by what proportion the final change was missed, on average, by the first estimate of change.

It will be seen that the average missed proportions varied widely, from only 3 per cent in the case of exports in the years 1959–60 to some 52 per cent in the case of government expenditure in the period 1953–58. Further, the missed proportions have been, in general, appreciably smaller in the period 1959–60 than in the preceding years, reflecting in most cases larger quarterly changes as well as smaller revisions. While it is felt that for a

[1] It is not within the purview of the present paper to consider the economic factors responsible for the differences in the observed quarter-to-quarter changes of the various items, but it should, perhaps, be noted that the much smaller absolute mean change in wages and salaries is, in the main, a reflection of the fact that wages and salaries are subject to less seasonal fluctuation in Canada than most other series. The large changes in personal disposable income and gross national expenditure reflect the sharp seasonal swings in farm income.

[2] Some of the individual quarterly changes (targets) hidden in the averages, are, in fact, small.

TABLE II

Absolute means of revisions of quarterly change compared with absolute means of final estimates of quarterly change, unadjusted series

	1953–58			1959–60		
	Absolute means of: Final estimate of Q to Q change $M	Revision in Q to Q change $M	Relative size of revision %	*Absolute means of:* Final estimate of Q to Q change $M	Revision in Q to Q change $M	Relative size of revision %
Gross national expenditure	3,418	325	9·5	3,452	243	7·0
Consumer expenditure	1,621	269	16·6	1,909	118	6·2
Government expenditure	556	287	51·6	728	111	15·2
Business fixed capital formation	816	154	18·9	1,024	101	9·9
Changes in non-farm inventories	584	314	53·8	829	111	13·4
Changes in farm inventories	2,172	132	6·1	2,156	119	5·5
Exports of goods and services	615	36	5·9	750	23	3·1
Imports of goods and services	594	69	11·6	671	36	5·4
Wages and salaries	504	123	24·4	542	50	9·2
Corporation profits	384	98	25·5	455	128	28·1
Net income of non-farm unincorporated business	254	83	32·7	377	88	23·3
Accrued net farm income	2,043	178	8·7	1,849	108	5·8
Indirect taxes less subsidies	75	33	44·0	111	31	27·9
Gross national product less farm income	1,429	257	18·0	1,717	191	11·1
Personal disposable income	2,424	256	10·6	2,130	126	5·9
Personal net saving	2,978	364	12·2	3,117	177	5·7

Notes to Table II:

(*a*) As indicated in column (3), the relative size of the revision was arrived at by (i) calculating the revisions of quarter-to-quarter change in *terms of dollars*, (ii) taking the absolute mean of these revisions and (iii) expressing the latter as a (percentage) ratio to the absolute mean of the final estimates of quarter-to-quarter change in *terms of dollars*. Another way of arriving at the relative size of the revisions is to (i) calculate the revisions of *percentage* quarter-to-quarter change, (ii) take the absolute mean of these revisions and (iii) express the latter as a percentage ratio to the absolute *mean of final estimates of percentage quarter-to-quarter change*. Calculations were also carried out using the second method and the same general picture emerged, even though there were, of course, some differences in detail. The calculations based on the dollar magnitudes are more clearly related to the revisions in the level of the estimates shown in Table V and to the discussion of sources of revisions of Part IV.

(*b*) The dollar value figures of Table II, and the following tables, were arrived at after the original quarterly estimates (first and final) had been multiplied by four. This was done in order to bring them to the same basis as the adjusted series which are published at 'annual rates'.

(*c*) The dollar figures of quarterly change of (the change of) farm inventories, which are reflected also in accrued net farm income, personal disposable income, personal saving and gross national expenditure, are determined mainly by the concentration of the farm crop in the third quarter. Accordingly, the large size of the means for these items reflects mainly the severe seasonal fluctuations in farm production.

(*d*) The symbol '$M' in this and the following tables represents 'millions of dollars'.

number of components, for example, fixed capital formation and government expenditure, this represents some genuine sharpening of the quality of the first estimates, it appears advisable to draw attention here to the caution already emphasized, that the estimates for most components for the years 1959–60 are still subject to change, possibly large change.

Some further comment regarding the relative size of the

revisions is made later, when corresponding ratios of the adjusted series are considered. But, before turning to a consideration of the next table, it appears appropriate to draw attention to the following:

First, it bears repeating that the relative size of revisions, even if they were all in final form, is an inadequate indicator of the quality of the various estimates. To illustrate, in 1959–60, the revisions in corporation profits have been somewhat higher than in the preceding years, and higher, too, than net non-farm unincorporated income. The revisions in the latter were smaller in 1959–60 than in the preceding period. It would clearly be unsafe to infer from this that the first estimates of corporation profits in 1959–60 were of lower quality than they were in 1953–58; or that the estimates of corporation profits are of lower quality than net income; or that the latter improved during the period. The fact is that appraisal of quality of the various estimates is necessarily a highly complex matter, encompassing many aspects, of which the revision characteristics as summarized in Table II are merely one.

Second, in all components, with the exception of inventories, the first estimates employed in the calculations are the ones actually published. In the case of inventories the first published estimates for the years 1953 to 1957 had been arrived at by differencing book values; they, therefore, represented the change in the value of inventories rather than the value of the physical change, as subsequently published. However, estimates of the value of physical change were also made in the earlier period, though they were not published. It was decided, for purposes of this paper, to use these unpublished data so that all estimates of inventory change employed in this paper, first as well as final, are on a value of physical change basis. The gross national expenditure and product series used here likewise incorporate these unpublished inventory figures.[1]

Third, a discussion of the factors responsible for the revisions is deferred to Part IV, but it should be noted here that the revisions shown in the tables of Part III arise from a variety of sources: factors giving rise to annual revisions as well as those related to quarterly estimation alone; non-repetitive factors such

[1] The calculations of the gross national expenditure were also made on the old (published) basis. The general picture of the revisions of this aggregate is substantially the same on either basis, but for inventories it would probably be quite a bit different.

as changes in concepts[1] which, once having been introduced, no longer constitute a source of revision, as well as repetitive factors resulting from the regular up-dating of available information.

We now proceed to an examination of Table III that summarizes the number of quarters in which the revision was larger

TABLE III

Number of quarters in which revision was larger than the quarter-to-quarter change in final estimates and number of quarters in which revisions altered direction of change, unadjusted series

	1953–58		1959–60	
	Revision in change larger than final change (1)	Revision altered direction of change (2)	Revision in change larger than final change (1)	Revision altered direction of change (2)
Gross national expenditure	0	0	0	0
Consumer expenditure	4	0	0	0
Government expenditure	7	3	1	0
Business fixed capital formation	2	1	0	0
Changes in non-farm inventories	5	3	0	0
Changes in farm inventories	2	1	0	0
Exports of goods and services	0	0	0	0
Imports of goods and services	0	0	0	0
Wages and salaries	4	2	0	0
Corporation profits	2	1	1	0
Net income of non-farm unincorporated business	4	2	1	1
Accrued net farm income	1	0	1	0
Indirect taxes less subsidies	5	5	3	2
Gross national product less farm income	3	2	0	0
Personal disposable income	0	0	0	0
Personal net saving	3	1	1	0

Notes to Table III:

(*a*) The total number of observations (quarters) for the period 1953–58 amounted to 23; and for 1959–60 to 8.

(*b*) In the case of column (2), in a few instances the first estimates showed no change, and the final showed an increase or decrease, or vice versa. These were not entered.

(*c*) 'Larger' in the context of this table refers to relative magnitude irrespective of sign.

[1] It could, of course, be argued that adjustment for conceptual changes should have been made before undertaking the calculations. This was considered but rejected, in part because it was inconvenient to do (with the exception of inventories).

than the final estimate of quarterly change, and the number of times the direction of change in the first estimate was opposite to that of the final estimate of change.

In view of what has been said above regarding the size of the 'target' embodied in the absolute mean quarterly changes, it might be expected that, with the exception of indirect taxes less subsidies and wages and salaries, the size of the revision in a quarterly change should seldom exceed the size of the actual change; or should seldom alter the direction of the change. This expectation is borne out substantially, but by no means entirely, by the record of performance of the first estimates.

One reason why the performance is somewhat short of expectations is hidden in the averaging process. While, for most components, the amplitudes of change in the unadjusted series are very large on average, they are quite small in certain quarters. Thus in the case of consumer expenditure the change from the second to the third quarter is typically small (in the neighbourhood of 2 per cent). More or less the same situation prevails in the case of non-farm unincorporated income. To a lesser extent this is also true for wages and salaries, the percentage change from the third to the fourth quarter being quite a bit smaller than the remainder, which, as we have seen, are also relatively moderate. Most cases of divergence did, in fact, occur in quarters with small amplitude of change, leaving aside the special case of government expenditure, which is discussed in Part IV.

In regard to the question of bias, that is to say, the extent to which the first estimates of quarterly change have tended to understate or overstate the final estimates of quarterly change, we turn to Table IV.

It will be seen from examination of Table IV that, for most components, the number of quarters in which the first estimate of change was higher than the final estimate of change was close to one-half of the total number of quarters for which the calculations were carried out, indicating little bias by this yardstick. However, during 1953–58 the size of the understatement of the first estimates of most components tended to be bigger than the overstatement. As a consequence, while there was substantial cancellation in the revisions over the period, the first estimates of change have tended to understate the final estimate of change on average, although by a moderate amount. During 1959–60 an opposite tendency is indicated for a number of components –

the first estimates of change have tended to be moderately higher on average.[1]

TABLE IV

Indications of bias in first estimates of change, unadjusted series

(Number of quarters in which first estimate of change was higher than final estimate of change; and algebraic mean of revisions of quarterly change)

	1953–58			1959–60		
	Number of quarters first estimate of change higher than final estimate	Algebraic mean final quarterly change	Algebraic mean revisions of quarterly change ('bias')	Number of quarters first estimate of change higher than final estimate	Algebraic mean final quarterly change	Algebraic mean revisions of quarterly change ('bias')
	(1)	$M (2)	$M (3)	(1)	$M (2)	$M (3)
Gross national expenditure	10	517	−54	4	333	57
Consumer expenditure	8	399	−43	4	271	41
Government expenditure	14	88	−45	3	66	−30
Business fixed capital formation	10	126	−32	3	−43	−1
Changes in non-farm inventories	10	−21	−5	4	20	34
Changes in farm inventories	11	−22	24	3	9	31
Exports of goods and services	10	90	−10	2	54	−9
Imports of goods and services	11	109	−9	5	50	−8
Wages and salaries	9	227	−17	6	196	30
Corporation profits	10	41	−18	4	−27	48
Net income of non-farm unincorporated business	12	45	−28	4	18	−8
Accrued net farm income	13	18	44	4	−23	7
Indirect taxes less subsidies	10	52	10	2	69	−14
Gross national product less farm income	7	499	−98	4	356	50
Personal disposable income	12	353	9	3	236	−20
Personal net saving	12	−46	51	4	−35	−61

Notes to Table IV:

(*a*) In regard to column (1) it should be noted that there were 23 observations (quarters) in 1953–8 and 8 in 1959–60.

(*b*) The means of columns (2) and (3) have been calculated in the same manner as those of Table II except that the sign was taken into account in the summation.

(*c*) The dollar values are, in effect, quarterly amounts multiplied by 4, as in Table II.

(*d*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.

Turning now to the average levels of the quarterly estimates, Table V compares the absolute means of the revisions in the level of the quarterly estimates with the absolute means of the final estimates of quarterly level.

[1] It should be noted that this moderate bias (both negative and positive) represents a considerable percentage of the algebraic means of the final estimates of change, in some cases (mainly inventories and personal saving) an extremely large percentage. The dollar values have been featured in Table IV because they are believed to be more meaningful here than the percentage relationships such as shown in column (3) of Table II.

TABLE V

Absolute means of revisions of quarterly level compared with absolute means of final estimates of quarterly level, unadjusted series

	1953–58			1959–60		
	Absolute means of: Final estimates of quarterly level $M (1)	Revisions of quarterly level $M (2)	Relative size of revision % (3)	*Absolute means of:* Final estimates of quarterly level $M (1)	Revisions of quarterly level $M (2)	Relative size of revision % (3)
Gross national expenditure	28,735	875	3·0	35,356	281	0·8
Consumer expenditure	18,218	579	3·2	22,931	201	0·9
Government expenditure	5,121	271	5·3	6,566	104	1·6
Business fixed capital formation	6,012	264	4·4	6,793	99	1·5
Changes in non-farm inventories	428	231	54·0	496	87	17·5
Changes in farm inventories	1,419	100	7·0	1,433	96	6·7
Exports of goods and services	5,901	42	0·7	6,853	47	0·7
Imports of goods and services	6,802	74	1·1	8,146	74	0·9
Wages and salaries	14,199	501	3·5	17,791	271	1·5
Corporation profits	2,890	111	3·8	3,388	162	4·8
Net income of non-farm unincorporated business	1,872	67	3·6	2,191	81	3·7
Accrued net farm income	1,263	175	13·9	1,156	72	6·2
Indirect taxes less subsidies	3,412	57	1·7	4,349	67	1·5
Gross national product less farm income	27,480	1,013	3·7	34,200	236	0·7
Personal disposable income	19,406	254	1·3	24,353	196	0·8
Personal net saving	1,622	434	26·8	1,966	207	10·5

Notes to Table V:

(*a*) The total number of observations for the period 1953–58 amounted to 24; and for 1959–60 to 8.

(*b*) Column (1) is simply the sum of the final quarterly estimates divided by the total number of quarters, ignoring sign. Column (2) has been calculated by subtracting the final estimate of each quarter from the first estimate of the same quarter, summing these differences, ignoring sign, and dividing by the total number of quarters.

(*c*) As in the preceding tables, the dollar figures are at 'annual rates', that is, the quarterly values multiplied by 4.

As before, the relative size of revisions for most components has been quite a bit smaller in 1959–60 than in the preceding years[1] and this should be interpreted in the light of the comments already made on Table II. The large percentage revision in personal saving, compared with that of most other components, should occasion no surprise, as this item is estimated residually, by subtracting consumer expenditure from personal disposable income. The saving residual is a small proportion of each of the components from which it is derived and, as a consequence, even small revisions in the components may loom very large as

[1] As already indicated, for most components the revisions in quarterly levels reflect, in the main, revisions in the annual estimates. See the appendix for the latter.

a percentage of the residual. Similarly, in the case of the inventory figures the base on which the percentages are calculated is not the value of the total inventory, but the much smaller figure of the value of physical change.[1]

The first estimates of the level of the quarterly figures have shown a noticeably more pronounced 'bias' than the first estimates of change described before, as a comparison of Table VI, below, with Table IV will indicate.

TABLE VI

Indications of bias in first estimates of quarterly level, unadjusted series

	1953–58		1959–60	
	Number of quarters in which first estimate of quarterly level higher than final estimate (1)	Algebraic mean of revision of first estimates of level $M (2)	Number of quarters in which first estimate of quarterly level higher than final estimate (1)	Algebraic mean of revision of first estimates of level $M (2)
Gross national expenditure	0	−875	2	−226
Consumer expenditure	0	−579	1	−190
Government expenditure	7	−158	4	−47
Business fixed capital formation	5	−175	2	−30
Changes in non-farm inventories	12	−68	2	−31
Changes in farm inventories	11	−13	5	20
Exports of goods and services	5	−35	0	−47
Imports of goods and services	5	−53	1	−61
Wages and salaries	0	−501	7	248
Corporation profits	6	−73	0	−162
Net income of non-farm unincorporated business	3	−56	0	−81
Accrued net farm income	18	138	4	−1
Indirect taxes less subsidies	1	−53	0	−67
Gross national product less farm income	0	−1,013	1	−225
Personal disposable income	7	−173	4	−49
Personal net saving	21	406	5	141

Notes to Table VI:

(*a*) The total number of observations for the period 1953–58 amounted to 24; and for 1959–60 to 8.

(*b*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.

[1] By coincidence the relative size of the revision in non-farm inventories, in 1953–58, in Table V is practically the same as the one in Table II.

For most components the first estimates of quarterly level tended to be lower than the final estimates, and in several cases this understatement persisted for nearly all quarters. In particular, the first estimates of consumer expenditure were lower than the final estimates for all quarters but one during the period from 1953 to 1960. However, the downward bias was much less in 1959–60 than in the preceding periods for many items.[1]

Adjusted series

The revisions in the adjusted series have been summarized in the same manner as those of the unadjusted series just described, except that the tables have been supplemented by charts, in recognition of the fact that the adjusted series are the ones that are generally used for economic analysis and, as a consequence, the revisions in them are of particular interest to users of the data. Examination of the charts should permit a more realistic appraisal of the significance of the revisions than can be made from an analysis of the summary measures alone.

Table VII below summarizes the data for the adjusted series in the same manner as Table I does for the unadjusted series.

It will be seen that in comparison with the unadjusted series the quarter-to-quarter changes of the adjusted series are very small. This is, of course, the result of adjusting the data for seasonal variation; its very purpose is to remove recurring intra-annual fluctuations, and the larger the latter the smaller will the quarter-to-quarter changes of the adjusted series usually be by comparison with the unadjusted. Thus the first estimates of change in the adjusted series have to try to hit a much smaller target, obviously a more difficult objective.[2]

[1] With the exception of inventories, personal saving and farm income, the final figures in all quarters were, naturally, positive; the algebraic means are, therefore, the same as the absolute means shown in column (1) of Table V. The relative size of the revisions in column (2) of Table VI may be obtained by comparing them with the figures in column (1) of Table V. It will be seen that where the first estimates of level have not been higher in any quarter during the period studied than the final estimates, the algebraic and absolute means of the revisions are identical.

[2] A similar comparison may be made with the annual figures; the year-to-year percentage changes having been quite a bit larger than the quarter-to-quarter changes in the seasonally adjusted series. The annual figures are shown in the Appendix. It should be noted here that the phrase 'at annual rates' which is customarily attached to the seasonally adjusted series is somewhat misleading: all that is meant is that the quarterly adjusted *value* series have been multiplied by 4 in order to bring them to an annual basis. The quarter-to-quarter percentage changes in Table VII would also have to be multiplied by about 4 in order to bring them to an annual basis (or rate).

TABLE VII

Absolute and algebraic means of quarter-to-quarter percentage change in the final, adjusted series

	1953–58		1959–60	
	Absolute mean (1)	Algebraic mean (2)	Absolute mean (1)	Algebraic mean (2)
Gross national expenditure	1·73	1·34	1·29	1·03
Consumer expenditure	1·58	1·50	1·20	1·20
Government expenditure	2·92	1·72	2·05	1·17
Business fixed capital formation	3·23	1·58	2·53	−0·57
Changes in non-farm inventories	*	*	*	*
Changes in farm inventories	–	–	–	–
Exports of goods and services	2·72	0·88	4·36	0·99
Imports of goods and services	3·17	1·35	1·55	0·60
Wages and salaries	1·51	1·47	1·12	1·12
Corporation profits	4·46	0·93	3·31	−0·78
Net income of non-farm unincorporated business	2·35	1·08	1·89	0·44
Accrued net farm income	10·76	−0·35	6·67	0·87
Indirect taxes less subsidies	2·16	1·46	2·09	1·53
Gross national product less farm income	1·80	1·48	1·23	1·05
Personal disposable income	1·71	1·48	1·38	1·03
Personal net saving	*	*	*	*

Note to Table VII:

(*a*) The percentage change of each quarter from the preceding quarter was calculated; these percentage changes were summed and divided by the number of quarters, ignoring sign in the summation to arrive at the absolute mean, and taking sign into account to arrive at the algebraic mean.

* The quarter-to-quarter percentage changes of these items are difficult to interpret.

On this account alone one would expect the relative size of revisions in the adjusted series to be larger than those of the unadjusted series. In addition, another factor, inherent in the process of seasonal adjustment, conspires to produce the same result. Since the averaging procedure employed in adjusting the series for seasonal variation centres the moving average two quarters back from the quarter for which the latest actual data are known, the factors for the two most current quarters can only be estimated. Unless, therefore, one is dealing with a time series which has stable seasonal factors, the first estimates of the adjusted series may have to be revised considerably as one progresses through time.

Thus it should occasion no surprise that the relative size of the revisions in Table VIII is substantially larger than the corresponding revisions in Table II.[1]

TABLE VIII

Absolute means of revisions of quarterly change compared with absolute means of final estimates of quarterly change, adjusted series

	1953–58			1959–60		
	Absolute means of: Final estimate of Q to Q change	Revision in Q to Q change	Relative size of revision	*Absolute means of*: Final estimate of Q to Q change	Revision in Q to Q change	Relative size of revision
	$M	$M	%	$M	$M	%
	(1)	(2)	(3) = (2)/(1)	(1)	(2)	(3) = (2)/(1)
Gross national expenditure	488	196	40·2	449	145	32·3
Consumer expenditure	286	145	50·7	272	94	34·6
Government expenditure	145	156	107·6	133	77	57·9
Business fixed capital formation	187	108	57·8	174	80	46·0
Changes in non-farm inventories	287	237	82·6	349	73	20·9
Changes in farm inventories	168	161	95·8	73	61	83·6
Exports of goods and services	158	70	44·3	297	27	9·1
Imports of goods and services	208	67	32·2	125	33	26·4
Wages and salaries	213	88	41·3	194	34	17·5
Corporation profits	*	*	*	*	*	*
Net income of non-farm unincorporated business	43	45	104·7	41	54	131·7
Accrued net farm income	138	108	78·3	75	65	86·7
Indirect taxes less subsidies	73	38	52·1	88	56	63·6
Gross national product less farm income	487	225	46·1	415	123	29·6
Personal disposable income	332	230	69·3	332	262	78·9
Personal net saving	209	278	133·0	355	296	83·4

Note to Table VIII:

(*a*) For a description of the procedures used in calculating the means of Table VIII see note to Table II. The dollar value figures of Table VIII, and the following tables, are at annual rates.

* Not available.

It will be seen that, while the relative size of the revisions has varied from item to item it has represented, in almost all cases, a large proportion of the actual quarter-to-quarter change of the final estimates. The revisions in gross national expenditure, consumer expenditure, exports, imports and wages and salaries were the smallest, but, on average, even they ranged from a third to about one-half of the quarterly change in the final estimates, if the revisions in exports, imports and wages and salaries during 1959–60, which were smaller, are not counted. Taking the period

[1] A comparison of Tables II and VIII will show that while the process of seasonal adjustment reduces substantially the size of the denominator (target) it has a much smaller effect on the size of the numerator (revision).

from 1953 to 1960, as a whole, the largest relative revisions took place in government expenditure, net income of non-farm unincorporated business, personal saving, net farm income, changes in farm inventories and personal disposable income.

As might be expected, the much greater difficulty of the first estimates of change of the adjusted series in coming close to the 'target', compared with the unadjusted series, is also reflected in Table IX, which corresponds to Table III.

TABLE IX

Number of quarters in which revision was larger than the quarter-to-quarter change in final estimates and number of quarters in which revisions altered direction of change, adjusted series

	1953–58		1959–60	
	Revision in change larger than final change (1)	Revision altered direction of change (2)	Revision in change larger than final change (1)	Revision altered direction of change (2)
Gross national expenditure	2	1	0	0
Consumer expenditure	5	3	1	0
Government expenditure	11	7	3	3
Business fixed capital formation	7	4	3	2
Changes in non-farm inventories	7	2	0	0
Changes in farm inventories	13	7	3	1
Exports of goods and services	8	5	0	0
Imports of goods and services	4	3	1	1
Wages and salaries	2	1	0	0
Corporation profits	*	*	*	*
Net income of non-farm unincorporated business	10	5	4	3
Accrued net farm income	10	8	4	3
Indirect taxes less subsidies	7	5	2	1
Gross national product less farm income	2	1	0	0
Personal disposable income	8	5	2	0
Personal net saving	13	10	4	2

Notes to Table IX:

(*a*) The total number of observations (quarters) for the period 1953–58 amounted to 23; and for 1959–60 to 8.

(*b*) In the case of column (2), in a few instances the first estimates showed no change, and the final showed an increase or decrease, or vice versa. These were not entered.

(*c*) 'Larger' in the context of this table refers to relative magnitude irrespective of sign.

* Not available.

Despite the prominence of the revisions in the adjusted series (as measured by the absolute means) the size of a revision exceeded the final estimate of quarterly change in relatively few quarters, during the thirty-one quarters being studied, for some important items: gross national expenditure, gross national product less farm income, wages and salaries, consumer expenditure and imports. However, for the other components the revision exceeded the final estimate of quarterly change more frequently. There were, naturally, fewer quarters in which the revisions altered the direction of the first estimate of quarterly change than for the comparisons just made.

The number of times the revisions have not exceeded the final quarterly changes, and the coincidence of movement of the first and final estimates, are, of course, less significant for items that have moved predominantly in a particular direction (for example, gross national expenditure, consumer expenditure and wages and salaries, the quarter-to-quarter changes of which have been usually positive during the period) than for items that have fluctuated in both directions (for example, fixed capital expenditure, inventories, exports and imports). On the other hand, closer inspection of the individual observations detracts considerably from the significance of the divergence as reflected in Table IX and impounded in the averages of Table VIII. The figures in Table IX hide the fact, for example, that for a number of items the instances where the revisions were larger than the final estimates of quarterly change occurred mainly in one or two years.[1] Further, as indicated later in the summary, Tables VIII and IX feature the revisions in a manner that would be appropriate if individual quarters were studied in isolation. In actual practice, users have available a time series of quarterly estimates, of varying degree of revision, which they study as a whole in the light of past experience and in conjunction with other quarterly and monthly data. In this context estimates which are subject to large revisions are nevertheless useful. Thus Tables VIII and IX should be considered against the background of the material presented in Part II of this paper.[2]

It will be seen that the general picture summarized in Table X

[1] In the period 1953–58, both instances took place in 1954 for the gross national expenditure; all but two in 1953 and 1954 for consumer expenditure, fixed capital formation and personal disposable income; all but two in 1955 and 1956 for exports, and all but three in 1953 and 1956 for non-farm unincorporated income.

[2] See, in particular, pp. 29–34, and Chart 2.

TABLE X

Indications of bias in first estimates of change, adjusted series

(Number of quarters in which first estimate of change was larger than final estimate of change; and algebraic mean of revisions of quarterly change)

	1953–58			1959–60		
	Number of quarters first *estimate* of change higher than final estimate	Algebraic mean final *quarterly* change	Algebraic mean revisions *of* quarterly change ('bias')	Number of quarters first estimate of change higher than final estimate	Algebraic mean final quarterly change	Algebraic mean revisions of quarterly change ('bias')
	(1)	$M (2)	$M (3)	(1)	$M (2)	$M (3)
Gross national expenditure	8	381	−48	4	357	−31
Consumer expenditure	12	274	−34	2	271	−19
Government expenditure	9	87	−28	3	75	−51
Business fixed capital formation	9	89	−18	4	−43	7
Changes in non-farm inventories	10	1	3	2	11	−15
Changes in farm inventories	12	−25	−22	5	38	43
Exports of goods and services	11	49	2	2	58	−21
Imports of goods and services	10	−86	−21	4	47	−16
Wages and salaries	12	207	−8	5	194	14
Corporation profits	*	*	*	*	*	*
Net income of non-farm unincorporated business	11	20	−9	3	9	−23
Accrued net farm income	13	−19	7	4	6	21
Indirect taxes less subsidies	11	48	−15	4	63	−5
Gross national product less *farm income*	8	400	−55	2	315	−52
Personal disposable income	11	290	−12	3	248	−31
Personal net saving	14	16	24	3	−24	−12

Notes to Table X:

(*a*) In regard to column (1) it should be noted that there were 23 observations (quarters) in 1953–58, and 8 in 1959–60.

(*b*) The means of columns (2) and (3) have been calculated in the same manner as those of Table II, except that the sign was taken into account in the course of summation.

(*c*) The dollar values are quarterly amounts multiplied by 4, as in Table II.

(*d*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.

* Not available.

is very similar to that of Table IV. The number of times the first estimate of change was higher than the final estimate of change was, in most cases, about one-half of the total number of observations or close to it. Further, the dollar values of the bias as reflected in the algebraic mean of the revisions was moderate in size and negative; that is, the first estimates of change tended to be smaller on average than the final estimates of change. This was the case in 1959–60 as well as in 1953–58. Chart 3 shows more clearly the moderate nature of the bias.

Turning now to the revisions in the level of the adjusted series, it will be seen again that, with some exceptions, in parti-

cular inventories, the general picture portrayed in Table XI, below, is similar to the one in Table V.

TABLE XI

Absolute means of revisions of quarterly level compared with absolute means of final estimates of quarterly level, adjusted series

	1953–58			1959–60		
	Absolute means of: Final estimates of quarterly level $M (1)	Revisions of quarterly level $M (2)	Relative size of revision % (3)	*Absolute means of:* Final estimates of quarterly level $M (1)	Revisions of quarterly level $M (2)	Relative size of revision % (3)
Gross national expenditure	28,735	876	3·0	35,356	327	0·9
Consumer expenditure	18,218	550	3·0	22,931	248	1·1
Government expenditure	5,121	175	3·4	6,566	76	1·2
Business fixed capital formation	6,012	248	4·1	6,793	71	1·0
Changes in non-farm inventories	356	215	60·4	377	101	26·8
Changes in farm inventories	165	132	80·0	75	47	62·7
Exports of goods and services	5,901	50	0·9	6,853	59	0·9
Imports of goods and services	6,802	81	1·2	8,146	93	1·1
Wages and salaries	14,199	495	3·5	17,791	270	1·5
Corporation profits	*	*	*	*	*	*
Net income of non-farm unincorporated business	1,872	53	2·8	2,191	83	3·8
Accrued net farm income	1,255	150	12·0	1,156	79	6·8
Indirect taxes less subsidies	3,412	56	1·6	4,349	76	1·7
Gross national product less farm income	27,480	986	3·6	34,200	309	0·9
Personal disposable income	19,406	226	1·2	24,353	245	1·0
Personal net saving	1,188	376	31·6	1,422	267	18·8

Notes to Table XI:

(*a*) The total number of observations for the period 1953–58 amounted to 24; and for 1959–60 to 8.

(*b*) Column (1) is simply the sum of the final quarterly estimates divided by the total number of quarters, ignoring sign. Column (2) has been calculated by subtracting the final estimate of each quarter from the first estimate of the same quarter, summing these differences, ignoring sign, and dividing by the total number of quarters.

(*c*) As in the preceding tables the dollar figures are at 'annual rates', that is, the quarterly values multiplied by 4.

* Not available.

It should, perhaps, not occasion surprise that the relative size of the revisions in level of the adjusted series appears, in many instances, similar to that of the unadjusted series, even though it is visibly different for corresponding comparisons of quarterly changes, in view of the fact that revisions that represent a small proportion of the quarterly levels are of much greater relative importance in the quarterly changes. The greater prominence of the negative biases of the first estimates of level than in the first estimates of change, already commented on in

the discussion of the unadjusted series, is indicated again in Table XII.

TABLE XII

Indications of bias in first estimates of quarterly level, adjusted series

Item	1953–58		1959–60	
	Number of quarters in which first estimate of quarterly level higher than final estimate	Algebraic mean of revision of first estimates of level	Number of quarters in which first estimate of quarterly level higher than final estimate	Algebraic mean of revision of first estimates of level
		$M		$M
	(1)	(2)	(1)	(2)
Gross national expenditure	0	−876	2	−301
Consumer expenditure	0	−550	1	−238
Government expenditure	5	−165	3	−62
Business fixed capital formation	5	−186	5	16
Changes in non-farm inventories	8	−61	0	−101
Changes in farm inventories	12	−28	5	16
Exports of goods and services	10	−22	1	−58
Imports of goods and services	4	−55	1	−84
Wages and salaries	0	−495	7	231
Corporation profits	*	*	*	*
Net income of non-farm unincorporated business	1	−51	0	−83
Accrued net farm income	15	110	3	−11
Indirect taxes less subsidies	2	−50	1	−70
Gross national product less farm income	0	−986	1	−292
Personal disposable income	6	−195	3	−78
Personal net saving	21	357	5	161

Notes to Table XII:

(*a*) The total number of observations for the period 1953–58 amounted to 24; and for 1959–60 to 8.

(*b*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.

* Not available.

Summary and further comment – adjusted series

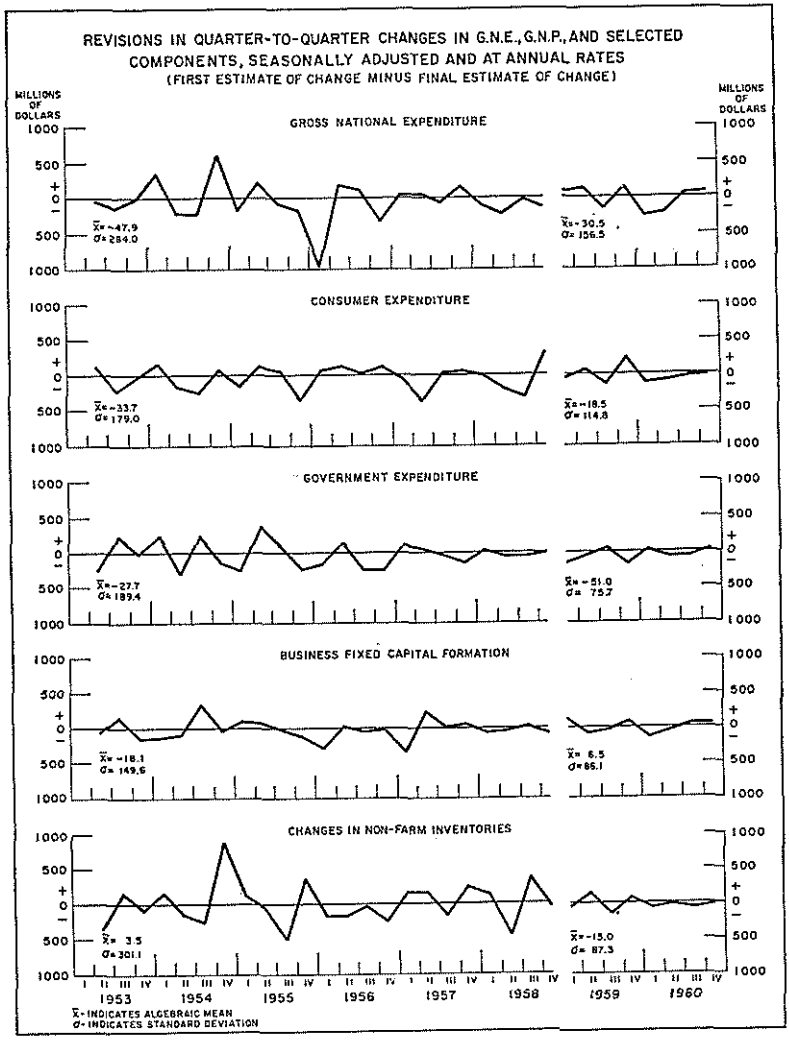
For most components the revisions of quarterly change in the adjusted series represented a sizeable percentage, on average, of the final estimates of quarterly change, and in a number of cases a very large percentage. Nevertheless, the record of performance of the adjusted series has been impressive for a number of

items: only once during the thirty-one quarters studied did the first estimate of change of the gross national expenditure, gross national product less farm income, and wages and salaries record the wrong direction of movement; and only twice was the revision in them larger than the final estimate of change. The first estimates of the strongly fluctuating series of non-farm inventory change showed a faulty direction only twice, although the revisions were larger than the final estimates of change in seven out of the thirty-one quarters. The first estimates of consumer expenditure missed the direction of change three times during the period, and the revision was larger than the change six times. The record of the first estimates of imports has been similar to that of consumer expenditure, although that of exports rather poorer. However, the first estimates of most of the other components studied, in particular changes in farm inventories, net income of non-farm unincorporated business, accrued net farm income, personal disposable income and personal saving were markedly poorer by the tests used in Table IX. For most components the tendency of the first estimates to understate the change was moderate on average, and less pronounced than their tendency to understate the level.

While the figures of the tables in Part III are of considerable interest and significance, they suffer from two limitations which bear the emphasis of repetition. The first arises from the nature of the averaging process and can only be overcome, in part at least, by study of the individual observations such as shown in the charts, especially Chart 2. To illustrate, examination of Chart 2 clearly shows that the divergences between the first and final estimates of business fixed capital formation were concentrated mainly in the earlier years of the period studied (especially 1953 and 1954) and that subsequently the performance of the first estimates was much better. This, of course, puts the averages of Tables VIII and IX in a rather different light. Similarly, Chart 2 shows that the performance of the first estimates of government expenditure was much better since 1957 (when a special timing adjustment was introduced to the previous estimates) than in the preceding period.

The second limitation arises from a more fundamental consideration involving an appraisal of the way in which the quarterlies are usually used in analysis. It is more difficult to deal with this limitation quantitatively because the necessary

CHART 3



evidence is not of a type that can be marshalled readily in statistical or graphical form. The summary measures of Tables VIII and IX are rather restrictive in that they treat each quarter as a discrete and isolated event. In actual practice analysts do not, of course, examine single quarters in isolation, but rather in perspective of emerging trends and patterns and in conjunction

with a great deal of other information. An invisible yet real and extremely vital dimension enters into this process of continuous reconciliation and cross-checking of current data within an integrated scheme; and in this process some of the imperfections of the statistics tend to get dissolved, as it were. Thus it will be recalled that the revisions have not changed the general tone

CHART 3 – Continued

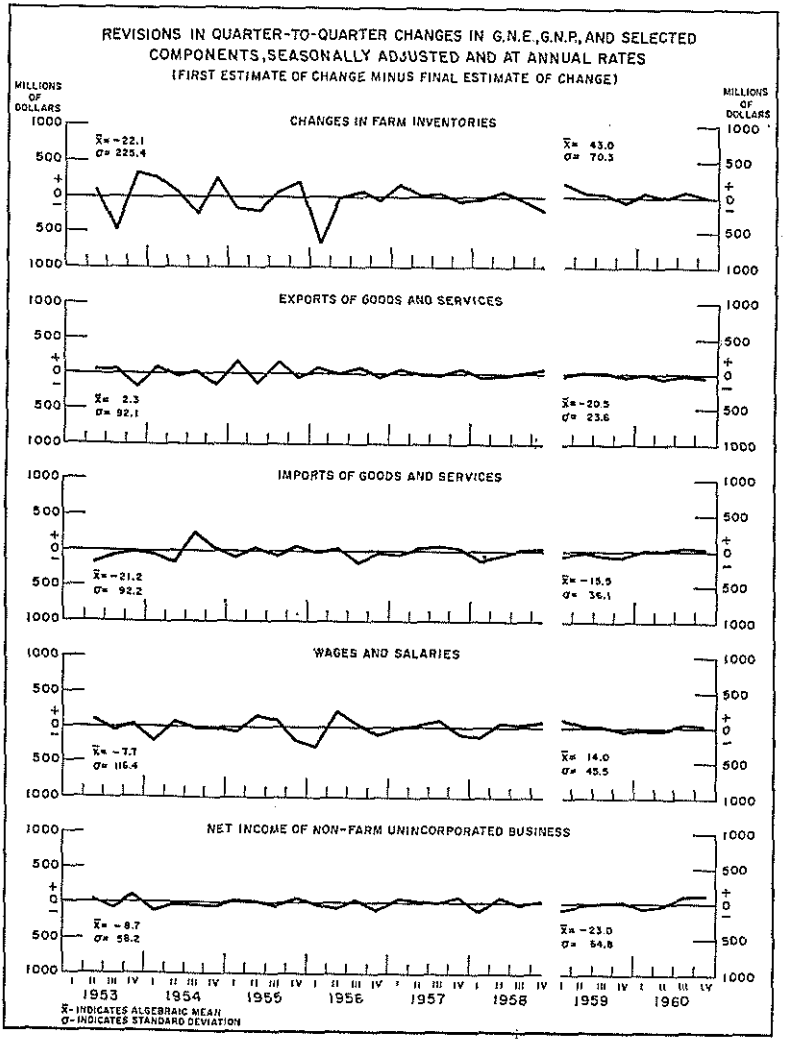
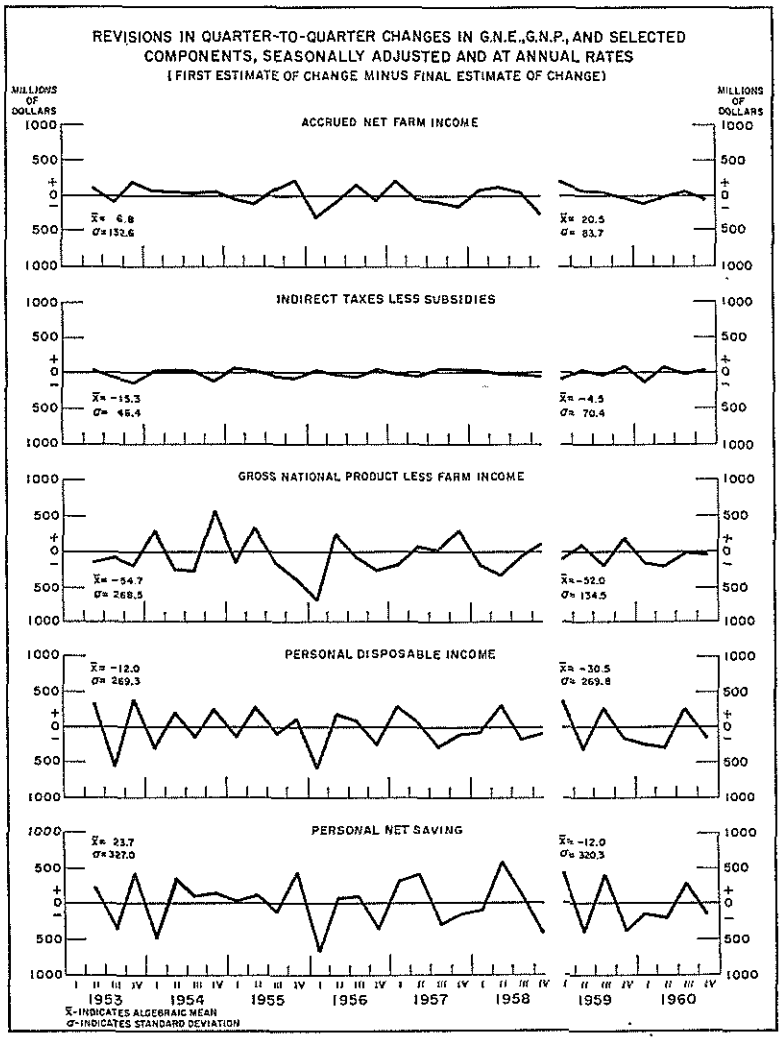


CHART 3 – Concluded



of the summary reviews that appeared in the introductory portion of the publications of the quarterly accounts from 1953 to 1960, or the broad picture that they presented.

By the same token, a comparison of Tables VIII and IX with Tables II and III of the Appendix (which shows corresponding figures for the annual estimates) will indicate that, in general,

the annual revisions of change were much less prominent than the corresponding quarterly revisions. However, in the words of one experienced user, 'This in no way suggests that it is preferable to use annual and not quarterly data. The analyst is frequently less concerned with the precise measurement of change in any particular quarter, or in any particular component, than with the whole sequence and pattern of quarterlies: (*a*) the magnitude of expansion from trough to peak, or from peak to peak; (*b*) the tendency for the increments in final demand to slow up as the economy approaches the peak; (*c*) the shifts in the relative composition of demand over the course of the cycle (with weaknesses in inventories and capital investment tending to occur in the downward phase of the cycle, and offsets occurring elsewhere in the system); and (*d*) the changing composition of the income flows, and the phasing in and out of the built-in stabilizers as they relate to incomes and profits. This information is blurred and hidden in the annual averages. It is revealed more clearly in the seasonally adjusted quarterlies despite a lower order of statistical accuracy.'

Finally, it should be noted that the preceding description of the revisions is incomplete. In particular, their seasonal characteristics are not dealt with, mainly for reasons of time. Another omission of considerable interest is the question of what the characteristics of the revisions have been at cyclical turning-points. A quick visual perusal of the data for a number of components suggests that their characteristics during cyclical turning-points were not significantly different from those during other quarters, but it was not possible to make a detailed analysis for this paper.

PART IV

SOURCES OF REVISIONS AND FURTHER COMMENT ON CHARACTER OF ESTIMATES

Introduction

It would have been of considerable interest to isolate the contribution of the revisions in the unadjusted series to those of the adjusted series from other causes contributing to the latter. The action called for to strengthen the unadjusted series (for example, new surveys and more reliable projectors) is different,

and more subject to control, than that required to improve seasonal adjustment factors. The overriding need for adjusting the data for seasonal variation is inescapable. However, the limitations still inherent in conventional seasonal adjustment procedures, notwithstanding the substantial progress of recent years, and the ensuing degree of approximation necessarily built into the estimates, in particular for the most recent quarters, could only be reduced by sustained research of a fundamental nature.[1]

Revisions in the unadjusted series frequently affect the seasonal factors; the latter are also influenced by the appearance of new current information as well as by changes in the technique of seasonal adjustment. Thus even if the basic worksheets had been maintained in such a manner as to facilitate this, which unfortunately has not been the case, it would have been extremely difficult to disentangle the impact of the revisions in the unadjusted series from the other causes of the revisions of the adjusted series, in any precise way.

The present review, accordingly, deals mainly with the major causes of the revisions in the unadjusted series as revealed by a careful scrutiny of the worksheets. This review, which is also designed to shed further light on the character of the quarterly estimates, is preceded by a brief outline of certain aspects of the seasonal adjustment practice having a bearing on the revisions in the adjusted series.

Seasonal adjustment practice having a bearing on revisions in the adjusted series

On the basis of experience in preparing the quarterly estimates it is possible to list certain practices which are known to have been of importance, to a greater or lesser extent, in the revisions of the adjusted series over the period from 1953 to 1960, aside from the influence of the revisions in the unadjusted series:

(1) The appearance of new successive quarterly estimates alone have had a strong influence on the pattern of quarter-to-quarter change and level in past periods, and therefore on the revisions, as already mentioned. It has happened that, with the

[1] See *Measuring Employment and Unemployment*, President's Committee to Appraise Employment and Unemployment Statistics (Washington, D.C., U.S.A.), 1962, especially pp. 184–9.

addition of later observations, a movement in the unadjusted series which was treated initially as an irregular factor has been established as having been the beginning of a change in the seasonal pattern. Alternatively, on occasion, the current estimate of the seasonal/irregular factor, which is based on a projection of the trend/cycle, may be revised later when the latter is recalculated when actual figures become available, causing, in turn, some revision in the estimate of the seasonal factor.

(2) The determination of the seasonal factor is influenced, in a degree, by professional judgement. It is likely that this fact has contributed to revisions, either because of changes in personnel between the first and final estimate, or because it was considered desirable, occasionally, to change the estimate of the seasonal factor in a series, within a narrow band of acceptable alternatives.

(3) In addition to the above, part of the revisions have been due to changes in the level of detail at which the seasonal adjustment has been undertaken in the final estimates. The seasonal factor for any composite series will vary depending upon whether the adjustment is carried out at an aggregative or detailed level, due to weight shifts and the extent to which irregular movements of the components offset each other at the aggregate level. In certain cases the seasonal adjustment in the final estimates was carried out at a different level of detail than in the first estimate. Examples include consumer and government expenditure. A similar-type revision has resulted from a change in the time period for which the seasonal adjustment was done; the seasonal factor for the same series will vary depending on whether the adjustment is the result of the sum of three separate monthly adjustments or one quarterly adjustment. This type of switch has had some effect on the labour income estimates.

(4) In contrast with the above, the underlying technique of seasonal adjustment employed is likely to have had only a minor effect on the revisions, simply because essentially the same approach has been used throughout the period under consideration. This will be evident from the following brief historical description:

> The figures that appeared in the first publication of the quarterly accounts were adjusted for seasonal variation

manually.[1] In essence this approach tended towards allowing the seasonal factor to be influenced by the last three available deviations of the seasonal/irregular component for any one quarter, but particularly by the deviation for the current quarter. The method tried to discriminate between 'high' and 'low' irregular series, using a less flexible curve for the former. For example, in a series such as exports, in which irregular factors are high, the last available deviation would be given less weight for fear that it is more likely to be an irregular movement than a seasonal movement.

At the time of the historical revisions of the quarterly national accounts from 1947 to 1957[2] the electronic computer was used to carry out the seasonal adjustment (U.S. Census Method II). However, because of the basic similarities between the manual and machine methods, and because of the considerable adjustment by hand of the machine results, it is felt that conversion to the machine method is responsible for a small fraction only of the difference between the first and final estimates of the seasonal factors for the years 1953–58.

Inasmuch as a manual adjustment had to be prepared on an up-to-date basis to check the validity of projected factors produced by the machine runs, it evolved that by the first quarter of 1959 the machine method had been almost entirely discontinued in favour of a manual adjustment for most components. Thus the first and final estimates of seasonal factors in the period 1959–60 were the result of essentially the same seasonal technique.

(5) Two points of special interest warrant mention in concluding these comments. The first, affecting a limited number of series, may be illustrated by the quantitatively unimportant series of military pay and allowance; the first estimates were thought not to be subject to seasonal influences, but additional data in later years indicated that this was not so and in the final estimates some variation in seasonal factors was introduced. The second point concerns the change in the method of season-

[1] See *Seasonally Adjusted Economic Indicators, 1947–1955* (An Outline of Problems and Methods), Catalogue No. 61–503, Reference Paper No. 77 (Dominion Bureau of Statistics, Ottawa, 1957).

[2] See *National Accounts Income and Expenditure, 1947–1957*, Catalogue No. 13–511 (Dominion Bureau of Statistics, Ottawa, 1959).

ally adjusting direct taxes levied on persons and hence has affected the estimates of personal disposable income and personal saving. Because of breaks in this series created by changes in tax legislation, the first estimate of the fiscal year average was treated as representing the trend/cycle component of the series. The seasonal/irregular factor was derived from this, thus ignoring the element of growth within the year. In the final estimates the growth factor was considered to be much more important than had been originally recognized and a switch was made to the regular method of seasonal adjustment. This switch had the effect of changing the estimate of the seasonal factor between the first and final figures.

It will be clear that the revisions due to points (1) and (2) above are likely to persist and reductions in the size of the revision in seasonal factors will result from the non-repetitive nature of points (3) to (5).

Sources of revisions in the unadjusted series

The factors responsible for revisions in the unadjusted data are also numerous, varied, complex and, in a degree, intangible.[1] An incomplete list would include: new series representing transactions not covered before; changes in methods of estimation either because new information has become available or because procedures have been devised which are, or are believed to be, superior; revisions in primary source information, quarterly as well as annual; new census benchmarks employed directly in the accounts, or indirectly when, for example, sample surveys are used and the new census statistics provide a more up-to-date frame, as in the case of retail sales; changes in concepts. Furthermore, purely subjective factors cannot be disregarded entirely, even though they are less important than in the case of seasonally adjusted data.

These various factors interact and it is extremely difficult to disentangle them, particularly when the basic records have not been designed with this in mind. It will be clear, further, that it is much more difficult to pinpoint exact causes of revision in the quarter-to-quarter changes than of revision in quarterly level; the latter give rise to the former, but in a somewhat unpredictable way.

[1] It will, of course, be clear that the revisions in the annual estimates are reflected in those of the quarterlies.

Accordingly, the following narrative of the sources of revisions is rather elliptical and undoubtedly an oversimplification, even though it is based on a detailed study of the worksheets. An attempt was made to convey a general impression of the character of the estimates; and to distinguish between repetitive sources of revisions, that is to say, revisions resulting from changes made to the regular flow of information as it was available at the time the first estimates were made; from non-repetitive sources, that is to say, changes in methods, concept and classification and the introduction of new series which, once having been built into the estimates, will not cause revision in the future.[1]

For reasons of space the review is confined to four components on the expenditure side: consumer expenditure, government expenditure, fixed capital expenditure, non-farm inventories; and three components on the income side: wages and salaries, corporation profits, and net non-farm unincorporated income. The revisions in the aggregate gross national expenditure or product, being the net result of the revisions in the constituent components, are not included in the present narrative.[2]

Consumer expenditure[3]

This component is the most important one in terms of relative size, representing roughly some two-thirds of aggregate gross national expenditure. It is composed of two major parts which are estimated independently: expenditure on goods and expenditure on services. The former is based on monthly retail sales figures, adjusted to exclude certain items such as business purchases at retail and the transfer value of sales of second-hand merchandise; and to include items such as goods purchased through non-retail outlets and the value of goods received in

[1] These are non-repetitive, then, so long as the present conceptual and methodological practices and range of available information remain unchanged.

[2] Because of the difficulties in measuring net farm income in a meaningful way, the aggregate of gross national product excluding farm income is frequently referred to in the published commentary. It is, therefore, of interest to note that the relative size of the revision of the latter was greater (in both level and change in 1953–8 and in change only in 1959–60) than that of the total gross national product. The reason for this is that the first estimates of change and level of net farm income were too high, on average, in 1953–8, in contrast with most other components, the first estimates of which were too low; the opposite was the case, on average, in 1959–60. In either situation the farm income figures served to reduce the revision in the aggregate gross national product.

[3] The published title of this component is 'Personal expenditure on consumer goods and services'.

kind. Estimates of expenditure on services are made, in general, by projecting annual data on the basis of extrapolating series which in certain cases are considered to be fairly reliable, and in others are based on assumptions of a rather tenuous nature.[1]

It will be recalled that the level of the first estimates of total consumer expenditure was consistently too low, by a considerable amount from 1953 to 1958, and by a smaller amount in the period 1959–60.

The understatement in the total for the period 1953–58 was the net result of substantial underestimation in the first estimates of expenditure on services offset, to some extent, by overstatement in the estimates of expenditure on goods. What were the factors responsible for the understatement in the first estimates of services? In part, they were due to certain changes in concept, method and classification. Major illustrations are: (*a*) the addition (in the final estimates) of new series, for example, personal payments of stock and bond commissions; (*b*) a change in the method of estimating gross rent which resulted in sizeable upward revision; (*c*) the transfer of the service portion of meals and beverages consumed on-premises to services; formerly it was included with goods. This transfer, incidentally, is also responsible for the major portion of the overstatement in the first estimates of goods.

The revisions just mentioned are non-repetitive and, having been introduced prior to 1959, the revisions from 1959 on may be expected to be smaller on that account. As a matter of fact, the revisions in 1959 and 1960 are smaller, and while this reflects, in part at least, the factors just mentioned, it is undoubtedly also due to the incomplete nature of the round of revisions for these two years.

The remaining revisions in level of the first estimates in these two years, as well as in the preceding period, may be attributed to certain factors of a rather repetitive nature and are, therefore, expected to continue to cause revisions in the future: (*a*) those due to later and more complete sample survey material, which in the case of expenditure on goods have arisen mainly from the incorporation, regularly, of the results of a more comprehensive annual retail sales survey; and, in the case of expenditure on

[1] For a more detailed description see *National Accounts Income and Expenditure*, Catalogue No. 13–519 (Dominion Bureau of Statistics, Ottawa, 1962), pp. 90–92.

services have arisen from numerous annual reports covering hospitals, schools, transportation and so on; (*b*) those due to occasional adjustments based on related information which are made in either the first or final estimates, but not in both; and (*c*) of relevance only for the years 1953–58, those due to incorporation of decennial benchmark material.

The above examples will serve to illustrate the nature of the factors responsible for revisions of the estimates of average quarterly *level*; they have been generated, in the main, by attempts to improve and bring up to date the annual data. The question arises: What were the factors responsible for the revisions in the figures of quarterly *change* of consumer expenditure? There are two main factors: first, changes in method of estimation directly affecting the quarterly *distribution* of the annual series (which are independent of revisions in the average quarterly level – to illustrate, a new method of calculating sales of passenger cars to business resulted in changes of the seasonal pattern of car sales to consumers); secondly, revisions in the level of the quarterly figures caused by factors such as those mentioned above. However, the extent to which the latter give rise to revisions in quarterly change is somewhat unpredictable, depending, as it does, on their impact on the relative importance of the various constituent series having different irregular, seasonal and cyclical characteristics, that is to say, the extent to which they affect the weighting pattern of such component series.

Before turning to government expenditure it should be noted that revisions may continue to be expected in the future in the estimates of consumer expenditure, for a time probably larger than those shown for the years 1959–60 if certain improvements are undertaken. These would include the strengthening of the sampling procedures used in the retail sales surveys; the extension of coverage of surveys to include certain new sales outlets; more precise information on business purchases from retail outlets; improvements contemplated in housing statistics affecting the gross rents estimates; improvements in the procedures used for estimating net new births of stores; and strengthening the portion of the estimates of services which at present is based on tenuous assumptions. As important as the improvement of the aggregate estimates is the provision of greater detail. This may be accomplished through the application of variants of the so-called 'commodity-flow' method, originally developed by

Simon Kuznets, but in the process of developing more detail the aggregates, too, may be affected and hence revisions will take place.

Government expenditure

The estimates of 'Government expenditure on goods and services' have been regarded, generally, as one of the more reliable series in the accounts. It will, therefore, occasion considerable surprise to note the very large size of the revisions and, in particular, the frequency with which the direction of the first estimates of quarter-to-quarter change does not coincide with that of the final estimates; and the frequency with which the revisions were larger than the quarterly change. It will be seen from what follows that for the years 1953–58 a major factor responsible for this situation is a special 'timing adjustment' that was introduced early in 1957 so that all first estimates prior to the fourth quarter of 1956 have excluded this adjustment, but the final data for the whole period 1953–58 have included it. The need for this adjustment, and its approximate nature, are illustrative of the fact that, even though data may be available from regular sources, difficulties arise if they are designed for purposes other than the requirements of the accounts.

The revision in the average *level* of government expenditure resulted, in part, from the combined influence of changes in concept and methods of estimation; in part they have resulted from the fact that the first estimates have had to be based on inadequate information and tenuous assumptions. The latter factors are still at play, but the former are non-repetitive.[1]

The level of the first estimates of federal government expenditure during the period 1953–58 has been raised; incorporated in the final estimates published in 1959 are an imputation of rental on government buildings and certain payments to the superannuation funds which had previously been excluded. These amounts were, however, offset in part by certain exclusions that need not be specified here.

As far as provincial government expenditure is concerned the first estimates for the first quarter of each year are very rough, as only a few of the (ten) provinces have been providing the information early enough to be used as the basis of estimation

[1] It should perhaps be indicated that in Canada there are three separate governmental jurisdictions: federal, provincial and municipal.

for that quarter. Furthermore, one large province has not been submitting complete quarterly returns. When it comes to municipal expenditures on goods and services, no quarterly information at all is available and the annual figures are simply projected quarterly on the basis of the movements of the provincial figures. The quarterly survey of municipal revenue and expenditure which has been instituted recently will go some distance to improving the basis of these estimates.

The factors just mentioned, together with the fact that the item of government expenditure on goods and services is estimated residually, that is by subtracting transfer payments and a number of other items from a larger total, are believed to have contributed about one-half to the revisions in quarter-to-quarter change. The other half is due to the inclusion of the timing adjustment, to convert expenditures on durable assets by governments at all levels from a cash to a 'work put in place' basis. However, this adjustment itself is amended in varying degree when the annual information becomes available. In addition, a new (non-repetitive) factor became operative for the years since 1958 when some government agencies, whose expenditures since 1958 became large, were excluded from the government sector as government business enterprises. Thus while the revisions in level and quarter-to-quarter change for the two years 1959 and 1960 are smaller than those for the preceding period, they have remained, nevertheless, significant.

It is likely that revisions of the order shown for the years 1959 and 1960 will persist in the future, and may even be larger as actions already taken, or contemplated, come to fruition and are incorporated into future estimates. It is hoped, however, that it will be possible to pinpoint the direction of change more precisely than in the past. The largest revisions will probably be associated with the incorporation of data from the quarterly survey of municipal expenditures, thus replacing the present practice of projecting forecasted annual figure of municipal expenditures on the pattern of provincial spending. At the provincial level, the tendency toward closer co-operation in statistical matters between the federal government and the provinces may be expected to result in more complete reporting of quarterly expenditure data, although difficulties associated with providing a reliable first estimate in time for the first quarter might be harder to solve. The introduction of the

'timing adjustment' has already resulted in a significant improvement, but the underlying data used in its construction are rather weak. It would, of course, be desirable to collect the expenditure data directly on an accrual basis, but the difficulties involved at present seem to be rather overwhelming.

Business gross fixed capital formation

Total business gross fixed capital formation is composed of three components, published separately – residential construction, non-residential construction, and machinery and equipment. Non-residential construction and machinery and equipment are discussed first. These components represent the most important instances where the quarterly movements are based entirely on related projectors rather than on survey data. The projectors, which are based on a wide and fairly reliable range of monthly statistical information,[1] are applied to annual estimates based on annual surveys of capital expenditure which have been conducted regularly since 1947.

For a number of years ambivalence has prevailed regarding the advisability of initiating quarterly surveys of capital expenditures. Comparisons of data secured from the annual surveys, with estimates for the year based on the projectors used in the quarterly accounts, yielded results which have engendered a feeling that quarterly surveys of capital spending, which would be costly, would not necessarily produce more reliable overall figures than those already available.

TABLE XIII

Absolute and algebraic mean revisions in quarterly level and change, unadjusted series

	1953–58						1959–60					
	Level			Change			Level			Change		
	Absolute		Algebraic	Absolute		Algebraic	Absolute		Algebraic	Absolute		Algebraic
	$M	(1)	$M	$M	(1)	$M	$M	(1)	$M	$M	(1)	$M
Total fixed capital	264	(4·4)	−175	154	(18·9)	−32	99	(1·4)	−30	101	(9·9)	−1
(1) Residential	67	(4·7)	−1	50	(18·5)	1	65	(4·1)	1	68	(24·7)	−12
(2) Non-residential	110	(4·8)	−60	75	(14·9)	−27	60	(2·3)	52	49	(7·3)	29
(3) Machinery	143	(6·2)	−114	116	(33·8)	−6	93	(3·5)	−83	78	(19·6)	−18
Sub-total (2) + (3)	239	(5·2)	−174	153	(22·5)	−33	110	(2·1)	−31	108	(10·2)	11

(1) Revision as per cent of final level or change, that is, 'relative size of revision'.

[1] Non-residential construction estimates are projected on combined weighted indexes of construction employment, hours worked, hourly earnings and building material prices. Separate indexes are prepared, in general, for four main types of works: building, engineering, highway and railway construction. Machinery estimates are projected on the basis of a flow study of producers' durables, taking into account domestic shipments, imports, exports and mark-ups.

The revisions of the first estimates are summarized above for the components that are published separately.

It will be clear from what we have said above that the revisions in non-residential construction and machinery and equipment are the net result of revisions in (*a*) the annual data and (*b*) the projectors. The former may be regarded as a repetitive source of revision.

Combing through the revisions caused by other than annual benchmarks an attempt was made to separate repetitive from non-repetitive factors. In regard to the estimates of non-residential construction, separate projectors for buildings and for engineering structures were introduced in 1956; later, allowance was made for the increasing importance of pipeline construction and oil-well drilling as these components assumed greater relative importance. While this type of methodological change amended the average levels of the estimates, it affected particularly the quarterly movements, as the different types of construction and engineering work have individual seasonal patterns. These changes, which were introduced prior to 1959, are non-repetitive; they partly explain the smaller revisions in the 1959–60 period. It should be noted, however, that the small size of revisions in this period is heavily influenced by the fact that almost no adjustment was necessary to bring the first quarterly estimates into line with the final annual survey data.

It is not quite as easy to generalize regarding changes in method of estimation of machinery and equipment. Aside from the repetitive revisions to annual survey data and the incorporation of more complete and later data into the quarterly projectors, a variety of refinements have been incorporated. Some of these are non-repetitive. During the period 1953–58 refinements of the import and export data were made to reflect more accurately flows of producers' durables, and a commodity-flow study of domestic shipments was prepared to determine more accurately the output of producers' durables in certain industries; a new method of estimating passenger-car sales for business use was introduced. The fact that the revisions in this component in 1959 and 1960 are, on average, smaller than for the earlier period is again partly a consequence of the non-recurring nature of such revisions.

Despite the sustained efforts to improve the estimates of non-residential construction and machinery and equipment, basic

weaknesses remain in the present techniques. These weaknesses result from the difficulties of (*a*) allowing for changes in profits and productivity, particularly in non-residential construction where the price for a large part of the work is determined after competitive bidding; (*b*) allowing for changes in inventory and mark-ups in the flow of machinery and equipment; and (*c*) separating public and private investment when the projectors can only be used to give an overall figure. To overcome such difficulties a rather ambitious programme of quarterly surveys (coupled with detailed investigations of methods of accounting used by firms in order to develop realistic factors to convert the data to a 'work put in place' basis) would probably have to be undertaken. However, for reasons already indicated, such a programme would have to be justified on other grounds as well as serving the needs of the quarterly national accounts.

Residential construction, to which we now turn, represents an area in which it is extremely difficult to collect expenditure data because of the multiplicity of contractors who do not maintain adequate accounting records and the varied time periods per unit of construction. At the present time, the estimates are based essentially on a survey of starts and completions of dwelling units, cost data derived from administrative sources (supplemented by a special one-time survey) and rather inadequate data on wage rates in construction and prices of residential building materials. The revisions have arisen in the past partly because of the introduction at the year-end of more complete data on type of housing and number of units under construction, and partly because of an attempt to improve estimates through a process of progressive approximations based on new methods and statistical series.

Some of the changes which have given rise to a non-recurring type of revision are outlined below. In 1957 an adjustment was made to prior years' figures when the base of capital spending on housing was extended to include such supplementary costs as legal and architectural fees, and incinerators, elevators and ventilation equipment; at the same time, revisions were made on the basis of a one-time survey on unit construction costs. The initial estimates of housing starts in the early years of the period under study were badly underestimated and a large part of the revision in this period is a correction of this underestimation.

These revisions had their main impact on the average level of the series, although they caused some revisions in the quarter-to-quarter changes also, particularly between the fourth and first quarters of successive years. However, the major part of the revision in the quarter-to-quarter changes occurred because of a basic incompatability between the method of initially calculating quarterly estimates and the final quarterly distribution made at the time that annual estimates were made, an incompatability which has since been removed.

The above comments would suggest some reduction in the size of revision in 1959–60; however, the table above does not bear this out. The explanation for this is that the incompatability noted above, which was becoming progressively more significant, was not eliminated until 1961; and further, large adjustments were made to the first estimates of 1959, as a result of some changes in survey techniques.

Basic improvements are clearly needed in this area of statistics. A programme for such improvements has been prepared and includes such features as the strengthening of coverage of building permit data and the selection from this of a probability sample to yield ratios of starts to building-permit material. This would allow an estimate of starts to be based on building-permit data rather than the present imperfect attempt at full enumeration of starts. The resultant savings could be applied to the collection of data on stage of construction, value of work put in place at various stages of construction, an investigation to determine the cost of apartment construction, and analysis of the relationship between building-permit data and starts. It is hoped to implement this programme (which should also attempt to strengthen the wage-rate data and reduce the deficiencies arising from the assumption of constant productivity now implied in the procedures used) in the years ahead.

Change in non-farm inventories

The inventory figures included in the national accounts are, of course, the change in level of stocks between two particular points of time. Small revisions in the level may, therefore, lead to large revisions in the change, available sample surveys and blow-up techniques in this field having been designed to render accurate the data in level rather than in change. Another factor, not unique to inventories, is the fact that many businesses,

particularly in retail and wholesale trade, do not maintain monthly or quarterly records on inventories.

The revisions to both the level of inventory change and to the rate of change are substantially smaller in 1959–60 than in 1953–58. Part of the explanation for this rests on the fact that the later estimates are not yet final and will undoubtedly undergo further revision, e.g. in manufacturing the 1960 census of manufacturers' results has yet to be incorporated. However, in spite of this, it appears likely that the final figures for 1959–60 will have been subject, on average, to smaller revisions than the earlier period, given the present source material and statistical procedures.

The evidence points to the fact that the revisions in the unadjusted data were due in the main to statistical changes brought about by the availability of later and more complete data. These revisions were concentrated in the estimates of the level of book value of inventories themselves, and were apparent only to a lesser extent in the related material which is used to convert book values to a value of physical change basis. The absolute mean revision of inventory change in the period 1953 to 1958 due to book-value revision was about three times greater than that due to converting the book-value figures to a value of physical change basis; this reflects mainly the fact that only minor revisions took place in price series related to inventories, and the lack of any new information concerning business methods of inventory accounting or turnover periods.

About 75 per cent of the book value of inventories is based on surveys in the current period. The first estimates of manufacturing inventories are revised for late returns, and again for changes in the sample due to births, deaths and reclassification of establishments to other manufacturing groups. Revision also takes place when census data become available for the previous year and the final revision is made when census data are available for the year of the estimate itself. It has proved impossible to generalize about the effect of these – generally repetitive – revisions on the change in book value because of their volatility and irregularity. In the wholesale and retail trades, where the basic statistics are particularly difficult to collect, repetitive-type revisions occurred during the period 1953–58 due to the introduction of decennial census data and of annual sample survey data.

Later and more complete annual data have also accounted for a large part of the revisions in the other industries where inventories are generally less important quantitatively.

Aside from the repetitive revisions just mentioned, a continuing effort to improve inventory statistics has resulted in changes in methodology, concepts or correction of errors. For example, prior to December 1955 the manufacturing-inventory estimates were published in index number form only. Since then the coverage of surveyed firms became sufficiently reliable to publish 'blown-up' estimates of the universe in current dollars. In wholesale trade, changes in coverage were also introduced, and the final figures contained estimates for agents and brokers and manufacturers' sales branches which were not covered in the first estimates for 1953 and 1954. In addition, and possibly due to the fact that inventories are regarded to some extent as being a residual item, on two occasions large and somewhat arbitrary adjustments were made in the first estimate of inventory change during the period 1953 to 1958 which were subsequently removed.

In general, the revisions due to converting the book-value data to a value of physical change basis can be attributed to improvements in methods of deflation. Examples include the calculation of a weighted price index of appropriate commodities for the deflation of 'Other Retail Stores' group, instead of a single, rather inappropriate, index of farm-equipment prices employed previously; and the expansion, between the first and final estimates, of the level of detail at which wholesalers' inventories were converted from a book value to a value of physical change basis.

Plans for improvement of inventory statistics in the future should include: (*a*) development of sample surveys designed to yield accurate data of change, (*b*) the establishment of adequate benchmark figures in the mining, forestry and construction industries, (*c*) the collection of franchised dealers' stocks of automobiles direct from manufacturers, and (*d*) an up-to-date survey of inventory-accounting methods in various industries.

Labour income

Labour income is the largest single component on the income side of the accounts, representing some 50 per cent of gross national product. Estimates of wages and salaries are prepared

monthly for the various industrial groups,[1] while supplementary labour income is prepared for all industrial groups combined. The general method is to distribute the estimated annual totals on the basis of related monthly indicators. In a recent year, for which no independent total is yet available, the first estimates are obtained by using the monthly indicators to project the monthly data of the last year for which such a total is available. The quarterly estimates are simply the sum of the three relevant monthly estimates.

The greater part of the monthly income estimates is based on projections using monthly payroll indexes which, in turn, are based on a monthly survey of establishments employing fifteen or more people. In industries such as agriculture and some of the services for which there are no monthly payroll indexes it is necessary to rely on estimated data on weekly earnings and the number of paid workers. In a few quantitatively unimportant cases the estimates are based on indicators of doubtful reliability.[2]

In the period 1953 to 1958 the largest single cause of revision of the level of the estimates resulted from the incorporation of decennial census benchmarks. Naturally these revisions had a much larger impact on a variety of industries in the finance and service groups, where inadequate, or no, annual or quarterly projectors are available, than on industries, such as manufacturing, where comprehensive annual data and reliable payroll indexes prevent serious straying from levels. On average, about one-quarter of the revisions in level may be attributed to factors of a non-repetitive nature. For example, the first estimates of industrial pension and welfare payments, included in supplementary labour income, were made by projecting, on the basis of wages and salaries, figures secured from a one-time survey for the year 1944. Subsequently, taxation data became available regularly from the Department of National Revenue, and these statistics, included in the final estimates, were higher. Similarly, a special study undertaken in 1958 revealed that some of the assumptions built into the first estimates of labour income in construction were erroneous and the correction resulted in an upward revision.

[1] Separate estimates are prepared for fifteen industrial groups of the Standard Industrial Classification.

[2] For a more complete description of sources and methods of estimation see *Labour Income, 1926–1958*, Catalogue No. 72–502 (Dominion Bureau of Statistics, Ottawa, 1960), pp. 33–45.

As in other series, the revisions in level have usually influenced the quarter-to-quarter changes. Apart from this, the revisions in quarter-to-quarter change were caused by other factors, some of which are not expected to be repetitive. The most important of this latter is the fact that the first estimates were prepared, for each industry, for Canada as a whole, while the figures incorporated in the final estimates were carried out, by industry, separately for each province. This change in procedure, together with a related amendment in the projectors used in estimating labour income in construction, had a much greater impact on the revisions in change than in level.

The uncertain relationship between revisions in level and in change already referred to in the discussion of consumer expenditure is illustrated in the following table, using figures for the years 1953–58. It will be seen that large revisions in the means of the estimates of quarterly level are quite compatible with relatively small revisions in the change and vice versa:

TABLE XIV

Absolute means of revisions in level and change, components of labour income, 1953–58

	Absolute means in $M		Algebraic means in $M	
	Revision in level	Revision in change	Revision in level	Revision in change
Primary industries	31	29	1	−1
Manufacturing	46	32	−40	−6
Construction	85	58	−78	−2
Transportation, communication, utilities and storage	113	11	−113	−1
Wholesale and retail trade	47	8	−46	0
Finance and service	230	20	−230	−1
Public administration	108	21	108	1
Supplementary labour income	103	8	−103	−5

Reflecting in part the non-repetitive factors referred to above, the revisions in 1959–60 were considerably smaller. While the figures for these years are still subject to regular annual revisions, past experience suggests that they will not be large, but, on the other hand, incorporation of the statistics from the 1961 Census when they are available may again cause large revisions. Although the revisions in both level and change in 1959–60 were relatively small, it will be recalled that they were positive, that is, the first

estimates in these years were too high, in contrast with the preceding period when they were consistently too low. A special factor responsible for about one-half of the revisions in the two recent years is of a non-recurring nature, having resulted from the change in method of estimating labour income in construction referred to above. The new figures were linked in 1958 in a manner that turned out to be erroneous, affecting, in particular, the first estimates of 1959.

As already indicated, the main shortcomings in the quarterly estimates of labour income have been inadequate payroll and employment information in certain industries, occasioned, in part, by the fact that the monthly survey of employment was confined to establishments with fifteen or more employees. A new programme was instituted two years ago, designed to cover, on a probability sample basis, the smaller establishments. As the results of this survey are incorporated, the estimates of labour income will be strengthened, giving rise to further revisions. Another source of both added improvement and revision is likely to arise from the continued efforts to fill gaps in employment statistics and the attempts at reconciliation of figures on paid workers from a variety of sources, which is carried out in conjunction with the current programme on productivity research.

Corporation profits

Aside from inventory figures, corporation profits[1] are one of the most volatile components of the accounts, being sensitive to small changes in myriad other items such as costs, sales, depreciation, tax policy and so on. The quarterly profits estimates are built on a specially designed quarterly survey, the results of which are tied to similarly structured annual data compiled by the Department of National Revenue from income-tax returns.

Experience with the survey has confirmed the view that there is no adequate indirect way of estimating this component. Prior to the initiation of the survey in 1950, corporation profits were obtained residually by deducting estimated expenses from estimated gross income of the various industries. It is significant that the quarterly pattern of total profits which emerged from this technique for the three years 1947–49 differed considerably

[1] Measured for present purposes before the deduction of earnings paid to non-residents.

from the pattern prevailing in any year after 1950 as indicated by the survey.

Availability of the survey data, however, has by no means removed all of the difficulties in this area. Aside from problems of sampling, response and bias, not all of which have been solved successfully,[1] there is, among other things, the public-relations aspect. Basically, the success of the survey hinges on the voluntary co-operation of the sampled firms, although the survey was made compulsory a year ago.

However, non-response in certain industries is associated with the nature of their activity, making it intrinsically difficult for the firms in question to ascertain quarterly profits; in such cases it is doubtful whether much improvement can be expected in the future. On the larger projects in the construction industry, for example, it is customary to make progress payments as the work advances which, usually, are only a pale reflection of the actual value of work put in place. Moreover, the interim costs cannot be accurately determined till the whole project is completed. Under these circumstances, an interim residual figure such as quarterly profits can be no more than an informed guess. Therefore, it is not surprising that there is not a sufficient number of reporting firms to represent this industry adequately. It is for this reason that the quarterly profits figures for construction are still estimated indirectly by moving forward the adjusted annual data from income-tax returns on the basis of quarterly expenditures on residential and non-residential construction, involving some question-begging assumptions.

The revisions in the quarterly figures of corporation profits have averaged about 3 per cent in terms of level in the 1953–58 period with less than 1 per cent attributable to conceptual changes. A large part of the revisions is statistical in nature and can be traced to causes which are mostly non-repetitive. These include the effect of special legislative changes on profits and depreciation, the impact of a natural disaster on insurance company profits and the lack of timely survey figures in the fourth quarter. Because of the volatile and residual nature of this item, and its sensitivity to so many factors, there will probably always be some special reasons whose effect on profits

[1] For a description and evaluation of the survey techniques and results see *Quarterly Corporation Profits 1950–1954* (Dominion Bureau of Statistics, Ottawa, 1955). Some important changes have been made, however, in the survey since this report was published.

cannot be properly assessed, and will not be apparent till the annual data become available after a two- or three-year lag.

The revision in the fourth quarter arises from a different reason. Since over 75 per cent of the firms have fiscal years which coincide with the calendar year, it was decided to allow them an extra month to report data which would tie in with their audited annual accounts. Therefore, the first estimates of the fourth quarter were calculated indirectly until 1960, when a special blow-up procedure was introduced to circumvent the lack of sufficient returns.[1]

It is of interest to note that, despite what has been said above about the non-recurring nature of a portion of the revisions, the latter were relatively larger in 1959–60 than in the earlier years; about three-fourths being accounted for by the finance, insurance and real-estate industry, reflecting assumptions and adjustments that turned out to be faulty when the annual tax data became available.

In summary, the volatile nature of corporation profits and its sensitivity to many factors, some of them non-economic, will probably always make it difficult to estimate this component accurately in the first instance. Action under consideration to strengthen the estimates includes plans to obtain quarterly data from insurance companies; this should strengthen the finance, insurance and the real-estate group figures. The problems of estimating profits in the construction industry are of a rather intractable nature, but improved reporting and further clarification of the concepts of quarterly profits pertaining to the industry should be conducive, at least, to greater stability of the first estimates.

Net income of non-farm unincorporated business

This component covers a heterogeneous group of incomes of working proprietors, ranging from own-account contractors to independent professional practitioners, and is in sharp contrast with the series of corporation profits and labour income in that it leans heavily on inadequate quarterly information. Most of the estimates of this component are based on straight-line projections of annual data which themselves leave a lot to be

[1] It should be noted, however, that the figures for the fourth quarter, as supplied by firms, may contain adjustments which should be spread over the preceding quarters, and to this extent the continuity of the fourth quarter and the preceding ones is broken.

desired, 'synthetic' operating accounts derived from piecemeal information, ratios of net to gross income, and a variety of specially constructed indexes, some of which rest on assumptions of questionable validity. The estimates are made by individual industries, and approximately four-fifths of total net income originates in construction, retail trade and the services group.

Although it cannot be claimed that much progress toward strengthening the estimates has taken place during the period under consideration, the sustained efforts to improve various constituent parts of this component have, undoubtedly, yielded some positive gains, and are reflected in some non-repetitive revisions. Much more important, quantitatively, have been revisions of a repetitive nature stemming from the regular appearance of more up-to-date information and 1951 census data.

During 1953–58, sizeable, repetitive revisions (in average quarterly level and change) in retail trade, occasioned by the utilization of more complete and up-to-date annual and quarterly data, were almost cancelled by revisions in the opposite direction in construction. The latter resulted from a combination of repetitive and non-repetitive factors, including a change in the method of distributing annual data among the four quarters of the year.[1] In forestry, rather large revisions, of both average level and quarterly change, were caused by a major change in method of estimation of the annual data and their quarterly distribution.[2] The quarterly revisions in the remaining industries were due, in the main, to new annual information and the 1951 census data. The revisions in the period 1959–60 were also due almost entirely to these factors of a repetitive character.

Although full awareness has always prevailed of the inadequacies of the quarterly estimates of net unincorporated income, the little progress towards improving them is due, in large part, to the basic difficulties of securing good information in this area,

[1] The first quarterly estimates were calculated by projecting annual net income figures on an index made up of the volume of residential construction and average weekly wages and salaries in construction; the final estimates employed the quarterly value of residential construction as used in gross fixed capital formation as an interpolator.

[2] The first annual estimates of net income in forestry were arrived at by projecting forward an estimate for 1949 on the basis of certain revenue and expense statistics. The final annual estimates were calculated by multiplying the number of working proprietors by average income in forestry secured from tax data. For the first quarterly estimates the annual series were extrapolated on the movement of cash income of farmers from woods operations; the final quarterly estimates were calculated by projecting the (final) annual series on the basis of the number of working proprietors in forestry.

composed as it is of predominantly small units which frequently do not maintain regular accounting records quarterly and (mainly in forestry and construction) have a high turnover rate. Thus, in relation to the analytical importance of this component, the cost of improving it directly has appeared high. However, gradual improvements in existing surveys, and the tendency to distinguish explicitly between incorporated and unincorporated forms of business organization on questionnaires, together with the greater knowledge and use of sampling techniques, should facilitate progress in the future. Further, the interest in recent years in the fate of small business should be conducive to greater efforts to strengthen the basic information on which the quarterly estimates of net income of unincorporated business are based.

PART V

CONCLUDING REMARKS

Some fifteen years have elapsed since work first began on the quarterly national accounts in Canada, and nearly ten years since regular publication began. This paper, however, represents the first attempt at a systematic critical appraisal of the accounting system as a whole.[1]

One of the purposes of the paper which has perhaps been fulfilled, in part at least, was to replace intuitive impressions based on scattered observations by a systematic inventory of the character and size of the revisions and their effect on the movement and level of the estimates. Another purpose was to convey a general impression of the texture of the quarterly accounts,

[1] Two of our colleagues, F. T. Denton and J. Kuiper, presented a paper, 'An Econometric Study of the Reliability of the Preliminary Annual National Accounts Estimates', at the Statistics Conference of the Canadian Political Science Association in 1963, which will be published in the proceedings of the Conference. Using a different approach, they constructed an econometric model for the period 1949–58 and fitted it to different sets of preliminary, revised, and final *annual* data. The results were compared to see whether the equations estimated from the various sets of data were appreciably different or, in other words, whether revisions of the data had much effect on the relationships between different economic series. The model was also used to generate different sets of 'forecasts' of annual change for the period 1949–59 by inserting into it different sets of annual data, and again the results were compared. On the whole the conclusions are similar to our own. In particular, it was found that the unrevised national accounts estimates performed rather well, both as a basis for estimating equations and as a basis for prediction. The most serious problem was a tendency towards understatement of annual change in the preliminary estimates which led to some understatement in 'forecasts' of annual change.

especially the first estimates, and to place both their limitations and their role in the evolution of economic statistics in some sort of perspective. It has been emphasized that the target (in the form of actual quarterly economic change) that the adjusted series aim at is, in general, a very narrow one, while the available instrument for 'shooting at it' is, in a number of cases, highly imperfect. In other cases, however, including some key components and aggregates, the available instrument has performed rather well.

During much of the period covered the quarterly accounts have undergone considerable development, consolidation and extension. This process will continue in the future. The first estimates of several important components, including government expenditure, business fixed investment and changes in non-farm inventories may be expected to show a better record of approximating the final estimates than that for the average of 1953 to 1958. The construction and maintenance of the accounts should be regarded as an evolutionary process in which each stage has benefited from the preceding one and itself represents a condition for future improvement.

It should be remembered that the criterion of quantitative precision of the estimates, determined retrospectively, is only one facet in a comprehensive appraisal of the role the accounts have played. Other facets are no less vital, even though they are more intangible and do not lend themselves to precise quantitative demonstration. One of these is the continuous reconciliation of current data, and feedback of impressions derived from a variety of sources, within an integrated accounting framework. Another is the comprehensiveness provided by the accounts. For approaches to current appraisal of the economic situation and short-term forecasting which enjoy widespread acceptance the quarterly accounts are simply a *sine qua non*. It can also be claimed that the accounts have played a unique role as an instrument for the development of a well-rounded system of current economic intelligence. As far as these facets are concerned, the question that appears relevant is: What alternatives are there to serve these functions as effectively as the quarterly accounts have?

Just as a major inherent advantage of the quarterly accounts over the annual figures arises from the fact that they portray economic events earlier, so it is the case that a major limitation

of the quarterlies springs from considerations of timeliness. The quarterly changes reflect movements that have taken place from approximately the mid-point of one quarter to the mid-point of the next. When the accounts are published – ten weeks after the end of the quarter – they show changes that have occurred *over* a period from about seven months ago to four months ago. Thus for the purpose of up-to-date study of emerging events a range of seasonally adjusted monthly statistics offers advantages not possessed by the quarterly estimates. Furthermore, some of these monthly indicators may be more sensitive to cyclical swings than the accounts. Even in this context, however, the accounts play a vital role in providing a comprehensive framework for testing earlier discrete impressions and for tying them together into a quantitative format amenable to analysis and interpretation in the light of alternative theoretical models.

It is against the background of the preceding paragraphs that we return to the question raised at the beginning of this paper: Are the quarterly accounts as accurate as they should be? The answer is clearly 'No' for a number of components, including net income of unincorporated business, personal disposable income, and personal saving. But even in the case of components which, in the light of the record of revisions as well as otherwise, appear to be fairly solid (including labour income, consumer expenditure, exports and imports, as well as the aggregate gross national expenditure and gross national product less farm income) it would not be appropriate to assert an affirmative reply, unequivocally.

In the first place, the present publication schedule cannot be regarded as final for all time and earlier publication would necessarily influence the accuracy of the first estimates. Secondly, the present level of published detail was taken as given in the discussion of accuracy and the record of revision, but greater detail may have to be published at some future date to satisfy strong demands. Thirdly, while experienced users usually discount relatively small changes in the estimates to take care of margins of inaccuracy, others tend to lean on them, despite indications that they may not be statistically significant. While to some extent at least appropriate comment and presentation of the statistics may serve to minimize this tendency, its existence raises questions regarding the level of accuracy the statistical agency should aim at, in the case of data that may be used for

the purpose of making important decisions. Finally, it is probably true that in order to maintain strength in the estimates and confidence in them visible efforts have to be made to improve their accuracy – like Alice in Wonderland, it seems that one has to keep running in order to maintain one's position.

Aside from what has been said in the preceding paragraph, certain known deficiencies arising from present estimation procedures, that have been detailed in the paper, could usefully be reduced, if not eliminated entirely. In particular, while some of the factors responsible for the tendency, in the past, to understate the *level* of the first estimates have been of a non-repetitive character so that this tendency should be smaller in the future, the situation requires careful study. It should be noted, however, that for most components the understatement of quarterly change was rather moderate, on average. At any rate, action designed to improve the average level of the first quarterly estimates must be guided by its likely impact on the quarter-to-quarter changes. Furthermore, it goes without saying that improvements in the quarterly series are inextricably tied up with improvements in the annual data.

An impression confirmed in the course of this study is that quality control, methodological research and exploitation of hitherto unused or new source material must be a continuous and substantially *independent* effort. The latter is perhaps of decisive importance. As personnel get absorbed in the inexorable task of producing statistics for regular publication it is only natural that the critical questioning of methods and sources is forced into the background, and the preparation of the estimates, their analysis, and attention to special detailed tabulations and studies to satisfy demands that cannot be by-passed once the statistics are published, occupy more and more of the statistician's time. It should be an aim of a statistical agency to provide for staff whose continuing function is to question present methods and sources, and probe ways and means of introducing important improvements. Naturally the carrying out of such functions requires personnel who, aside from being versed in the necessary statistical and mathematical techniques, have acquired an appropriate familiarity with the character of the statistics.

The establishment of such quality control and basic research functions should include the following aspects, among others which need not be detailed here: statistical worksheets should be

set up in such a way as to facilitate regular audits quickly, and the assessment of the character and size of revisions and the factors responsible for them. Procedures should be developed for testing systematically assumptions underlying the relationship between projectors and projected data, in all important cases. Familiarity with the character of the data and judgemental notions play an important role in the construction of a number of components of the accounts; this may have been conducive, in the past, to an inadequate exploitation of modern statistical techniques in the estimation process,[1] and this deficiency should be corrected wherever investigation suggests that it is likely to be important. Of even greater importance and urgency, in the light of the results described in Part III of the paper, is the need to carry out basic research and experimentation in the methods employed in adjusting the series for seasonal variation.

Although the relative size of revisions has been treated above as a reflection of deficiency in the first estimates, it has been stressed in the paper that it may also be viewed as an indication of improvement. Clearly if improvements of the type just discussed are introduced, revisions (classified in Part IV as non-repetitive) will be added to those which occur regularly in virtue of the fact that a statistical service must face demands for timeliness as well as accuracy. Other factors which will give rise to revisions, the seriousness of which it is extremely difficult to foresee, are the construction of related accounting tables, and the present practice of withholding certain revisions for a time. Dealing with the latter first, they arise from the present administrative decision to revise only the most recent four years, meanwhile splicing in estimates for the recent period to those for the preceding period until new decennial census data become available. It will be clear that not all components are affected by this practice.

At the moment, the Dominion Bureau of Statistics is engaged in the construction of an interindustry flow table for 1961, studies of the stock of fixed capital, research on global and industry productivity indexes, and the development of data which eventually will be the basis for a money flows table. This work, which is conceived as an integral part of the annual and quarterly

[1] See, for example, Milton Friedman, 'The Interpolation of Time Series by Related Series', *Journal of the American Statistical Association*, December 1962, pp. 729–57.

income and expenditure accounts, may throw light on various constituent series which will necessitate revision. In addition, a basic change in the definition of 'establishment' (used as the unit of reporting and classification of surveys of industrial statistics) has been introduced in 1961, and it is expected that some revisions will arise from this change.

It bears emphasis that programmes of improvement and development such as described above, and in Part IV (at the end of each section discussing the revisions of the unadjusted series) must be conceived in terms which are balanced and practical, in the sense that due account is taken of alternative utilization of scarce resources and the relative importance of the end-results, not to speak of the implied burden on respondents. They must also be realistic, in the sense that the intrinsic limitations of the information emanating from reporting units are fully recognized. It is, for example, difficult to see how truly reliable statistics of quarterly corporation profits in the construction industry can be secured, as indicated in Part IV. More fundamentally, most of the data utilized in the quarterly national accounts are collected for a variety of important purposes which generally emphasize accuracy in the *level* of the data. For the analysis of the changing economic scene, however, major interest naturally lies in data reflecting the changes that have taken place from one period to another, and the degree of accuracy required in the data of such changes is relatively greater and more difficult to achieve. The prospects for securing data on changes directly do not appear promising, although basic research aiming to design surveys paying more attention to the accuracy of the statistics on changes would probably be worthwhile.

It will be clear from the preceding that, in the last analysis, the question of accuracy and revision of the quarterly national accounts is, in fact, an integral part of the question of accuracy and revision of the whole range of available economic statistics. In conclusion, reference is made again to the question: Taking their accuracy as given, is it likely that sufficiently better judgements regarding current economic developments have been made in Canada, in virtue of the fact that quarterly accounts have been published regularly, to justify the expense and time involved? This is clearly not a question that lends itself to a direct and fully objective evaluation, but this study, which subjected the quarterlies to rather severe tests, supports, we believe,

the prevailing view that they have been sufficiently accurate to fulfil their role as an indispensable framework for current analysis, in which monthly and annual as well as quarterly statistics, and a variety of analytical tools, play their due part. In this context even the weak components of the quarterly accounts are useful, especially if the user is fully aware of their characteristics and makes allowances for their shortcomings. Like 'the building of Rome', it takes a long time to build a fully-rounded system of current economic intelligence in which all components are strong; in the interval even weak components (which may be likened to temporary accommodation in the building of a city) play an important role. Thus our answer to the question posed at the beginning of this paragraph is a decided 'Yes'.

STATISTICAL APPENDIX

TABLE 1

Absolute and algebraic means of final estimates of year-to-year percentage change

	1953–58		1959–60	
	Absolute mean (1)	Algebraic mean (2)	Absolute mean (1)	Algebraic mean (2)
Gross national expenditure	5·68	5·49	4·52	4·52
Consumer expenditure	6·24	6·24	4·38	4·38
Government expenditure	6·38	6·38	3·99	3·99
Business fixed capital formation	11·48	8·39	2·05	2·05
Changes in non-farm inventories	*	*	*	*
Changes in farm inventories	*	*	*	*
Exports of goods and services	5·24	2·37	4·81	4·81
Imports of goods and services	9·07	5·87	4·95	4·95
Wages and salaries	6·73	6·73	4·73	4·73
Corporation profits	12·27	2·73	10·69	4·35
Net income of non-farm unincorporated business	5·86	5·23	1·62	1·53
Accrued net farm income	24·19	0·15	6·88	−0·25
Indirect taxes less subsidies	6·21	6·21	7·05	7·05
Gross national product less farm income	6·31	6·31	4·70	4·70
Personal disposable income	*6·11*	*6·11*	4·16	4·16
Personal net saving	*	*	*	*

Note to Table 1:

The percentage change of each year from the preceding year was calculated; these percentage changes were summed and divided by the number of years, ignoring sign in the summation to arrive at the absolute mean, and taking sign into account to arrive at the algebraic mean.

The year-to-year percentage changes of these items are difficult to interpret.

TABLE 2

Absolute means of revisions of annual change compared with absolute means of final estimates of annual change

	1953–58			1959–60		
	Absolute means of: Final estimate of year-to-year change $M (1)	Revision in year-to-year change $M (2)	Relative size of revision % (3)	*Absolute means of:* Final estimate of year-to-year change $M (1)	Revision in year-to-year change $M (2)	Relative size of revision % (3)
Gross national expenditure	1,533	160	10·4	1,517	70	4·6
Consumer expenditure	1,077	155	14·4	1,061	175	16·5
Government expenditure	317	61	19·2	252	37	14·7
Business fixed capital formation	614	111	18·1	142	74	52·1
Changes in non-farm inventories	418	159	38·0	376	43	11·4
Changes in farm inventories	213	53	24·9	105	6	5·7
Exports of goods and services	287	39	13·6	341	38	11·1
Imports of goods and services	557	40	7·2	369	7	1·9
Wages and salaries	886	136	15·3	799	219	27·4
Corporation profits	283	74	26·1	291	29	10·0
Net income of non-farm unincorporated business	103	20	19·4	35	74	211·4
Accrued net farm income	329	60	18·2	79	2	2·5
Indirect taxes less subsidies	194	21	10·8	282	41	14·5
Gross national product less farm income	1,610	205	12·7	1,520	71	4·7
Personal disposable income	1,135	119	10·5	971	145	14·9
Personal net saving	264	191	72·3	155	184	118·7

Note to Table 2:

For a description of the procedures used in calculating the means of Table 2 see note to Table 1.

TABLE 3

Number of years in which revision was larger than actual change in final estimates and number of years in which revisions altered direction of change

	1953–58		1959–60	
	Revision in change larger than final change	Revision altered direction of change	Revision in change larger than final change	Revision altered direction of change
	(1)	(2)	(1)	(2)
Gross national expenditure	0	0	0	0
Consumer expenditure	0	0	0	0
Government expenditure	1	1	0	0
Business fixed capital formation	0	0	0	0
Changes in non-farm inventories	0	0	0	0
Changes in farm inventories	0	0	0	0
Exports of goods and services	0	0	0	0
Imports of goods and services	0	0	0	0
Wages and salaries	0	0	0	0
Corporation profits	1	1	0	0
Net income of non-farm unincorporated business	0	0	1	0
Accrued net farm income	0	0	0	0
Indirect taxes less subsidies	0	0	0	0
Gross national product less farm income	0	0	0	0
Personal disposable income	0	0	0	0
Personal net saving	3	1	1	1

Notes to Table 3:

(*a*) The total number of observations (years) for the period 1953–58 amounted to 6; and for 1959–60 to 2.

(*b*) In the case of column (2), in a few instances the first estimates showed no change and the final showed an increase or decrease, or vice versa. These were not entered.

(*c*) 'Larger' in the context of this table refers to relative magnitude irrespective of sign.

TABLE 4

Indications of bias in first estimates of change

(Number of years in which first estimate of change was higher than final estimate of change; and algebraic mean of revisions of yearly change)

Item	1953–58			1959–60		
	Number of years first estimate of change higher than final estimate	Algebraic mean final annual change	Algebraic mean revisions of yearly change ('bias')	Number of years first estimate of change higher than final estimate	Algebraic mean final annual change	Algebraic mean revisions of yearly change ('bias')
	(1)	$M (2)	$M (3)	(1)	$M (2)	$M (3)
Gross national expenditure	1	1,483	−145	1	1,517	28
Consumer expenditure	0	1,077	−155	1	1,061	−120
Government expenditure	1	317	−39	2	252	37
Business fixed capital formation	1	421	−54	1	−142	−7
Changes in non-farm inventories	4	−48	29	2	236	43
Changes in farm inventories	3	−91	6	0	105	−6
Exports of goods and services	2	128	−21	0	341	−38
Imports of goods and services	1	337	−27	1	369	−3
Wages and salaries	2	886	−76	2	799	219
Corporation profits	2	40	−16	1	101	−11
Net income of non-farm unincorporated business	0	92	−20	0	32	−74
Accrued net farm income	6	−127	60	0	−3	−2
Indirect taxes less subsidies	1	194	−21	0	282	−41
Gross national product less farm income	0	1,610	−205	1	1,520	30
Personal disposable income	1	1,135	−25	1	971	57
Personal net saving	5	57	154	1	−91	41

Notes to Table 4:

(*a*) In regard to column (1) it should be noted that there were 6 observations (years) in 1953–58 and 2 in 1959–60.

(*b*) The means of columns (2) and (3) have been calculated in the same manner as those of Table 2, except that the sign was taken into account in the summation.

(*c*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.

TABLE 5

Absolute means of revisions of yearly level compared with absolute means of final estimates of yearly level

	1953–58			1959–60		
	Absolute means of: Final estimates of annual level $M	Revisions of annual level $M	Relative size of revision %	*Absolute means of:* Final estimates of annual level $M	Revisions of annual level $M	Relative size of revision %
	(1)	(2)	(3)	(1)	(2)	(3)
Gross national expenditure	28,735	801	2·8	35,356	111	0·3
Consumer expenditure	18,218	514	2·8	22,931	138	0·6
Government expenditure	5,162	140	2·7	6,566	23	0·4
Business fixed capital formation	6,012	140	2·3	6,793	74	1·1
Changes in non-farm inventories	306	112	36·6	344	52	15·1
Changes in farm inventories	163	48	29·4	75	6	8·0
Exports of goods and services	5,901	41	0·7	6,853	46	0·7
Exports of goods and services	6,802	50	0·7	8,146	41	0·5
Wages and salaries	14,199	495	3·5	17,791	325	1·8
Corporation profits	2,487	106	4·3	2,902	117	4·0
Net income of non-farm unincorporated business	1,872	36	1·9	2,191	64	2·9
Accrued net farm income	1,256	104	8·3	1,156	12	1·0
Indirect taxes less subsidies	3,412	43	1·3	4,349	44	1·0
Gross national product less farm income	27,480	905	3·3	34,200	100	0·3
Personal disposable income	19,406	200	1·0	24,353	148	0·6
Personal net saving	1,188	330	27·8	1,422	211	14·8

Note to Table 5:

Column (1) is simply the sum of the final annual estimates divided by the total number of years, ignoring sign. Column (2) has been calculated by subtracting the final estimate of each year from the first estimate of the same year, summing these differences ignoring sign, and dividing by the total number of years.

TABLE 6

Indications of bias in first estimates of annual level

	1953–58		1959–60	
	Number of years in which first estimate of annual level higher than final estimate (1)	Algebraic mean of revisions of first estimates of level $M (2)	Number of years in which first estimate of annual level higher than final estimate (1)	Algebraic mean of revisions of first estimates of level $M (2)
Gross national expenditure	0	−801	1	−80
Consumer expenditure	0	−514	1	−96
Government expenditure	1	−134	1	11
Business fixed capital formation	1	−121	1	−7
Changes in non-farm inventories	1	−56	0	−52
Changes in farm inventories	1	−43	2	6
Exports of goods and services	1	−24	0	−46
Imports of goods and services	1	−31	0	−41
Wages and salaries	0	−495	2	325
Corporation profits	2	−59	0	−117
Net income of non-farm unincorporated business	0	−36	0	−64
Accrued net farm income	6	104	1	2
Indirect taxes less subsidies	1	−39	0	−44
Gross national product less farm income	0	−905	1	−82
Personal disposable income	1	−185	1	115
Personal net saving	6	330	2	211

Notes to Table 6:

(*a*) The total number of observations for the period 1953–58 amounted to 6; and for 1959–60 to 2.

(*b*) 'Higher' in the context of this table refers to relative magnitude taking sign into account.