

ESTIMATION OF QUARTERLY GROSS STATE PRODUCT ACCOUNTS

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Introduction

Gross State Product (GSP) accounts, as introduced by Kendrick and Jaycox [3], have become a popular system for measuring economic activity at the state level. In formalizing the concept of GSP, Kendrick and Jaycox sought to create a system of state product accounts that would be consistent with national product accounts on an aggregate basis and for individual industries defined on a broad scale. This goal was phrased by Kendrick and Jaycox [3, pp 154] as "it is necessary and desirable to define the concept of GSP consistently with the concept of GNP, as well as to use consistent data and estimating methods." Various authors have made alterations to the GSP accounting system since its inception and have noted problems and potential inaccuracies which are associated with the procedures. A concise discussion of the alterations and problems is given by Weber [9] and will not be repeated here. Rather, the issue addressed below is the level of time aggregation (frequency) at which GSP accounts can be calculated. A method is presented for estimating GSP by industry at a quarterly frequency given that the accounts are calculated on an annual basis with a general approach that is by now standard. The method also provides the capability of predicting quarterly GSP by industry in out-of-sample periods. Reporting lags in GSP, which are as long as six quarters, can be shortened by this capability. An illustration of the method is presented using data from one state. Weber [10] has also proposed a system of quarterly GSP accounts but there are substantial differences between his method and the one outlined below.

Review Of Annual Gross State Product Accounts

The following symbols are adopted for various national and state accounts involved in the discussion of GSP:

NIWCJ — National Income Without Capital Consumption Adjustment
CJNI — Capital Consumption Adjustment to National Income
IBT — Indirect Business Taxes and Nontax Liability
BTP — Business Transfer Payments
SD — Statistical Discrepancy
SUB — Subsidies Less Current Surplus of Government Enterprises
CCA — Capital Consumption Allowances
CCACJ — Adjustment to Capital Consumption Allowances
GNP — Gross National Product

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GSP — Gross State Product
NER — Earnings at the National Level
SER — Earnings at the State Level
NVA — Value Added in Manufacturing at the National Level
SVA — Value Added in Manufacturing at the State Level
NLC — Labor Costs in Manufacturing at the National Level
SLC — Labor Costs in Manufacturing at the State Level

Accounts in the list which are tabulated at the state level are indicated by their titles. The remaining accounts are officially tabulated at the national level only and a subset of those is also available for a broad industry breakdown of the national total. Table 6.1 of the National Income Accounts, which can be referenced in the *Survey of Current Business* [8], contains the list of industries in the breakdown. The SER and GSP accounts are also tabulated by industry. Table 1 outlines the reporting frequencies and sources of selected accounts from the above list which will be used in the development of quarterly GSP accounts. In using the account symbols within algebraic formulae, the subscript i will denote industry i. Absence of a subscript implies either a national or state aggregate tabulated over all industries. The frequency of all accounts is annual in what follows unless the subscript q appears which denotes a quarterly account. When dealing with quarterly accounts, it is assumed that they are expressed in annual rates.

Distinct methods have been used in calculating annual GSP for each of four subsets within the group of industries. The subsets are composed of:

1. Farm
2. Manufacturing
3. Agricultural Services, Forestry, and Fisheries; Mining; Construction; Transportation and Public Utilities; Wholesale Trade; Retail Trade; Finance, Insurance, and Real Estate; Services
4. Government

A direct calculation of value added is used to estimate GSP of the farm industry. Annual data on the value of farm output and costs of operation by state are available from the U.S. Department of Agriculture. Details of the rather extensive calculation procedure may be found in Kendrick and Jaycox [3] or in L'Esperance and Schutter [5]. Quarterly data for all of the components involved in the direct calculation are not available, thereby preventing direct calculation of quarterly farm GSP.

Two approaches to the calculation of GSP in the manufacturing sector have been pursued. The first approach is based upon earnings received in the industry at the state and national levels:

$$GSP_i = GNP_i\,(SER_i/NER_i).$$

The ratio of state to national earnings in the industry is used to allocate a portion of manufacturing GNP to the state. In the second approach, ratios of value added in the state and national sectors are used either in place of or in conjuction with the earnings ratio above. Replacement of the earnings ratio by the value added ratio gives

$$GSP_i = GNP_i\,(SVA_i/NVA_i),$$

a formula introduced by Suits [7]. L'Esperance and Taylor [6] proposed a combination of the earnings and value added ratios with the components of the value added ratio being divided by labor costs in the industry. Their formula is

$$GSP_i = GNP_i\,(SER_i/NER_i)(SVA_i/SLC_i)(NLC_i/NVA_i).$$

Incorporating value added measures into calculations of GSP in manufacturing is an attractive option. However, data for value added on an annual basis have typically been subject to a very long reporting lag. The recent experience of reporting lags has been particularly disappointing. At the time of this writing, value added data for several preceding years have not been published and the reporting schedule of these series in the future is uncertain. As a result of current and anticipated difficulties with data availability, the approach based on the earnings ratio has the advantage of timeliness and will be used below.

The majority of industies fall in the third subset and the earning ratio approach is used to calculate annual GSP for these industries. Ratios of earnings in the respective industries at the state and national levels are applied to the gross product of the industries at the national level. Gross national product is tabulated by industry on an annual basis in Table 6.1 of the National Income Accounts. The formula, for industry i in the subset, is

$$GSP_i = GNP_i\,(SER_i/NER_i). \qquad (1)$$

Since GSP in the manufacturing industry will also be based on the earnings ratio approach, the entire group of industries for which the above formula is used may be referred to as the private non-farm industries.

Calculation of GSP in the government industry is based on an extension of the method presented by L'Esperance, Nestel, and Fromm [4]. Their method makes a distinction between the federal, and state and local subsectors of total government activity. NIWCJ in the two subsectors is allocated to the state level by using ratios of state to national wage and salary totals in the subsectors. The extension of this approach seeks to allocate GNP in the government industry, rather than just the NIWCJ component, to the state level. Three subsectors comprise the government industry with respect to available GNP information: federal, state and local, and government enterprises; the latter of which is not decomposed into federal and state and local classification. The ratios of state and national earnings are used as the allocative device instead of wages and salaries. The formula for government GSP to be used is:

$$GSP_i = GNPSLG\left(\frac{SERSLG}{NERSLG}\right) + GNPFG\left(\frac{SERFG}{NERFG}\right) + GNPGE\left(\frac{SERSLG + SERFG}{NERSLG + NERFG}\right), \qquad (2)$$

where the SLG, FG, and GE portions of the account symbols denote state and local government, federal government, and government enterprises, respectively. This formulae recognizes the split of government activity into the three available components and utilizes earnings ratios as the allocative device, thereby lending some consistency to the formulae for all non-farm industries. In addition, the majority of the involved accounts in the formula are available on a quarterly basis, a situation that will be exploited below.

Quarterly GSP — Private Non-Agricultural Industries

As reviewed above, annual GSP for all of the industries, with the exception of farm, can be calculated by the method involving earnings ratios and GNP on an industry basis. Of this group, the agricultural services, forestry, and fisheries industry and government industry will receive separate treatment due to unique characteristics with respect to data availability. The remaining industries can be termed to the private non-agricultural industries and will be considered as a group in the calculation of quarterly GSP accounts.

Direct calculation of quarterly GSP by the formula used for annual GSP is not possible since quarterly GNP data by industry are not available. However, quarterly data on one major component of GNP by industry is available and provide the basis for creating a system of quarterly GSP accounts. Even if quarterly data for all the components of GNP by industry were available, and the appropriate annual formula in (1) applied on a quarterly basis, the average of the constituent quarterly GSP calculations would not necessarily equal annual GSP due to the nonlinear character of the formula. Specifically, the sum of quarterly products would not equal the annual product of quarterly sums.

To clarify these issues, GNP of an arbitrary industry in the private non-agricultural group is decomposed into components that match those appearing in a particular formula for aggregate GNP:

$$GNP_i = NIWCJ_i + CJNI_i + CCA_i - CCACJ_i + IBT_i + BTP_i + SD_i - SUB_i.$$

It should be noted that the minor portion of aggregate NIWCJ attributed to the "rest of the world" is not allocated among respective industries. Thus, GNP can be viewed as GDP (gross domestic product) in this accounting framework. The reporting status, frequency, and sources of data on the respective components are given in Table 1. Noting the components for which data are available on an annual basis leads to the condensed form:

$$GNP_i = NIWCJ_i + CCA_i + IBT_i + MIN_i,$$

where MIN_i is the sum of the minor accounts not explicitly written. GSP for industry i on the annual basis is then

$$GSP_i = (NIWCJ_i + CCA_i + IBT_i + MIN_i)\ (SER_i/NER_i).$$

The logical extension of the GSP formula to a quarterly basis is

$$GSP_{iq} = (NIWCJ_{iq} + CCA_{iq} + IBT_{iq} + MIN_{iq})\ (SER_{iq}/NER_{iq}),$$

where q denotes a calendar quarter. Of the four GNP components, quarterly data are available only for NIWCJ by industry. However, quarterly data are available for the state and national earnings totals by industy. Rearranging the formula and accumulating the components CCA_{iq}, IBT_{iq}, MIN_{iq}, for which quarterly data are not available, gives

$$GSP_{iq} = NIWCJ_{iq}\ (SER_{iq}/NER_{iq}) + RES_{iq}\ (SER_{iq}/NER_{iq}).$$

$NIWCJ_i$ is the major component of GNP_i in all industries of the group and should be incorporated into quarterly GSP accounts since quarterly data are available. Thus, calculation of quarterly GSP for the industries in the private non-agricultural group requires estimation of the second additive term in the above formula. However, an important constraint must be recognized and forced upon any estimation procedure. It is required that the average of quarterly GSP calculations equal the annual GSP calculation in each industry for any year:

$$GSP_i = \tfrac{1}{4} \sum_{q=1}^{4} GSP_{iq} = \tfrac{1}{4} \sum_{q=1}^{4} NIWCJ_{iq} \left(\frac{SER_{iq}}{NER_{iq}}\right) + \tfrac{1}{4} \sum_{q=1}^{4} RES_{iq} \left(\frac{SER_{iq}}{NER_{iq}}\right), \quad (3)$$

or

$$GSP_i - \tfrac{1}{4} \sum_{q=1}^{4} NIWCJ_{iq} \left(\frac{SER_{iq}}{NER_{iq}}\right) = \tfrac{1}{4} \sum_{q=1}^{4} RES_{iq} \left(\frac{SER_{iq}}{NER_{iq}}\right). \quad (4)$$

Since GSP_i is available on an annual basis, the term on the right side of the equality in (4) is available on an annual basis. This term will be called the "remainder" and is the annual average of the unknown components of quarterly GSP for a given year. The term in (4) involving $NIWCJ_{iq}$ is the annual average of the known component of quarterly GSP for a given year. Table 2 illustrates that the remainder term is dominated by the term involving $NIWCJ_{iq}$ in all industries of the group with the exception of mining. The task now becomes one of allocating the annual value of the remainder term to constituent quarters subject to the constraint that the quarterly values so estimated will average to the annual value of the remainder. Note that the numeric portion of the remainder allocated to a particular quarter will be a combination of the theoretical RES_{iq} (SER_{iq}/NER_{iq}) term of the quarter along with the quarter's particular adjustment (typically small) that is necessary to satisfy the averaging constraint over the year. After allocation, GSP_{iq} is then calculated as

$$GSP_{iq} = NIWCJ_{iq} (SER_{iq}/NER_{iq}) + \hat{R}_{iq} \quad (5)$$

where $\hat{R}_{iq}$ represents the portion of the annual remainder, R_i, allocated to quarter q within the year. Note that $\hat{R}_{iq}$ must be expressed in annual rates. If the quarterly values $\hat{R}_{iq}$ average to R_i for a given year, then the averaging constraint for GSP_{iq} outlined in (3) is also satisfied.

The approach of Chow and Lin [2] to distributing aggregates reported at time periods of a given frequency among constituent periods of a higher frequency can be used for allocating the annual remainder R_i for an industry among quarters. Consider the column vector $\underline{R}$ of 4n hypothetical quarterly values of the remainder for an industry and a set of p column vectors containing 4n quarterly values of variables that are to be related to $\underline{R}$. The relationship between the remainder, $\underline{R}$, and the 4n observed values of the related variables is specified as a linear model

$$\underline{R} = X\underline{\beta} + \underline{u}, \quad (6)$$

where X is the 4n x p data matrix of the p related variables, $\underline{\beta}$ is the p x 1 vector of parameters, and $\underline{u}$ is the 4n x 1 vector of quarterly error terms with covariance matrix $V = \sigma_u^2\Omega$. The matrix Ω contains the autocorrelations among respective pairs of elements in $\underline{u}$.

The linear model must be transformed from a quarterly basis to the annual basis of the n observations on the remainder and the related variables. The transformed model is

$$C\underline{R} = CX\underline{\beta} + C\underline{u}$$

or

$$\underline{R}_* = X_*\underline{\beta} + \underline{u}_*;$$

where $\underline{R}_*$ contains the n observed annual values of the remainder. The n x 4n matrix C that accomplished the necessary aggregation is

$$C = [I \otimes \underline{i}'],$$

where $\underline{i}'$ is the vector [¼ ¼ ¼ ¼] and I is an n x n identity matrix. The covariance matrix of $\underline{u}_*$, the error vector of the transformed model, is $V_* = CVC' = \sigma_u^2 C\Omega C'$.

The generalized least squares estimator of $\underline{\beta}$ is

$$\hat{\underline{\beta}} = (X_*'V_*^{-1}X_*)^{-1}X_*'V_*^{-1}\underline{R}_*, \quad (7)$$

while the best linear unbiased estimator of the 4n quarterly values of the remainder in $\underline{R}$ is

$$\hat{\underline{R}} = X\hat{\underline{\beta}} + VC'V_*^{-1}\hat{\underline{u}}_*, \quad (8)$$

where $\hat{\underline{u}}_* = \underline{R}_* - X_*\hat{\underline{\beta}}$, the vector of residuals from the annual data. Quarterly values in $\hat{\underline{R}}$ are formed by applying the estimated parameters to the quarterly observations of the related variables and then allocating the annual residuals according to the assumed character of the quarterly error terms. The result $C\hat{\underline{R}} = \underline{R}_*$ holds, that is, the average of estimated quarterly values within a year equals the observed annual observation. Thus, the averaging constraint in (3) required by the annual GSP value will be satisfied. In addition, the quarterly GSP series formed by using $\hat{\underline{R}}$ in (5) will not have artificial "jumps" between the fourth quarter and first quarter of contiguous years as is the case when simple interpolation schemes are applied to each year in isolation.

Prediction of quarterly values of the remainder outside of the sample can also be done. The predictor of an m x 1 vector of contiguous out-of-sample values, $\underline{R}_m$, is

$$\hat{\underline{R}}_m = X_m\hat{\underline{\beta}} + E(\underline{u}_m\underline{u}')C'V_*^{-1}\hat{\underline{u}}_*, \quad (9)$$

where X_m is a m x p matrix containing out-of-sample values of the related variables while $\underline{u}_m$ is the m x 1 vector of errors for the out-of-sample quarters.

The three estimators, $\hat{\underline{\beta}}$, $\hat{\underline{R}}$, $\hat{\underline{R}}_m$, to be used in the quarterly allocation and out-of-sample prediction of the remainder depend upon covariance matrices involving the model errors, $\underline{u}$, and the errors in the out-of-sample periods, $\underline{u}_m$. These covariance matrices are V_*, VC', and $E(\underline{u}_m\underline{u}')C'$ with dimensions n x n, 4n x n, and m x n, respectively. The contents of each are conveniently expressed in terms of the autocorrelations among the quarterly errors, ρ_r, where $\rho_r = \rho_{-r} = E(u_t u_{t-r}) / \sigma_u^2$ for r = 0 . . . ., 4n-1. In terms of i, j elements, V_* is

$$(\sigma_u^2/16) \sum_{s=0}^{3} \sum_{v=1}^{4} \rho_{4(|i-j|+1)-v-s}; \qquad (10)$$

VC′ is

$$(\sigma_u^2/4) \sum_{v=1}^{4} \rho_{|i-4j+v-1|}; \qquad (11)$$

and $E(\underline{u}_m \underline{u}')C'$ is

$$(\sigma_u^2/4) \sum_{v=1}^{4} \rho_{4(n-j)+i+v-1} \qquad (12)$$

Specification of the autocorrelation structure in the errors, for example as a first-order autoregressive process with $\rho_r = \phi^r$, establishes the exact form of the three matrices. The generalized least squares estimator $\hat{\underline{\beta}}$ can then be calculated in the usual way be minimizing $\hat{\underline{u}}_*'\hat{\Omega}_*^{-1}\hat{\underline{u}}_*$ where $V_* = \sigma_u^2\Omega_*$. Since Ω_* is dependent upon the parameter(s) from the assumed error process, a search procedure which scans values of the error process parameter(s) can be used to determine $\hat{\underline{\beta}}$. Parameter estimates from the conclusion of the seach are used to form estimates of V_*, VC′, and $E(\underline{u}_m\underline{u}')C'$. Calculation of $\hat{\underline{R}}$ and $\hat{\underline{R}}_m$ can then be completed using their formulae in (8) and (9). Finally, the calculation of quarterly GSP follows from (5) and uses the $\hat{R}_{iq}$ contained in $\hat{\underline{R}}$.

The above techniques are applied to the group of private non-agricultural industries in Nebraska over the span of annual observations 1968-1983. A constant, time trend, and squared time trend were used as the related variables in the quarterly models of the remainder for each industry in the group. This set of related variables may appear to be simplistic but was chosen because the annual remainder term consists of a large number of factors that are combined in a rather involved fashion as dictated by the GSP formulae. Specifically, with reference to (4) above, the annual remainder is the average of the respective quarterly earnings ratios within a year times the unobserved quarterly sums of all accounts except $NIWCJ_{iq}$ appearing in the decompsition of GNP_i. The error terms in $\underline{u}$ were assumed to follow a first-order autoregressive process, $u_t = \phi u_{t-1} + e_t$ for $t=1, \ldots, 4n$, where e_t is a random error. Substitution of the autocorrelation structure implied by this process, $\rho_r = \phi^r$, into the respective matrix elements given above specifies the matrices needed for this application. Values of ϕ in the admissible range of -1 to 1 were scanned to obtain the value of $\hat{\underline{\beta}}$. Table 3 contains the estimated parameters $\hat{\underline{\beta}}$ and $\hat{\phi}$ for each industry in the group. While the first-order autoregressive process was chosen for illustration, other error processes can be used by substituting the appropriate autocorrelations into (10), (11), and (12).

Quarterly GSP — Farm And Agricultural Services, Forestry, And Fisheries

GSP in the farm industry is calculated at an annual frequency by balancing various income and cost accounts of the industry but the required set of accounts is not available on a quarterly basis. Thus, quarterly GSP in the industry cannot be directly calculated but can be formed by the same allocation technique outlined above for the remainder terms of the private non-farm industries. Farm earnings in the state, available on a quarterly basis from Table 2A of the Regional Economic Information System, was used as the related variable for allocating annual farm GSP in Nebraska. A constant was also included in the quarterly model and the errors were assumed to follow a first-order autoregressive process. Parameter estimates are given in Table 3.

As noted in the preceding section, quarterly values of NIWCJ are not available for the agricultural services, forestry, and fisheries industry. Thus, annual GSP must be allocated to quarters in the aggregate and not by components. This situation matches the circumstances in the farm industry and a similar approach is taken. Industry earnings in Nebraska was used as the related variable in the quarterly allocation model, along with a constant term and a first-order autoregressive process in the error terms of the model. Parameter estimates are given in Table 3.

Quarterly GSP — Government

GNP for the federal and state and local subsectors of government is available on a quarterly basis, as are the earnings totals of the two subsectors. Thus, two of the three parts of the annual GSP formula for government in (2) can be directly applied on a quarterly basis. The remaining part of the annual GSP formula pertains to the government enterprises subsector for which quarterly data is not available. Thus, the situation is similar to that encountered in the private non-agricultural industries where the dominant portion of quarterly GSP could be directly calculated but an annual remainder had to be allocated among quarters. The necessary algebra incorporating the constraint that quarterly GSP must average to annual GSP is

$$GSP_i - \tfrac{1}{4}\left(\sum_{q=1}^{4} GNPSLG_q \left(\frac{SERSLG_q}{NERSLG_q}\right) + \sum_{q=1}^{4} GNPFG_q \left(\frac{SERFG_q}{NERFG_q}\right)\right) = R_i\,,$$

where R_i is the annual remainder term that reflects the portion of annual GSP attributable to government enterprises and the imposition of the averaging constraint. Selected values of the remainder appear in Table 2 and comprise only a minor fraction of the GSP total. After allocation of the annual remainder to quarters, quarterly GSP is calculated as

$$GSP_{iq} = GNPSLG_q \left(\frac{SERSLG_q}{NERSLG_q}\right) + GNPFG \left(\frac{SERFG_q}{NERFG_q}\right) + \hat{R}_{iq}.$$

The modeling technique described earlier for quarterly allocation of an annual aggregate was applied to the remainder term for government. As in the models of the private non-agricultural industries, a time trend and squared time trend were used as related variables and a constant was also included. The errors of the quarterly allocation model were assumed to follow a first-order autoregressive process. Parameter estimates are given in Table 3.

Quarterly Deflators and Real GSP

Annual GSP for the non-farm industries is converted to real terms using industry GNP deflators obtained from Table 7.22 of the National Income Accounts. GNP deflators by industry are not tabulated on a quarterly basis and must be estimated if real GSP accounts at a quarterly frequency are to be formed. The general technique used above for allocating annual values of variables to quarterly periods can be applied to each of the industry GNP deflators. Implicit price deflators pertaining to broad product classifications and sectors were used as related series in the allocation models of the respective industry GNP deflators. A constant was included as well. Thus, the relationships between industry GNP deflators and the more broadly defined deflators at the annual frequency is imputed to the quarterly series. A first-order autoregressive process for the errors in the quarterly models was assumed. Parameter estimates for the deflator models are given in Table 4.

It should be noted that the annual deflator for GSP in the farm industry is state specific and is calculated as an implicit deflator from farm GSP in current dollars and real farm GSP. The latter is obtained by deflating the income and cost components of farm GSP with agricultural price and cost indices. As a result, annual deflators and estimated quarterly deflators for farm GSP will differ across states in contrast to the deflators pertaining to non-farm industries.

The average of the estimated quarterly deflators for an industry within any year will sum to the known annual deflator. However, the average of quarterly real GSP, based on the quarterly deflators, need not equal annual real GSP. The difference between the average of the quarterly ratios of GSP to the deflators and the annual ratio of GSP to the deflator is typically quite small. If desired, this difference in any given year can be allocated back to the constituent quarters (perhaps in proportional amounts) to obtain final estimates of quarterly real GSP while enforcing the necessary averaging constraint.

Prediction of Quarterly GSP

Tables 6.1 and 6.2 of the National Income Accounts which contain annual GNP by industry for year t have typically been published in the July issue of the *Survey of Current Business* during succeeding year $t + 1$. By the end of the second quarter of year $t + 2$, the most recent period for which GSP calculations can be made is still year t. Six quarterly periods constitute this interim span. Any economic accounting system can be criticized if timeliness in reporting is lacking.

The technique for quarterly allocation of annual aggregates provides a predictor for quarterly values outside the time span covered by the sample. Recall that the allocation effort in the non-agricultural industries focused upon the remainder term. Use of the predictor in (9) depends on the availability of data for the set of related variables in out-of-sample quarters. With a constant, time trend, and squared time trend as the related variables, prediction of the remainder term can proceed through an arbitrary (but reasonable) number of quarters. The remaining components in the quarterly GSP formula for the non-agricultural industries, $NIWCJ_{iq}$, SER_{iq}, NER_{iq}, and the various government sector components, are subject to a maximum reporting lag of approximately four months past the end of a given quarter. Thus, quarterly GSP accounts for these industries can be routinely calculated and reported with above lag. The same reporting lab would hold for the farm and agricultural services industries since SER_{iq} is the related series used in the quarterly allocation models and predictors of GSP. Industry deflators can also be obtained in out-of-sample quarters using the predictors from their respective quarterly allocation models. The related variables in the deflator models are subject to a similar reporting lag. Thus, real GSP can be calculated and reported on a routine basis with a four-month lag past the end of a given quarter.

Summary

An approach has been presented for estimating quarterly GSP accounts by industry from a time series of annual GSP accounts. Where possible, official quarterly data for the components in annual GSP formulae are incorporated. The portion of quarterly GSP which cannot be directly calculated, the remainder term, is derived from estimating a quarterly allocation model of the corresponding annual remainder. Eight of the industries in the ten-industry breakdown of state activity may be analyzed in this way. Quarterly components are not available in the remaining two industries, farm and agricultural services, forestry, and fisheries. In those industries, annual GSP is allocated in the aggregate to constituent quarters.

Quarterly price deflators for each of the ten industries can also be estimated using the general allocation technique. Quarterly deflators will provide for the calculation of real GSP accounts on a quarterly basis. The prediction of quarterly GSP accounts and deflators outside of the time span covered by annual GSP accounts can significantly shorten GSP reporting lags. As an illustration, quarterly GSP for selected Nebraska industries and quarterly deflators for corresponding national industries are listed in Table 5. The table includes the quarters of the last year in the estimation period, 1983, and the first two out-of-sample quarters (predictions) of 1984. These computations were performed in October 1984, immediately after the necessary state data for the second quarter of 1984 had been received.

Potential users of the above methods may prefer formulae for annual GSP which are different from those used here. The method is sufficiently general to allow for such alternatives. If possible, any desired formula for annual GSP should be broken into portions for which quarterly data is available and not available, respectively. The unknown portion can then be allocated to quarters while enforcing the relevant averaging constraint. In addition, alternative specifications of the related variables in the quarterly allocation models can be entertained.

TABLE 1

Reporting Frequencies of National and State Accounts

		Frequency			
Account	Source	U.S. Total	U.S. Industries	State Total	State Industries
NIWCJ	NIA-6.4	Q	Q*	—	—
CJNI	NIA-1.7, 6.4	Q	—	—	—
IBT	NIA-1.7	Q	A+	—	—
BTP	NIA-1.7	Q	—	—	—
SD	NIA-1.7	Q	—	—	—
SUB	NIA-1.7	Q	—	—	—
CCA	NIA-1.7, 6.17B, 6.26B	Q	A	—	—
CCACJ	NIA-1.7	Q	—	—	—
GNP	NIA-1.7, 6.1	Q	A	—	—
GSP	State Calculation	—	—	A	A
NER	REIS-2A	Q	Q	—	—
SER	REIS-2A	—	—	Q	Q

Notes:

* — Not available for the agricultural services, forestry, and fisheries industry on a quarterly basis.

\+ — Available in unpublished form from the Bureau of Economic Analysis.

A — Annual.

Q — Quarterly.

NIA — National Income Accounts. The standard source is the *Survey of Current Business* [8] and various supplements. Table numbers given are those in effect as of July, 1983.

REIS — Regional Economic Information Service — Bureau of Economic Analysis. Table numbers are those in effect as of October, 1983.

Listing of two NIA tables indicates that different frequencies are reported in each of the tables or that certain items must be combined to obtain the account.

TABLE 2
Annual GSP and the Remainder Term for Non-Agricultural Industries — Nebraska (Millions of Dollars)

	GSP			Remainder Term		
Industry	**1970**	**1975**	**1983**	**1970**	**1975**	**1983**
Mining	36.4	76.4	156.6	19.8	39.8	100.9
Construction	352.7	564.2	766.4	29.4	60.2	108.3
Trans. and Pub. Util.	678.6	1159.7	2762.1	180.2	328.0	853.0
Trade	1227.6	2095.9	3797.1	317.8	538.0	1061.4
Fin., Ins., Rl. Est.	1025.3	1667.6	3942.1	339.1	548.4	1080.3
Services	671.9	1104.4	2726.4	60.5	103.8	290.1
Manufacturing	993.6	1486.5	2739.1	145.8	168.7	421.1
Government	928.4	1405.3	2772.2	104.0	155.3	295.4

Note: Wholesale and retail trade are combined in the above. Agricultural equipment dealers were reclassified from retail trade to wholesale trade in 1977. This change created an artificial discontinuity in the separate series.

TABLE 3
Quarterly Allocation Models of Annual Aggregates — Nebraska, 1968-1983

Industry	**Annual Aggregate**	**Constant**	**Time**	**Time²**	**SER**	**ϕ**	R^2
Mining	R	15.81	-.046 (-.050)	.027 (2.950)	—	.72	.804
Construction	R	17.45	1.281 (4.627)	.002 (.472)	—	.76	.966
Trans. and Pub. Util.	R	162.04	-.205 (-.165)	.173 (9.380)	—	.73	.990
Trade	R	240.24	7.017 (6.413)	.098 (6.044)	—	.64	.994
Fin., Ins., Rl. Est.	R	280.45	3.738 (4.171)	.143 (10.729)	—	.78	.996
Services	R	54.39	-.520 (-1.173)	.067 (10.160)	—	.81	.988
Manufacturing	R	147.57	-2.533 (-1.475)	.102 (3.995)	—	.80	.878
Government	R	76.95	1.893 (6.095)	.026 (5.616)	—	.61	.994
Farm	GSP	560.19	—	—	1.106 (6.428)	.83	.747
Ag. Ser., For., Fish.	GSP	-3.68	—	—	1.415 (35.396)	.63	.989

Note: R-"Remainder" term. T-ratios are in parentheses. The R^2 measure for models estimated by generalized least squares is from Buse [1].

TABLE 4
Quarterly Allocation Models of Annual Industry Deflators
1968-1983

Industry	Constant	Goods Deflator	Services Deflator	Structures Deflator	Govt. Deflator	Farm Deflator	ϕ	R^2
Mining	-356.50	4.621 (14.159)	—	—	—	—	.77	.935
Construction	-2.79	—	—	1.027 (53.923)	—	—	.67	.995
Trans. and Pub. Util.	11.30	—	.887 (53.600)	—	—	—	.75	.995
Trade	-3.71	1.038 (89.075)	—	—	—	—	.67	.999
Fin., Ins., Rl. Est.	12.06	—	.880 (50.507)	—	—	—	.77	.995
Services	-.60	—	1.018 (123.175)	—	—	—	.69	.999
Manufacturing	6.75	.937 (40.743)	—	—	—	—	.76	.992
Government	1.99	—	—	—	.979 (390.717)	—	.59	.999
Farm	-2.53	—	—	—	—	.849 (4.689)	.84	.611
Ag Serv., For., Fish	12.37	—	.917 (13.476)	—	—	—	.81	.928

Notes: Sources of the national deflators used as related variables are: Goods, Services, Structures — Table 7.3, NIA; Government, Farm — Table 7.4, NIA. The government deflator used as the related variable in the above pertains to federal and state and local subsectors but excludes government enterprises. T-ratios are in parentheses.

TABLE 5

Quarterly GSP and Deflators for Selected Industries
1983:I - 1984:II

Quarter	Construction	Trade	Services	Manufacturing
		Nebraska GSP		
83:I	720.7	3652.4	2664.4	2541.3
83:II	753.3	3798.1	2717.1	2684.3
83:III	811.7	3883.6	2806.0	2864.0
83:IV	780.0	3854.2	2718.1	2866.7
84:I	775.0	3922.7	2799.4	2946.9
84:II	801.5	4048.0	2867.1	3059.0
		National Deflators		
83:I	259.2	199.3	226.0	191.8
83:II	257.8	200.3	229.7	193.0
83:III	261.2	201.0	232.6	193.6
83:IV	263.0	203.4	235.2	195.6
84:I	261.2	205.3	238.6	197.0
84:II	262.4	205.6	241.5	196.9

Notes: GSP is in millions of dollars. All deflators have a base year of 1972 (=100.0).

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