Preliminary Estimates of GNP: 1972-78

By Dan M. Bechter and Steven P. Zell

Economic policymakers need reliable, comprehensive, and timely data on U.S. business and financial conditions. The most comprehensive measure of the country's economic activity is its gross national product (GNP). Data on GNP and its components are part of the national income and product (NIP) accounts, maintained by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. Since these accounts are estimated for calendar quarters as well as for years, the "Estimates . . . have become an indispensable tool for formulating and evaluating economic policy. . . ."[1]

The BEA publishes its first estimate of a quarter's NIP data about 15 days after the end of that quarter. For example, the first, or preliminary, estimate of GNP for the fourth quarter of 1978 will be published on or about January 15, 1979. The NIP accounts for a particular quarter are then revised several more times, including a revision each July for the following three years.

This article has two purposes. The first is to provide a summary of how BEA arrives at its preliminary estimates of GNP. The second is to assess the reliability of these estimates over the, most recent business cycle.

DEFINITION AND ESTIMATION

The major components on the product (GNP) side, as opposed to the income side, of the NIP accounts are personal consumption expenditures, gross private domestic investment, government expenditures, and net foreign investment. These four categories define the respective purchases of the four major sources of aggregate demand in the economy: consumers, businesses, governments, and foreigners. Every final good or service produced in the country during a particular period must, by definition, be purchased by one of these sources of aggregate demand.[2] Thus, the basic approach to measuring the economy's total production, or GNP, during a particular quarter is conceptually straightforward: find out how much each of the four major sources of demand spent on final goods and services produced over the quarter.

---

1 Allan H. Young, "Reliability of the Quarterly National Income and Product Accounts of the United States, 1947-1971," Bureau of Economic Analysis Staff Paper No. 23, July 1974.

2 Only final purchases need be counted, since the value of production at intermediate levels is already included in the final price. Changes in business inventories are included in gross private domestic investment to adjust final sales for the difference between unsold goods produced in the current period and goods sold in the current period that were produced in an earlier period.

Unfortunately, the conceptual simplicity of the approach to determining quarterly GNP is not matched by simplicity in its implementation.

Quarterly GNP cannot be constructed from a monthly GNP series, for such a series does not exist. However, the many thousands of monthly economic series that are available, together with special surveys by the BEA, provide a basis for preliminary estimates of quarterly GNP. Still, as will be apparent in the following discussion, the coverage and reliability of the data available to the BEA are far from ideal, giving rise to errors in preliminary estimates of quarterly GNP. A summary of the estimation procedure for each of the major sources of aggregate demand indicates some sources of these errors.

Personal Consumption Expenditures

As defined in the NIP accounts, personal consumption expenditures (PCE) include most of what is commonly considered household purchases of goods and services. The major exception is in the treatment of housing. By convention, the purchase of a new home and expenditures to add to or improve existing homes are not considered part of PCE, but as part of gross private domestic investment. In effect, the household is considered a business in matters of residential investment. In addition, since rents paid to landlords are treated as a measure of services (shelter) from rented housing, personal consumption expenditures on services also include an amount of imputed rent for owner-occupied housing.

Consumers purchase over three-fifths of GNP. More than half of these purchases are consumer goods.[3] The fact that consumer expenditures are so large in GNP is one of the reasons for the existence of a monthly retail sales series that tracks the goods portion of PCE quite well.

To arrive at its preliminary quarterly estimate of goods purchased by consumers, BEA makes several adjustments to the retail sales figures for the months in that quarter. There are three major reasons for these adjustments. First, not all sales by retail stores are to consumers. Prime examples are sales of new cars to businesses, which are counted as part of business purchases, and sales by lumberyards and other building materials stores, most of which are reflected in figures for investment in structures. Second, not all sales by retail stores are sales of new goods. Sales of used cars by automobile dealers are a good example. Except for an amount indicating markup over cost, which reflects the preparation and sales services of the dealer, the value of used cars purchased during a quarter does not belong in a measure of productive activity (GNP) in that quarter. Third, not all sales by retail stores are sales of goods. Sales by gasoline service stations, for example, usually include significant revenue from maintenance, assistance, and repair services. While most of these sales of services reflect consumer expenditures, they are properly counted as PCE-services rather than PCE-goods.

The available data are not as good for making preliminary quarterly estimates of PCE-services as they are for PCE-goods. In arriving at its estimates of consumer spending on services, BEA draws on many public and private data sources; conducts surveys of service establishments; and makes ". . . considerable use of proxy variables and trend extrapolations. . . ."[4] For example, estimates

[3] In the 14 quarters of economic expansion since the trough of the recession in March 1975, PCE has averaged 64 per cent of GNP, and consumer purchases of goods have averaged 55 per cent of PCE, or 35 per cent of GNP.

[4] *Report of the Advisory Committee on GNP Data Improvement,* 1977, p. 165.

of consumer spending on many types of services, such as haircuts, travel accommodations, and movies, are made from a monthly survey of selected services establishments conducted by the U.S. Bureau of Census. Estimates of consumer expenditures on electricity, natural gas, and telephones are made from monthly sales data collected by individual companies and their industrial associations. Estimates of consumer spending on legal, medical (except hospital), religious, and private educational services are made by fitting trends to annual levels.

Preliminary estimates of PCE can be no better than the data, assumptions, and procedures on which these estimates depend. The estimation procedures used by BEA undergo constant study and improvement. However, even the best of statistical techniques does not eliminate errors due to lack of reliable data or possible incorrect assumptions made to compensate for data inadequacy. The use of monthly data for making quarterly estimates seems reasonable, but when preliminary quarterly estimates must be made, complete data for the last one or two months in the quarter may not yet be available. As a result, projections of data for these months are required.

Less serious, yet definite sources of error in preliminary estimates of quarterly GNP, are instances when the monthly data are themselves in tentative, preliminary form. A month's retail sales data, for example, are revised regularly in each of two successive months to reflect a larger sample coverage, and are revised irregularly from time to time to reflect improvements in the sampling and estimation techniques. In the cases where trend extrapolations are used as estimates of consumer expenditures on certain services, the assumption that the average increase of the past is being experienced in the current quarter is no more than a best guess. Trend estimates are therefore subject to substantial revision when a quarter's actual experience is unexpectedly abnormal, as shown by data that become available after the preliminary quarterly estimates are made.

Gross Private Domestic Investment

Preliminary quarterly estimates of gross private domestic investment (GPDI) are, like the estimates of PCE, built from estimates of its components. In the case of GPDI, the major components are investments in (1) residential buildings, (2) nonresidential buildings, (3) business equipment, and (4) business inventories.

For its preliminary quarterly estimate of investment in structures, both residential and nonresidential, BEA uses a monthly series of the value of new construction put in place (Census). Only two months of data from the latest quarter are available at the time of the preliminary estimate; the third month must be projected.

Sometimes, available monthly data are not completely "hard" themselves, but include projections. A quarterly estimate can then involve two or more levels of projection, as is the case for the preliminary quarterly estimate of residential structures. As noted, the first estimate requires projecting one month of residential construction activity.[5] However, even the two months of data that are available on the value of new residential construction put in place are based partly on projections. Specifically, the investment expenditures on single-family homebuilding during a month is a

[5] A projection is not necessarily a blind trend extrapolation. It usually reflects the consideration of other data sources and information likely to be relevant to the estimate being made. For example, the effects of unseasonably bad weather on construction, sales, etc., can be estimated from past experience, and these effects can be reflected in the projection.

projected amount based on an assumed rate at which the construction of a home is completed once it is started. Thus, the preliminary quarterly estimate of investment in residential structures actually depends largely on the monthly series of housing starts and on estimates of the average value of units started each month. Finally, the monthly Census estimate of expenditures for additions and alterations of existing residential structures, included in the value of new construction put in place, is an estimate based on historical trend, and this projection becomes incorporated in the preliminary estimate of quarterly GPDI.

Expenditures for petroleum and natural gas drilling and exploration are also part of investment in structures in the NIP accounts. These expenditures are the only part of the quarterly estimates not derived from the monthly Census series of the value of new construction put in place. For a preliminary quarterly estimate of oil and gas drilling, BEA uses industry sources for monthly footage drilled, multiplied by an estimated cost per foot drilled, derived from an industrial price index.

Preliminary quarterly estimates of business expenditures on equipment, the "producers' durable equipment" category in the NIP accounts, are made for four major subcategories. Business purchases of automobiles are assumed to be the same fraction of total new car sales, calculated from monthly trade-source data, as in the preceding year. Business purchases of trucks are estimated from a trade source on unit sales by franchised dealers, together with the producer price index for trucks. Census data on commercial sales of aircraft are the basis for preliminary estimates of business purchases of airplanes. For estimates of investment expenditures on most other types of producers' durable equipment, the BEA relies on monthly Census data of manufacturers' shipments of selected capital goods. The BEA also assumes that the prior year's composition of imports and exports can be used to estimate the capital goods components of imports and exports, as tracked by the monthly Census series on merchandise trade. In making preliminary quarterly estimates for all four of these subcategories of producers' durable equipment, and therefore for the total itself, only two months of data for that quarter are available.

The remaining major category of GPDI is investment in inventories, or changes in business inventories. Changes in farm business inventories are estimated from projections by the U.S. Department of Agriculture. Changes in nonfarm business inventories at the manufacturing, wholesale, and retail levels are all estimated from monthly series compiled by Census, Again, inventory data for only two months of the quarter are available when preliminary quarterly estimates are made.

Government Purchases of Goods and Services

Preliminary quarterly estimates of Federal purchases of goods and services are based, in general, upon monthly data available for two months of the quarter. Data are more fragmentary for preliminary quarterly estimates of purchases of goods and services by state and local governments.

For the first two months of a quarter, Federal purchases are estimated primarily from the U.S. Treasury Department's "Monthly Statement of Receipts and Outlays of the United States Government." The items in this statement are not strictly equivalent to NIP account definitions, so BEA must translate cash outlays into Federal purchases of goods and services. For its preliminary quarterly estimate, BEA must project the third, or missing, month's purchases after obtaining estimates of third-month expenditures from the

agencies responsible for most of Federal Government purchases. These agencies include the Department of Defense, the Department of Energy, the Commodity Credit Corporation, and the National Aeronautics and Space Administration. Two other major categories of Federal purchases are employee compensation, estimated from Civil Service Commission's monthly payroll data, and Federal expenditures for construction, estimated from the monthly Census series of new construction put in place.

In developing quarterly estimates of GNP components, some of the most serious deficiencies in data are in state and local government purchases, which is particularly unfortunate because of the extremely rapid growth of purchases by state and local governments. The quarterly estimates, and especially the preliminary quarterly estimates, of purchases by state and local governments are ". . .based heavily on trends and extrapolations of annual data, and judgment."[6] For most of the subcategories of state and local government purchases, only one month of data is available at the time of the preliminary estimate. So, as a result, chances of error in this sector are especially acute and are camouflaged only by usually consistent patterns, which tend to make projections more reliable.

Net Exports of Goods and Services

The rest-of-the-world component of GNP is sometimes called "net foreign investment," but net exports of goods and services, or the difference between exports of goods and services and imports of goods and services, describes it better.' Exports and imports of goods are easier to estimate than are exports and imports of services. Preliminary quarterly estimates of foreign trade in goods are constructed from monthly Census data on imports and exports of merchandise. Preliminary estimates of a quarter's exports and imports of services are mainly projections, based on trend extrapolations from a variety of sources of primarily annual data, and modified when trend estimates are believed to misrepresent actual developments. Partly because of the increasing importance of the rest of the world to the U.S. economy, NIP account users and analysts have been studying ways to improve the reliability of quarterly estimates of net exports of goods and services.

RELIABILITY OF PRELIMINARY ESTIMATES

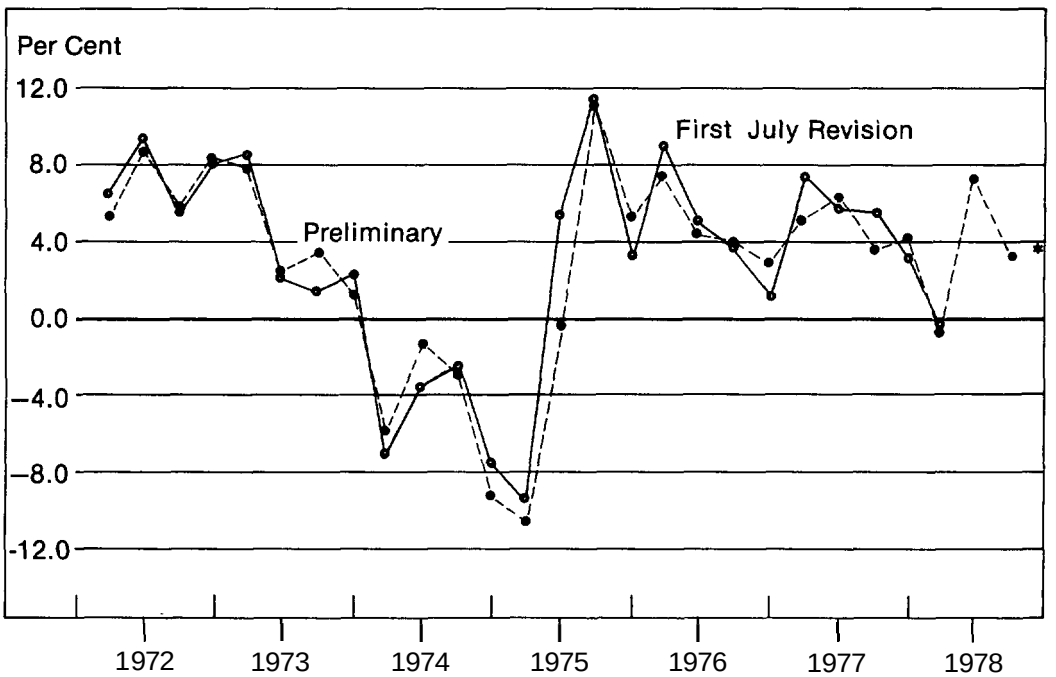
Despite the data inadequacies associated with making preliminary quarterly estimates of GNP, these estimates have been found to be useful indicators of economic activity.[8] The

6 *Report.* p. 196.

7 Goods and services produced in this country but sold to foreign buyers are exports of goods and services. These exports are clearly all part of the nation's national product. Why, then, is it necessary to subtract imports of goods and services from exports to arrive at GNP? The answer is that, in summing up the purchases of consumers, businesses, and governments, no distinction is made between goods produced domestically and those imported from other countries. In effect, imports have been counted in aggregate demand, so they must be subtracted out if a measure of output (GNP) is the objective. Making the subtraction in the rest-of-the-world account accomplishes this purpose and also provides a meaningful summary statistic of the nation's balance of trade.

8 Several studies have been made of the changes in the estimates of quarterly GNP as the original estimate proceeds from its preliminary stage, through several revisions, on to its ultimate final value. Among these are George Jaszi, "The Quarterly National Income and Product Accounts of the United States, 1942-62," paper presented at the 1963 meetings of the International Association for Research in Income and Wealth, published in ***Studies in Short-Term National Accounts and Long-Term Economic Growth;*** Simon Goldberg and Phyllis Deane, ed., ***Income and Wealth: Series XI,*** 1965; Rosanne Cole, ***Errors in Provisional Estimate of Gross National Product,*** National Bureau of Economic Research Studies in Business Cycles No. 21, 1969; and Allan Young, ***op.cit.***

Chart 1
GROWTH OF REAL GNP: QUARTERLY, 1972:1 TO 1978:1
PRELIMINARY ESTIMATES AND FIRST JULY REVISED ESTIMATES
(Per Cent Changes At Annual Rates)



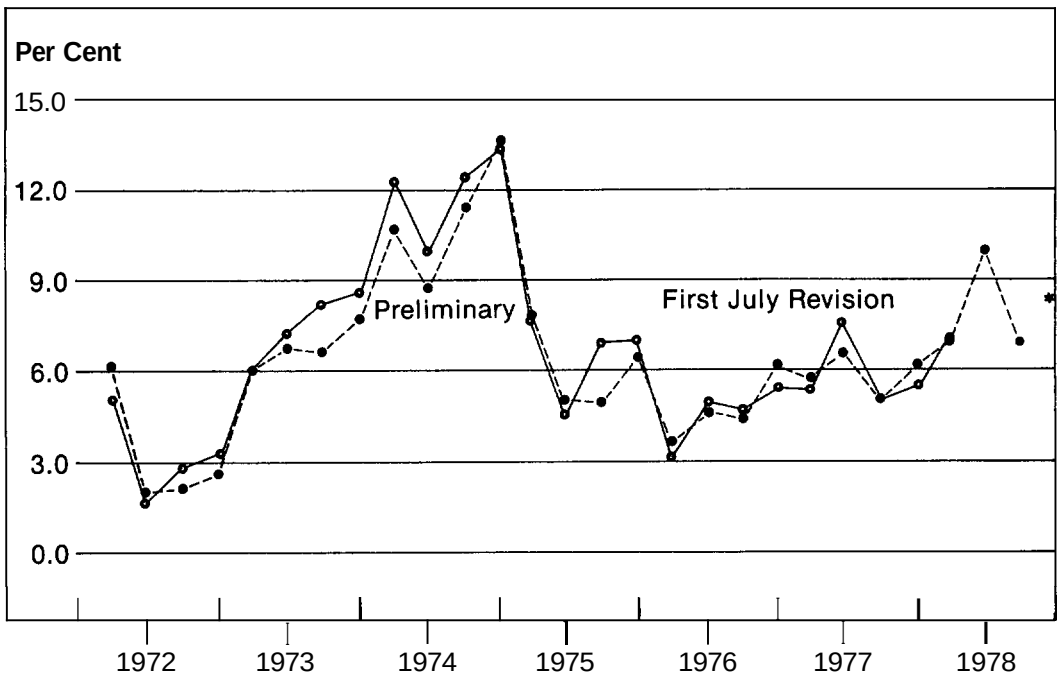
'Fourth quarter 1978 projection.

most recent study of preliminary GNP estimates covered a period ending with the fourth quarter of 1971. Since that time, however, the economy has been through a complete business cycle, including the most severe postwar recession on record, and the national income accounts have undergone another major "benchmark" revision. Another look at the reliability of preliminary estimates of quarterly GNP is warranted.

Economic analysts generally have a fairly good idea of the level of economic activity, so their attention is commonly focused on changes in GNP. Back when inflation was not a problem, the rate of growth of GNP itself was the summary statistic depended on to indicate how fast and in what direction productive activity was changing. But now with inflation high and variable, the rate of growth of GNP unadjusted for price changes is not very meaningful. However, the rate of growth of GNP is the sum of the rate of growth of real GNP (GNP adjusted for changes in prices) and the rate of inflation. Preliminary quarterly estimates of both the economy's rate of growth and rate of inflation are therefore now the indicators of most interest to economic policymakers.

How reliable have been these preliminary estimates in recent years? To answer this question, some other later estimates must be chosen as a basis of comparison. In Chart 1, preliminary estimates of growth in real GNP are compared with "first July" revised

Chart 2
THE RATE OF INFLATION AS MEASURED BY THE IMPLICIT PRICE DEFLATOR: QUARTERLY 1972:1 TO 1978:1 PRELIMINARY ESTIMATES AND FIRST JULY REVISED ESTIMATES
(Per Cent Changes At Annual Rates)



*Fourth quarter 1978 projection.

estimates. The same kind of comparison is made in Chart **2,** for estimates of the rate of inflation as it is measured by the implicit price deflator of **GNP.**[9] The charts show that preliminary estimates have tracked the rate of growth of real **GNP** and inflation quite well, using first July revisions as proxies for "actual" growth and inflation in the economy. In particular, Chart **1** shows that the preliminary estimates captured the downturn in the business cycle when the economy went from expansion in the fourth quarter of **1973,** as indicated by a positive per cent change in real **GNP,** to recession in the first quarter of **1974,** as indicated by a negative rate of growth, or decline, in real **GNP.** Again, when the economy bottomed out in the first quarter of **1975,** the preliminary estimate narrowly missed the trough of the recession by estimating second quarter **1975** real growth to be slightly negative instead of strongly positive.

Charts **1** and **2** give visual impressions of the

9 First July revisions in GNP are those made each July for the four quarters ending with the first quarter of the year of that July. For example, in July of 1978, quarterly GNP estimates for the quarters 1977:2 through 1978:1 receive their first July revisions. The word "first" is used because estimates are revised for the three prior years (12 quarters) each July, so each quarterly estimate ends up getting a first, second, and third July revision.

reliability of preliminary estimates of the rate of growth of GNP and inflation. Using the same data, numerical measures of reliability can be calculated. Two such numerical measures, bias and dispersion, are useful and easily calculated summary statistics.

Bias is the average difference between the earlier and later estimates. For example, if a preliminary estimate differs from a first July revised estimate by +2 percentage points in one quarter and −2 percentage points in the next quarter, the average difference or bias is 0 for those two quarters. When preliminary estimates ex bit negative bias over a period, it means that the preliminary estimates are systematically underestimating actual changes, as defined here by first July estimates.

Dispersion is the average **absolute** difference between the earlier and later estimates. Thus, in the two-quarter example of the preceding paragraph, dispersion = (|+2|+|−2|)/2 = 4/2 = 2. A measure of dispersion gives an idea of the accuracy of the earlier estimates as compared with the later estimates over the period.

Table 1 reports values of bias and dispersion for preliminary estimates of the rate of growth of real GNP and of the implicit GNP deflator as compared with first July estimates of the same variables. Besides showing the statistics for the period as a whole, values of bias and dispersion are shown also for the most recent two-year subperiod. This subperiod begins with the first quarter of 1976, just after the extensive "benchmark" revision of the NIP accounts in January 1976.

The tabulated results indicate that, for the period as a whole, preliminary quarterly estimates tended to underestimate the rates of real growth and inflation by the same amount (bias = −.03 percentage points). Revisions of preliminary estimates of real GNP growth tended to be larger (dispersion = 1.3) than revisions of preliminary estimates of the rate of inflation (dispersion = 0.7). In the recent two-year subperiod, there is little indication of improvement in the preliminary estimates of the rate of growth of real GNP, but a hint of some improvement in preliminary estimates of the rate of inflation.

Table 1
MEASURES OF REVISIONS IN QUARTERLY PERCENTAGE CHANGES IN REAL GROSS NATIONAL PRODUCT AND IMPLICIT PRICE DEFLATOR (Preliminary Vs. First July Estimates, 1972:1 to 1978:1)

Period and Item	Bias (% Points)	Dispersion (% Points)
1972:1 to 1978:1	−0.3	1.3
Real Gross National Product	−0.3	1.3
Implicit Price Deflator of GNP	−0.3	0.7
1976:1 to 1978:1		
Real Gross National Product	−0.4	1.2
Implicit Price Deflator of GNP	0.1	0.5

NOTE: The quarterly percentage changes used in these calculations of bias and dispersion are at annual rates.

The performance of preliminary estimates in this recent 6-year period can also be compared with the performances of these estimates in earlier periods, as reported by other researchers. To be fair in making such comparisons, however, slightly different measures of reliability must be employed in the cases of those variables subject to distortion by inflation. These modified measures of bias and dispersion are required because unmodified measures have been larger in the 1970's than in the 1950's and 1960's, due to the higher rates of inflation in the 1970's. That is, a one percentage point bias or dispersion in a preliminary estimate of, for example, the rate of inflation during a noninflationary period indicates a larger **relative** revision than the

same percentage point "error" during a period of rapidly rising prices.

Measures of relative bias and relative dispersion provide a fair basis for comparing the reliability of preliminary estimates in different periods. As their names imply, relative bias and relative dispersion are ratios. Relative bias is defined as bias (the average difference between the earlier and later estimates) divided by the average of the later estimate. For example, if the preliminary estimate of the rate of growth of current dollar GNP misses the first July estimate by +1 percentage point on the average (its bias), and if the rate of growth of current dollar GNP has averaged 8 per cent over the period of calculation, relative bias = +1/8 = .125. Relative dispersion is defined as dispersion (the average absolute difference between the earlier and later estimates) divided by the average absolute value of the later estimate. For example, if the preliminary estimate of the percentage change in current dollar GNP misses the first July estimate by an average absolute amount of 3 percentage points, and if the average absolute percentage change in current dollar GNP, as measured by the first July estimate, is 10 per cent, the relative dispersion = 3/10 = .30.

Part of the results of Allan Young's comprehensive study of quarterly estimates of GNP through 1971 is shown in Table 2, along with values for the same measures of reliability calculated for the more recent period covered in this study. The comparative results would seem to indicate a slight deterioration in the reliability of preliminary estimates of quarterly changes in real GNP from the 1966:1-1971:4 period to the 1972:1-1978:1 period. Considering the much wider fluctuations of growth in real GNP in the latter period, however, some decline in reliability might have been expected. That is, the deterioration in the values of relative bias and relative dispersion for preliminary estimates of growth in real GNP over the more recent period is probably not indicative of decreased reliability of techniques of preliminary estimation. Instead, the deterioration indicates that any estimation procedure performs somewhat less well under periods with relatively dramatic fluctuations compared to periods of relatively stable growth. In light of this observation, the deterioration can be considered quite small, and it can be concluded that preliminary estimates have remained reliable under a period of severe strain in the economy.[10]

Table 2
MEASURES OF REVISIONS IN QUARTERLY PERCENTAGE CHANGES OF GROSS NATIONAL PRODUCT AND REAL GROSS NATIONAL PRODUCT
(Preliminary Estimates Compared With First July Estimates)

Variable and Period	Relative Bias	Relative Dispersion
Gross National Product		
1964:1 to 1971:4 (Young)	−.06	.11
1972:1 to 1978:1	−.05	.12
Real Gross National Product		
1966:1 to 1971:4 (Young)	.05	.19
1972:1 to 1978:1	−.09	.23

[10] In a study that preceded Young's, Rosanne Cole focused on the quarterly levels of GNP and its components as well as on the quarterly changes (in dollars, not per cent) in these levels. Cole found that preliminary estimates of the level of current dollar GNP over the period 1957:4-1962:4 underestimated "actual" GNP levels, as defined by the then final estimates provided by the 1965 benchmark revision of the NIP accounts, by about 2 per cent. For the period 1972:1-1978:1 covered in this article, preliminary estimates of the level of GNP have been, on the average, about 1 per cent below the latest available estimates. These latest available estimates have not all undergone a benchmark revision, however, so no conclusions as to improved reliability can be reached on the basis of this comparison.

SUMMARY AND CONCLUSIONS

Of all the measures of economic activity, GNP is the most comprehensive. Of those estimates of GNP, the preliminary quarterly estimates—available for a calendar quarter about 15 days after that quarter is over—receive the most attention. The timely character of these preliminary quarterly estimates requires, as one might suspect, some sacrifice in reliability. Data available for the three months of the quarter at the time of the preliminary estimates are often incomplete, and always subject to revision. Consequently, there is some question as to whether or not preliminary quarterly estimates of GNP are useful for making economic policy.

The six-year period from the first quarter of 1972 through the first quarter of 1978 includes a complete business cycle in which the country experienced both its most severe recession and its most severe inflation since World War II. These extreme shocks to the economy, it would seem, are a good test of how well preliminary estimates of GNP stand up under change. The findings of this study tend to parallel those of others covering earlier periods: preliminary quarterly estimates of GNP do provide a generally reliable basis for assessing recent economic developments.

Research Working Papers
of the
Federal Reserve Bank of Kansas City

The following Research Working Papers (RWP) were published by the Federal Reserve Bank of Kansas City from late 1977 through 1978. Copies are available from the Research Division, Federal Reserve Bank of Kansas City, Federal Reserve Station, 925 Grand Ave., Kansas City, Mo. 64198.

RWP 77-01	October 1977	Bryon Higgins "The Impact of the Kansas City Proposal on Monetary Policy"
RWP 77-02	October 1977	Bryon Higgins "Reducing Reserve Requirements as a Solution to the Membership Problem"
RWP 78-01	February 1978	Carl M. Gambs "The Federal Reserve System in the National Income Accounts"
RWP 78-02	March 1978	V. Vance Roley "A Theory of Federal Debt Management"
RWP78-03	June1978	Jack L. Rutner "Temporal Causality Between Several Definitions of Both Income and Money"
RWP78-04	July1978	Benjamin M. Friedman (Harvard University) and V. Vance Roley "Structural Versus Reduced-Form Models of Long-Term Interest Rate Determination"
RWP 78-05	August 1978	Carl M. Gambs "State Reserve Requirements and Bank Cash Assets"
RWP 78-06	August 1978	V. Vance Roley "Short-Run Portfolio Selection Behavior, Asset Supply Effects, and the Joint Determination of Yields on Two Maturity Classes of Treasury Securities"
RWP 78-07	November 1978	Scott Winningham "A Model of the Financial System With Managed Liabilities"
RWP 78-08	November 1978	William G. Dewald (Visiting Scholar) and Maurice N. Marchon (University of Montreal) "Monetary Growth,. Inflation, and Unemployment: Projections Through 1983"