The Effects of the Fiscal Deficit on the Composition of U.S. GDP: An Analysis of Disaggregated Data

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1 INTRODUCTION

The impact of the federal budget deficit on the economy is a source of continuing concern, both among macroeconomists and — even more urgently — among political decision makers. The old Keynesian consensus that budget deficits were generally good for the economy, in the sense of making it more prosperous (or, at least, in bringing it out of recessions), has been pushed aside by the fear that the apparently-large deficits that began in the 1980s in the United States have damaged the economy and are impoverishing future generations of Americans. The continuing debate over whether fiscal deficits make us better off or worse off — or some combination of the two — can, of course, best be addressed by returning to the data.

In previous work (Buchanan 1996a, 1996b), I have investigated various measures of the US fiscal deficit in terms of their potential uses in time-series empirical research. Those studies, based on previous work by Eisner (among many examples, see 1991, and Eisner and Pieper 1988, 1992), reached two major conclusions: (1) among alternative measures of the fiscal deficit, the so-called price-adjusted standardized-employment deficit (PASED) provides the most statistically significant time-series results in a variety of standard macroeconomic regressions (at least among federal-level deficit measures); and (2) there is an identifiable, positive statistical correlation in annual data between the one-year-lagged deficit and the annual growth rate of US gross domestic product (GDP) — but this correlation has widely varying statistical significance, depending upon the specification and sample period chosen.

Looking at the second conclusion (which concerns theoretical macroeconomic relationships as opposed to the definitions and derivations of particular deficit series), it is important to ask whether a robust specification of the growth/deficit relationship can be found where the relationship varies based on the state of the economy. It is also natural to ask whether the effect of fiscal deficits on GDP
is a broad-based effect, or whether particular sectors of the economy or types of expenditure are more likely to respond positively (or negatively) to deficit spending than are others. This chapter will investigate those questions.

Section 2 presents the results of an expanded analysis of aggregate GDP growth as a dependent variable, including a description of the use of an interactive term in the regression. Section 3 describes the reasons for, and approach to, disaggregating of GDP growth for use in further regression analysis. Section 4 presents the results of the statistical and regression analyses of disaggregated data, emphasizing not merely the statistical results but also the macroeconomic implications of those findings. Section 5 concludes.

2 ANALYSING AGGREGATE GDP GROWTH

The econometric tests summarized below are based on a non-linear variant of equations found in Eisner (1991) and tested further in Buchanan (1996a, 1996b). Those results were based on a simple reduced-form equation, based on a standard Keynesian IS/LM framework, with GDP growth as the dependent variable, and the monetary base, the exchange rate and the fiscal deficit as independent variables.

For the current study, this framework was enhanced to allow for the possibility that the effect of deficits varies with the state of the economy, consistent with (but not limited to) the logic of the multiplier/accelerator interaction concept, pioneered by Samuelson (1939). That is, if the response of private firms to increases in real GDP is to increase fixed investment (in a positive response to good economic news, à la 'animal spirits'), then this effect could be captured by a non-linear, interactive term which couples the GDP gap and the fiscal deficit.

The implications of the interactive term are potentially much broader than this, however, in that it would capture any response to deficits when the economy has a GDP gap, for example, changes in residential investment in housing, changes in consumption of any kind, or responses by any other component of GDP. Indeed, one of the main purposes of this chapter is to identify the disaggregated responses of GDP growth to deficits. Section 4 summarizes that analysis.

The interactive term, moreover, is designed to capture the effects of supply constraints in the economy, or what Keynes (1936) referred to as 'bottlenecks'. That is, when the economy is running at higher levels of capacity, the likelihood grows that increases in aggregate demand will have smaller effects. For example, in a deep recession, there are plenty of workers, machines, factories and farms that are not producing anywhere near their potential output. The real economic response to a deficit in such a situation is likely to be quite strong, as potential suppliers will readily respond to the demands from either government (if the
deficit is a result of higher government spending) or consumers (if the deficit is, instead, a result of lower net taxes) by providing more goods and services. The response to multiplier effects (the spending by the workers and business owners who were the beneficiaries of the first round of deficit spending) is also likely to be strong and immediate.

As the economy strengthens, however, this effect naturally weakens. Since there are fewer workers available to produce more goods, and factories are running with little down time, the existence of a deficit does not (and most likely cannot) lead to increases in output — or, at best, it can only lead to smaller increases in output. The multiplier responses are similarly diminished.

Given this intuition, a statistical test which is based on the simple assumption that the response of the economy to deficits is always the same (independent of the state of the economy) will miss this potentially-important non-linearity. Separating the effects of deficits on the economy into linear and interactive effects will indicate whether this notion of bottlenecks, or supply constraints, is empirically supported.

In the larger sense, therefore, the results below will act as a consistency test of standard Keynesian theory as it relates to the macroeconomic impact of fiscal deficits. While there are many variations on the meaning of the term Keynesian, it is none the less true that the various groups (synthesis Keynesians, post Keynesians, new Keynesians and variations thereof) have a set of views of deficits and their effects on the economy that are broadly similar — although there is certainly disagreement even among adherents of individual schools of thought.

Each group would, with some qualifications, answer 'yes' to each of the following questions. Do deficits affect GDP at all? Do deficits raise GDP growth, at least in the short run? If there are effects, do they differ depending on the state of the economy? Do consumption and imports rise when the economy strengthens? Are government purchases independent of prior deficits? Are exports exogenous?

Perhaps most importantly, the results summarized below can also shed some light on the areas of controversy that exist even among Keynesians, especially on questions relating to fiscal deficits and investment. Do deficits crowd out investment at all? If so, do they crowd out investment more or less as the economy weakens? Which types of investment respond most strongly to deficits? For example, is equipment investment more responsive to deficits (especially during recessions) than investment in plant?

Finally, it is also possible to investigate questions about which some uncertainty exists even at the intuitive or theoretical level. For example, how do the components of consumption respond to deficits? Of particular interest for policy, is consumption of durables more responsive to deficits than are other types of consumption?
Each of these questions is addressed (although certainly not definitively answered) in the analysis below. Virtually all of the results which Keynesians would expect are confirmed, the most basic being that deficits do have real effects. For the controversial questions, the results show (among other things) that crowding out of investment is supported by the point estimates, but that those point estimates are not statistically significant at standard levels of confidence. Accelerator effects on equipment investment are supported, and the relevant coefficients are highly statistically significant. Overall, a believer in activist fiscal policy (especially as a countercyclical measure) will not be disappointed by these results.

2.1 The Growth Equation and the Meaning of the GAP

The dependent variable continues to be the GDP growth rate. (All variables were analysed using real values, expressed in fixed-weighted 1987 dollars, unless otherwise noted.) The independent variables are: a monetary variable, a deficit variable and an interactive variable (the product of the deficit and the GDP gap), with each entered as a distributed lag for one through four quarters. The equation to be estimated, therefore, is:

$$\%\Delta GDP_t = \alpha_0 + \alpha_1 \text{Trend} + \sum_{i=1}^{4} \beta_i \Delta MB_{t-i} + \sum_{i=1}^{4} \gamma_i DEF_{t-i} + \sum_{i=1}^{4} \delta_i GAP_{t-i} DEF_{t-i} + \epsilon_t$$

where MB is the real monetary base as a percentage of real GDP, DEF is the real structural deficit (nominal PASED divided by nominal GDP), and GAP is the GDP gap (which is defined as $$\frac{(GDP - GDP^*)}{GDP^*} \times 100$$, where GDP* is the value of GDP when the unemployment rate is at NAIRU).

I shall refer to the sum of the estimated coefficients on $$DEF_{t-1}$$ through $$DEF_{t-4}$$ (that is, $$\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$$) as the 'linear coefficient'. The term 'interactive coefficient', on the other hand, refers to the sum of the coefficients in the last term of the regression ($$\delta_1 + \delta_2 + \delta_3 + \delta_4$$).

What distinguishes the present analysis from the studies noted above (other than the use of quarterly data rather than annual data) is the use of the interactive term. The theoretical reason for the use of this term was described earlier. The technical reason is that the $$\gamma$$'s will provide an estimate of the response of GDP growth to the deficit when there is no gap (since a gap of zero makes the last term drop out). This isolates the response of GDP growth to a change in the deficit when the economy is at NAIRU. Therefore, the positive sum of the estimated $$\gamma$$'s (as discussed below, and shown in the tables at the end of the chapter) reflects the surge in GDP growth as the level of GDP rises from the current level of GDP* to a higher level of GDP* after an increase in the deficit.
The interactive coefficient can then identify the effects of deficits that arise only when there is a gap, with the weighted sum of the linear and interactive coefficients indicating the total effect of the deficit on GDP growth in any given state of the economy.

With a distributed lag, there is a question as to how to test the statistical significance of the coefficients on the four quarterly lagged independent variables. An 'exclusion test' indicates the probability value (or p-value, which is the same as the significance level, or one minus the confidence level) of the F-test that the coefficients of the four quarterly lags of the deficit variable are all zero, that is, the test of whether it would hurt the regression to 'exclude' the four lagged values of the deficit (as a group) from the list of independent variables.

An alternative test of the significance of the deficit variables is the t-test of whether the sum of the coefficients of the four lags of the deficit is significantly different from zero. However, this test is less meaningful than the exclusion test, because it is possible for the coefficients not to be of the same sign. In that case, even if all four coefficients are individually significantly different from zero, the sum of the coefficients might not significantly differ from zero, even though the inclusion of the four lags of the independent variable improves the regression results. Therefore, the results below and in the tables at the end of the chapter test statistical significance using the exclusion test criterion.

For the sample period 1972:1 through 1994:4, using quarterly data, the above regression produces the following results (with the p-values of the significance tests – for individual parameters and for exclusion tests, as appropriate – in parentheses):

\[
\% \Delta GDP_t = 6.38 - 0.05 \text{Trend} + \\
(0.00) \\
19.94 \Delta MB_{t-r-1} - 6.84 \Delta MB_{t-r-2} - 2.32 \Delta MB_{t-r-3} + 22.73 \Delta MB_{t-r-4} + \\
(0.08) \\
0.40 \text{DEF}_{t-r-1} + 0.73 \text{DEF}_{t-r-2} + 0.99 \text{DEF}_{t-r-3} - 1.88 \text{DEF}_{t-r-4} + \\
(0.51) \\
0.04 \text{GAP}_{t-r-1} \cdot \text{DEF}_{t-r-1} + 0.01 \text{GAP}_{t-r-2} \cdot \text{DEF}_{t-r-2} + \\
(0.70) \\
0.05 \text{GAP}_{t-r-3} \cdot \text{DEF}_{t-r-3} - 0.27 \text{GAP}_{t-r-4} \cdot \text{DEF}_{t-r-4} + \\
(0.65)
\]

Linear coefficient (\(\Sigma \gamma_i\)) = 0.24, Interactive Coefficient (\(\Sigma \delta_i\)) = 0.16 
\[
(0.03) \\
(0.21)
\]
Adjusted \(R^2 = 0.24\), Durbin–Watson = 1.47.

The critical values of the Durbin–Watson test statistic (DW), at a 5 per cent two-sided level of significance, are 1.72 and 2.28 for the beginning of the
inconclusive range and 1.51 and 2.49 to reject the null hypothesis that there is no first-order serial correlation (AR(1)). The estimated DW value of 1.47 indicates that the equation needs to be re-estimated, correcting for AR(1).

Since the equation to be estimated is non-linear, however, the standard methods of correcting for serial correlation (the Cochrane–Orcutt procedure and the Hildreth–Lu procedure being the most common) cannot be used. Therefore, an analogous generalized least squares procedure (using non-linear least squares), described in more detail below, was used.

The corrected equation was:

\[
\%\Delta GDP = \rho \%\Delta GDP_{t-1} + \alpha_0 + \alpha_1 \text{Trend} + \sum_{i=1}^{4} \beta_i (\Delta MB_{t-i} - \rho \Delta MB_{t-i-1}) + \\
\sum_{i=1}^{4} \gamma_i (\text{DEF}_{t-i} - \rho \text{DEF}_{t-i-1}) + \sum_{i=1}^{4} \delta_i (\text{GAP}_{t-i} \text{DEF}_{t-i} - \rho \text{GAP}_{t-i-1} \text{DEF}_{t-i-1}) + u_t.
\]

The results of that regression are shown below:

\[
\%\Delta GDP = 4.61 \quad -0.03 \text{Trend} + \\
0.01 \\
\begin{array}{cccc}
19.44 & -6.06 & -2.04 & 20.10 \\
(0.08) & (0.58) & (0.86) & (0.08)
\end{array} \\
\begin{array}{cccc}
0.36 & 0.75 & 1.00 & -1.88 \\
(0.54) & (0.20) & (0.09) & (0.00)
\end{array} \\
\begin{array}{cccc}
0.05 & 0.02 & + & -0.29 \\
(0.63) & (0.86) & (0.01)
\end{array} \\
\begin{array}{cccc}
0.05 & + & - & \\
(0.64)
\end{array}
\]

Linear coefficient ($\Sigma \gamma_i$) = 0.23, interactive coefficient ($\Sigma \delta_i$) = 0.17

Adjusted $R^2 = 0.27$, Durbin–Watson = 1.93, $\rho = 0.25$ (0.03)

In the results immediately above, note that the values of the linear coefficient and the interactive coefficient (0.23 and −0.17, respectively) are very close to the estimates in the OLS regression (0.24 and −0.16).\(^{11}\)

(I also estimated the model with eight quarterly lags of the linear deficit and interactive terms. The results were roughly consistent with the results here, with the sum of the coefficients of the eight linear DEF variables almost exactly double the sum of the four linear coefficients shown above (0.49 versus 0.23). The sum of the eight coefficients on the interactive terms, on the other hand, was almost exactly half of that shown above (−0.09 versus −0.17). This
indicates that two years of a 1 per cent deficit is twice as stimulative as one year (when there is no gap), and the interactive response is both absolutely and relatively less important when the deficit persists for that long. The statistical significance of each of the coefficients, however, was markedly worse than the results here, with the $p$-value of the exclusion test on the (eight-lag) linear coefficient rising above 0.07 (versus 0.02 for four lags) and that for the interactive coefficient ballooning to more than 0.41 (from 0.13). The adjusted $R^2$ fell to 0.22. Therefore, the analysis below proceeds from a model using four lags of all independent variables.)

2.2 The GAP and the Interactive Term

The interactive term indicates the response of GDP growth to the deficit when the economy is in a boom (a positive GAP) or a recession (a negative GAP). If the $\delta_i$'s are significantly different from zero, therefore, the GDP growth rate would respond differently to the deficit, depending on the condition of the economy.

Even before initiating the regression tests of the specified equation, however, it was important to ensure that inclusion of the GAP variable was justified on statistical grounds. That is, if it turned out that DEF and GAP were highly correlated (for example, if the deficit were only positive when GAP was negative, a case of pure countercyclical spending), then the collinearity between the two right-hand-side variables would compromise the statistical results – and the economic implications of the specification would be seriously brought into question as well.

Therefore, I measured the gap in two ways: as an income gap (as described above) and as an unemployment gap (where GAPU is defined as the actual unemployment rate minus the NAIRU unemployment rate). The results of simple correlations were quite definitive. Not only does neither GAP nor GAPU have a strong correlation with DEF, but the correlation coefficients are extremely low. For the 1972:1–1994:4 period, GAPU and DEF had a correlation coefficient of 0.20, while GAP and DEF had a correlation of 0.03. GAP also had a correlation of 0.03 with the other explanatory variable, $\Delta MB$. Since GAP was almost perfectly non-collinear with either of the other exogenous variables, therefore, it was both economically meaningful and statistically legitimate to include the interactive term in the regression equation.

While the exclusion test for the interactive coefficient in the AR(1) regression summarized above does not achieve the usual 95 per cent level of confidence, it will turn out that some of the components of GDP do have significant interactive coefficients; so the interactive term will be extremely important in understanding the overall response of GDP and its components to deficits. Also, it is worth looking at the point estimate of the interactive coefficient in
the aggregate growth equation to understand how to interpret it – both economometrically and macroeconomically.

Since a value of unity for the GAP variable means that the economy is 1 per cent above GDP* (and since the DEF variable is also measured in full per cent at an annual rate), the interactive coefficient indicates the response of the economy to a 1 per cent real structural deficit (in the preceding year) when GDP is 1 per cent above GDP*. If the coefficient were found to be positive, therefore, this would imply that there is a positive response of GDP growth to the deficit (in addition to the response measured by the linear coefficient) when the economy is booming. A negative coefficient, on the other hand, would mean that the response of GDP growth to deficits is less than the response would be at NAIRU (as measured by the linear coefficient).

For the estimates obtained from the GLS regression summarized above, the positive sum of the $\gamma_i$'s (0.23) indicates that there is a stimulative effect of deficits when the economy is at GDP*, so that a 1 per cent deficit causes GDP growth to be 0.23 per cent higher than it would otherwise be. If the economy is in a 1 per cent recession (that is, $\text{GAP} = -1.0$), and DEF is 1.0, then the negative sum of the $\delta_i$'s (-0.17) indicates that GDP growth rises (since the two negative signs cancel out) more than indicated by the $\gamma_i$'s alone, or a total of 0.40 per cent of extra growth due to the deficit. On the other hand, adding together the $\gamma_i$'s and $\delta_i$'s would tell you that GDP growth is only 0.06 per cent higher when there is a 1 per cent deficit and the economy is 1 per cent above GDP*.

This is shown graphically in Figure 7.1, which shows that there is a linear relationship between deficits and growth with a slope of 0.23. This relationship pertains when $\text{GAP} = 0$. When $\text{GAP} = 1$, however, the response of GDP growth to the deficit becomes much weaker, as indicated by the flatter line in the graph. When $\text{GAP} = -1$, the line becomes steeper, reflecting the greater responsiveness of growth to the deficit. The lines for $\text{GAP} = -3$ and $\text{GAP} = -5$ are steeper still, with the response to $\text{DEF} = 1$ in the latter case being a rise in GDP growth of 1.08 per cent.

Note that it is possible for the deficit to have a net negative impact, since when $\text{GAP} = 2$ (which has only been exceeded from 1972:4-1973:2 and from 1979:1-1979:3 during the sample period), the effect of a 1 per cent deficit is to lower GDP growth by 0.11 per cent. This would mean that the economy is so strong that any positive impact of the deficit is being more than crowded out by some combination of responses among consumers, businesses and the foreign sector.

Also, although it is not shown on the graph, as the gap becomes more and more negative (which means that the economy is weaker and weaker), the stimulative effect of deficits is further enhanced by the strong responses of private actors to the stimulus to the economy. In other words, the weaker the economy, the more underutilized resources there are to respond to any stimulus,
and the more likely is the stimulus to be re-spent and thus provide further stimulus to income.

Figure 7.1  The effects of the interactive coefficient

This is analogous to arguments dating back at least to *The General Theory*, that deficits are much less stimulative when the economy is near or above capacity and more so when the economy is in a recession. In fact, although the current model is specified differently from the aggregate supply/aggregate demand model (in that this model does not have prices in it, and it includes both the level of GDP and the growth rate of GDP in different variables), these results tend to confirm the ‘Keynesian version’ of the short-run aggregate supply curve in that model. That is, rather than a constant upward slope of the short-run aggregate supply curve, this suggests that the curve is steeper to the right of GDP* and flatter to the left.

2.3  Looking for Asymmetric Effects

This method of estimation, however, assumes that the effect of deficits varies symmetrically around GDP*, that is, that the effect of deficits when there is a positive 1 per cent GDP gap is the same in absolute value as the effect when there is a negative 1 per cent GDP gap. Clearly, this need not be true. Therefore,
I also performed a test which attempted to allow for an asymmetric effect of deficits, depending upon whether GAP is positive or negative. This was done by adding a new interactive variable, where each of the four lags of the new interactive term is multiplied by a dummy variable, with the dummy equal to 1 when GAP was positive and zero otherwise. This would allow the effect of being above or below GDP* to differ (although it still assumes linearity).

However, the statistical results were disappointing in two ways. First, the exclusion test of the four coefficients on the dummyed interactive terms had very low statistical significance, with a confidence level of only 52 per cent that all four coefficients were significantly different from zero. Second, the numerical sum of those variables was positive and more than three times greater in absolute value than the interactive coefficient without a dummy (1.11 versus −0.29). Also, the linear coefficient became negative, −0.30.

This would mean that the effect of deficits on GDP growth is negative when there is no gap, near zero when GAP = −1, and very positive as the economy gets stronger. Since this result is both unfounded in theory and statistically weak, the analysis was limited to a simple symmetric interactive relationship, as described above.

3 WHAT CAN BE LEARNED FROM DISAGGREGATING GDP?

The above results indicate that there is an interesting set of statistical relationships that tend to confirm certain well-known theoretical macroeconomic propositions. A positive fiscal deficit raises the rate of GDP growth, and the effect is greater in a weak economy and lesser (and perhaps even negative) in a strong one. This indicates that it would be useful to know just what it is in the GDP that responds to the deficit when there is no gap, and what creates the interactive response to the gap. In order to pursue those questions, it will be necessary to disaggregate the left-hand side of the equation.

Before describing the specific empirical tests and the estimates obtained from disaggregating GDP, however, it will be useful to explore further what might be learned by separating GDP into its components. This will provide a preview of the issues that are raised by such an analysis, and it will also offer a glimpse of the types of results that might be found.

3.1 Macroeconomics and Disaggregation

Having found a robust statistical relationship between an aggregate variable such as GDP and any explanatory variable(s), it is sensible to ask whether less-
aggregated series which add up to that aggregate dependent variable are similarly correlated with the explanatory variable(s). For example, if there were fifty separate series of state domestic product, and those fifty series summed in each time period to GDP, then it would be natural to ask how the variables that statistically correlate to GDP correlate to each of the fifty state output series.

More to the point for the analysis below, it is natural to ask in what way the variables that affect GDP growth also affect the growth of the different types of expenditures and production that make up GDP. If the deficit increases GDP, does it increase C, I, G and NX proportionately, or does one of those variables (or a subset of them) correlate more strongly than the others with the deficit? On the supply side, does the increase in GDP show up as proportionate increases in goods, services and structures? For either question, of course, there are further potential disaggregations made possible by the official statistics; so each of these questions can be asked about different types of consumption, investment, goods production, and so on.

The answers to these questions, of course, have direct import for macroeconomic policy. If higher deficits were found to correlate with higher business investment in structures, for example, that would lead to quite different attitudes about deficit spending than a finding that nearly all of the increase in GDP was accounted for by increases in the production and purchase of nondurable goods. In the latter case, concerns about deficits ‘impoverishing our grandchildren’ would tend to gain credibility, whereas the former case would tend to diminish such concerns.

Of course, the relationships described above between the deficit and GDP growth have to carry over to at least one of GDP’s components (or a combination of components), simply as a matter of mathematical fact. The challenge is to find those components (or relationships among components) that account for the robust statistical relationship between deficits and GDP growth.

The most basic question that can be asked is: are each of the four major components of expenditure as responsive as GDP itself is to deficits, or does the deficit lead only to (for example) higher investment spending — which, as noted, would tend to alleviate fears that public dissaving is compromising the economy’s future growth? Or, do other types of expenditure respond?

If one found, on the other hand, that consumer expenditure was the most responsive element of total expenditures, it would be useful to know whether this rise is for immediate consumption or is based on a more investment-like motivation. That is, as argued by, among many examples, Gordon (1993) and Fuhrer (1992), consumer expenditure on durable goods can potentially be better understood as an accumulation of assets for future consumption, and is thus a different way of saving for the future. Clearly, then, knowing that
consumption spending responds to deficits would argue for further disaggregation of the consumption series.

Therefore, if one finds a strong relationship between deficits and a particular type of expenditure, one would then want to know how the expenditures in that category break down: for example, is the higher investment composed of higher inventories, residential construction, or plant and equipment spending? Is higher consumption concentrated in durables, nondurable, services, or all three?

More questions can be addressed. Do the presumably exogenous components of GDP, federal government purchases and exports, display weak statistical correlation to the right-hand-side variables, or is their presumptive exogeneity brought into question by the results? Do imports and consumption respond similarly to deficits, or do deficits seem to cause a greater response in the purchases of domestic goods over foreign goods (or vice versa)?

Finally, do results regarding demand-side responses correspond with those regarding supply-side responses: for example, if there is a strong response of both business plant expenditures and residential construction to an increase in the deficit, is there also a strong increase in the production of structures?

3.2 Disaggregated Data in the NIPA

While there are a theoretically limitless number of ways to break down the GDP into component parts, the statistical method used for this analysis will exploit two of the disaggregations which are provided as part of the National Income and Product Accounts (NIPA), each of which sums to total GDP. These are: (1) the expenditures method, which separates GDP into the four familiar spending categories (private consumption, private investment, government purchases and net exports) as well as subcategories (and, in some cases, sub subcategories) of those four aggregates, for a total of eighteen series; and (2) the major products method, which separates GDP into the various types of output produced (such as nondurable goods and structures), for a total of thirteen series.

Eisner and Pieper (1988) perform a similar analysis on disaggregated expenditures, but not at a significant level of disaggregation (for example, only breaking investment into fixed investment and inventories), and using annual data and a simpler specification of the growth equation. Their results are contrasted with the results of this analysis in Section 4.

3.3 Disaggregation and Statistical Correlation

The simplest relationship between an aggregate variable and its components would be one in which each component individually mirrors the variance of the aggregate. This is shown in Figure 7.2, which displays what I call Type 1 Disaggregation, where a variable \( Y \) and each of its component series \( Y_1, Y_2 \) and
Y3, which add up to Y) are similarly correlated to each other and to an independent variable, X.

\[ Y, \quad Y3, \quad Y2, \quad Y1, \quad X \]

*Figure 7.2  Type 1 Disaggregation*

However, it clearly will not always be the case that each of the component series is significantly correlated with the explanatory variable(s) in question. For example, if the explanatory variable that showed statistical significance in the GDP equation were 'tourist visits into the United States', it might well be the case that the regressions for only a few states (most likely New York, Maryland, Virginia, Florida, California and Hawaii) would show a strong relationship between state domestic product and that explanatory variable.

This possibility is shown in Figure 7.3, which displays Type 2 Disaggregation, the situation where an independent variable (X) has a strong correlation with an aggregate series (Y) but with only one of Y’s components (Y3, in this case). The robust statistical relationship is between Y3 and X, with Y1 and Y2 clearly showing no correlation with X (and, in this case, simply showing diverging linear trends). In the aggregate, therefore, Y3 is the part of Y that accounts for the strong statistical relationship between Y and X.

It is also possible, however, to find that there is no strong relationship between any single component series and the explanatory variable(s). Figure 7.4 shows an example of Type 3 Disaggregation, which shows that none of the three subseries is well correlated with X over their entire range, but the three summed together produce a good (actually, a perfect) statistical fit. Clearly, there are a limitless number of ways in which this situation can be drawn (including cases
where no single subseries tracks \( X \) even for a short time period), with the common factor being merely that the summed components must correlate to \( X \).

![Figure 7.3 Type 2 Disaggregation](image)

In the case of Type 3 Disaggregation, moreover, the relationship among the components might be either 'systematic' or 'independent'. That is, the relationship among the components could be driven by a causal process ('systematic') and would therefore continue to be found over different sample periods, or it could simply be a statistically random coincidence ('independent').

An example of a systematic relationship among components would be a regression of total crop yield against rainfall with quarterly data. One is likely to discover, upon looking at disaggregated data on particular crop yields, that some crops only respond to rainfall in certain quarters. (That is, a crop which is planted in April and harvested in June would respond to rainfall in only one quarter of the year – with no output response to any exogenous variables at other times of the year.) Aggregate crop yield would, of course, none the less be reliably related to rainfall.

Thus, while one most likely could not identify any component of total crop yield which is significantly correlated with rainfall in every quarter, it is undoubtedly true that aggregate crop yield is statistically correlated with rainfall each quarter, year after year. The robust statistical relationship, therefore, would not be a historical anomaly.

On the other hand, it could be that the component series are essentially independent, in which case the visible statistical relationship between the aggregate dependent variable and the exogenous variable(s) is merely fortuitous.
for the time period under study. For example, one might find that the results of US presidential elections (the left-hand-side variable) are correlated with major leaguers' batting averages (the right-hand-side variable) in the baseball season preceding the election. In that case, trying to find a sub-aggregate of voting patterns (disaggregated by state, or congressional district, or gender of voters, for example) that is correlated with batting averages would likely prove futile.

![Graph showing Y1, Y2, Y3, and X]

Figure 7.4 Type 3 Disaggregation

In such a case, the aggregate results are statistically unlikely to repeat themselves over different sample periods; so none of the individual components, or any combination thereof, is likely to be correlated with batting averages. It would not be reliable, therefore, to assume that the statistical correlation will continue; and it would be dangerous at best to make predictions about the results of policy based on such a relationship!

Thus, the possible results of investigating the components of GDP are: (1) Type 1 Disaggregation, where each component series is correlated to the explanatory variable(s) in similar ways; (2) Type 2 Disaggregation, where only some of the underlying series are so correlated; (3) Type 3 Disaggregation which is systematic, where the particular components will continue to interact in the same way over different time periods; and finally (4) Type 3 Disaggregation which is independent, where the overall statistical correlation among the aggregated series and the independent variable is not likely to continue, because the components and the exogenous variable are moving independently of one another.
Realistically speaking, of course, Type 1 is highly unlikely for any serious amount of disaggregation. Type 2, on the other hand, is simultaneously desirable (in the sense of implying a meaningful statistical relationship to study) and at least reasonably likely to be found in real data (as opposed to Type 1). Type 3 Disaggregation is certainly possible; but it raises more questions than it answers. Upon finding Type 3 Disaggregation, it would be necessary to design further tests to determine whether the statistical relationship is systematic or independent.

Furthermore, in the case under study here, for even the most basic forecasting of the effects of policy changes on disaggregated series, Type 2 Disaggregation allows one to infer the effects of a change in the deficit on at least some of the components of GDP, whereas Type 3 would not allow such a direct inference.

Of course, this process could be taken to an absurd extreme. That is, having found a situation which displays Type 2 Disaggregation, one could focus on the relevant series (Y3 in the Figure 7.3 above) and disaggregate once again. If one were then to find Type 1 Disaggregation among the components of Y3, this would argue for analysing each of the separate series at a further level of disaggregation. This could continue in principle indefinitely, since any disaggregated series can be disaggregated further not only in the same dimension (for example, disaggregating the United States into fifty states, and then each of the states into its counties) but along an entirely different dimension (for example, disaggregating state data by industry or gender, rather than by geography).

Therefore, the point is not simply to disaggregate as far as the data allow, but to disaggregate when there is an interesting economic question to be answered by the disaggregation. Section 3.1 described some of the potentially interesting questions that analyses of disaggregated GDP data might help to answer.

Finally, the entire logic of this section can be reversed. That is, rather than starting from a robust relationship between Y and X and analysing whether disaggregation of Y identifies further robust relationships with X, it is possible for Y and X to be uncorrelated while some of the components of Y might be strongly correlated with X in ways that are masked in the aggregation. I call this Type 4 Disaggregation.

One example of this is displayed in Figure 7.5, in which Y and X are uncorrelated, while Y1 is perfectly correlated with X. Neither Y2 nor Y3 is correlated with X over their entire range, but the sum of Y1, Y2 and Y3 results in Y being a straight line. Thus, disaggregation reveals a robust statistical relationship that aggregation had obscured.

As noted earlier, both Type 2 and Type 4 Disaggregation are present in the statistical analysis summarized here. One of the exogenous variables (the deficit alone) is significantly correlated with real GDP growth, while another (the product of the GDP gap and the deficit) is not — at least, at standard cut-off levels of statistical significance. Disaggregating GDP reveals that the former variable is correlated with only a few of the components and subcomponents
of GDP growth (Type 2 Disaggregation), while the latter is correlated in economically important ways to some of the subcomponents, even though it is not correlated to GDP growth at a high level of statistical significance (Type 4 Disaggregation).

![Figure 7.5 Type 4 Disaggregation](image)

4 ANALYSING DISAGGREGATIONS OF GDP GROWTH

The exercise here asks the following question. If we take the GDP growth equation specified above seriously, what do regressions of exactly the same form but substituting components of GDP growth for the dependent variable tell us?

4.1 The Adding-up Property

The econometric tests summarized below are based on separate regressions with each component of GDP as the dependent variable and with the same regressors used for each regression. Since each of the component breakdowns of GDP is based on a simple additive disaggregation method, it is a matter of computational certainty that – using ordinary least squares estimation – the coefficients of the fiscal deficit (or of any exogenous variable) for each of the separate component regressions must sum to the coefficient of the fiscal deficit in the regression with total GDP as the dependent variable.

This can be seen most easily in Figure 7.2 above (Type 1 Disaggregation). Clearly, the coefficient on \(X\) in the regression \(Y = a + bX\) is equal to 1. The \(b_i\)
coefficient on $X$ in each of the disaggregated regressions ($Y_1 = a_1 + b_1 X$, $Y_2 = a_2 + b_2 X$, $Y_3 = a_3 + b_3 X$) is equal to 1/3, so that the $b_i$'s sum to 1. Also, while each of the intercept terms is different, it is still true that $a_1 + a_2 + a_3 = a$.

Therefore, the estimates of the coefficient on the deficit variable from a set of four regressions (with the same exogenous variables and functional form) which take consumption, investment, government purchases and net exports as the dependent variable in turn will sum to the estimated coefficient on the deficit variable in a regression where GDP is the dependent variable. If further regressions are run with smaller subdivisions of each aggregate used as dependent variables, the coefficients on each independent variable must still add up to the overall estimate (just as, in any given year, the levels of these components must sum to total GDP).

The above discussion requires one clarification, however. The dependent variable in the regressions summarized above is the growth rate of GDP, which is simply the change in GDP divided by the lagged GDP. Therefore, the division of GDP into separate components must be in a form which will allow the disaggregated components of GDP to add up to the GDP growth rate.

However, the growth rate of GDP is obviously not equal to the sum of the growth rates of consumption, investment, government purchases and net exports; rather, it is equal to 'the change in consumption divided by lagged GDP' plus 'the change in investment divided by lagged GDP', and so on.\textsuperscript{14} In the discussion below, these variables are designated in lower-case, bold-face type. For example: $\Delta c_t$ represents the change in consumption from quarter $t - 1$ to quarter $t$, divided by the value of GDP in quarter $t - 1$, with the result multiplied by four to express the quarterly change at an annual rate. The precise definition of any variable $x_t$, therefore, is $4\Delta x_t/GDP_{t-1}$.

In each of the complete sets of regressions tested, ordinary least squares estimation produced at least two regressions whose Durbin–Watson statistics (DW) indicated the presence of serial correlation (at a 5 per cent two-sided level of significance), as well as many more with inconclusive tests (see Tables 7.2 and 7.5).

The first recourse in such a situation is to perform a regression with correction for first-order serial correlation, such as the Cochrane–Orcutt procedure, which is a generalized least squares approach, using quasi-differencing.\textsuperscript{15} This involves transforming an equation of the form:

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t$$

where $\epsilon_t = \rho \epsilon_{t-1} + u_t$,

where $\rho$ is the coefficient of serial correlation, into an equation that can be estimated using ordinary least squares regression. Simple manipulation of those equations results in:
Effects of fiscal deficit on the composition of US GDP

\[ Y^*_t = \beta^*_0 + \beta_1 X^*_t + u_t, \]

where

\[ Y^*_t = Y_t - \rho Y_{t-1}, \quad X^*_t = X_t - \rho X_{t-1}, \]

and

\[ \beta^*_0 - \beta_0 - \rho \beta_0. \]

Note that \( \beta_1 \) is unchanged by the transformation. If a value for \( \rho \) is given, the \( Y^*_t \) equation is then estimated using OLS. Otherwise, the value of \( \rho \) is determined through an iterative procedure, which is what the Cochrane–Orcutt algorithm performs. The equation discussed in Section 2 above was derived by adapting this method to the non-linear equation under investigation.

Performing this procedure equation by equation on a set of disaggregated variables will, however, generally prevent the estimated coefficients on the deficit from adding up appropriately, since each new corrected regression will generate a different estimate of \( \rho \), which will then cause the adding-up property to be violated. Another way to see this is to note that the dependent variables no longer add up according to the disaggregation pattern, because each variable has been quasi-differenced using a unique estimate of \( \rho \).

In order to preserve the adding-up property of a set of regressions, one possibility is to impose the same value of \( \rho \) for all regressions within the set. Choosing that value of \( \rho \) is, however, not straightforward. One possible approach is to choose the minimum absolute value of \( \rho \) which would bring the most extreme DW value into the acceptable range.

However, in each set of regressions there was at least one component of GDP that had a Durbin–Watson statistic on the opposite side of 2.0, indicating serial correlation of the opposite sign. Imposing the appropriate value of \( \rho \) (to move the lowest or highest DW into the acceptable range) in many cases pushed the opposite DW statistic so high or low as to indicate that the imposed value of \( \rho \) had actually created (or worsened) serial correlation in the regression associated with that DW statistic.

The available data could not, therefore, simultaneously be used to produce estimates which preserved the adding-up property and in which every equation was corrected for serial correlation. Given that, it would still be possible to report regression results (after correcting for serial correlation) for only the most disaggregated series and to add up the resulting coefficients into more-aggregated results, culminating in the GDP regression. This would, however, produce no standard test statistics for the more-aggregated regressions, making it difficult to infer whether the sum of two regression results – one with very significant results and one with insignificant results – is in the aggregate significant.
Fortunately, however, tests of the data showed that simply using a generalized least squares technique (with quasi-differencing) on each equation separately (each with its own estimated value of \( \rho \)) provided estimates which added up surprisingly well. Thus, for example, the estimated sums of the coefficients on the lagged deficit variables from the GLS estimates of the \( e, i, g \) and \( nx \) regressions (Table 7.3) sum to 0.24, while the linear coefficient in the \( gdp \) regression itself is 0.23. Therefore, Tables 7.3 and 7.6 simply report the results of AR(1) regressions for each component of GDP, with the differences between the more- and less-aggregated components obvious by inspection.

4.2 Averages and Average Growth

It will be useful to analyse the historical changes in the components of GDP, in order to compare the changes in these components induced by deficits with the average changes over the sample period. Tables 7.1 and 7.4 summarize some basic statistics within each accounting method for the 1972:1–1994:4 sample period.

The first column, labelled ‘First’, indicates the ratio of each component of GDP to aggregate GDP, in the first quarter of the sample (1972:1). Similarly, ‘Last’ indicates the ratio of each component to GDP in the last quarter. ‘Average’ is the ratio of the average value of the component for the twenty-three-year sample period to the average value of aggregate GDP for that period.

The final column is labelled ‘Ave. growth’. This takes the average growth rate for a component of GDP (that is, the change in the component divided by lagged GDP, as defined above) for the sample period and divides it by the average growth rate of total GDP for that time period. For example, for total consumption, the entry in the last column is calculated as follows:

\[
\text{Ave. growth of consumption}_t = \frac{\text{average} \frac{C_t - C_{t-1}}{\text{GDP}_{t-1}}}{\text{average} \frac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}}
\]

\[
= \frac{\sum \frac{C_t - C_{t-1}}{\text{GDP}_{t-1}}}{n} = \frac{\sum \frac{C_t - C_{t-1}}{\text{GDP}_{t-1}}}{n} = \frac{\sum \frac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}}{\sum \frac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}} = \frac{\sum \frac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}}{n}
\]
Thus, this column in each table allows one to compare the relative importance of each component of GDP in over two decades of economic growth. The entries in Table 7.1 highlight several important trends in the expenditure data over the sample period. First, both consumption and gross investment became larger parts of total GDP, while government purchases became smaller, and net exports ended where they started.

Therefore, while the ‘Last’ column indicates that consumption was 66.8 per cent of overall GDP at the end of 1994, the growth of consumption had constituted a markedly larger share of GDP growth during the period, 70.6 per cent of the average growth in GDP. A similar difference appears for total investment, which accounted for 18.2 per cent of GDP at the end of the sample period but had accounted for 20.4 per cent of GDP growth over the twenty-three-year period.

The story for government purchases is quite the opposite. While it continued to constitute 17.0 per cent of GDP in 1994:4, and an average of 19.0 per cent for the period, its contribution to the growth of GDP for those years was a paltry 11.0 per cent. Moreover, looking at the two subcomponents of government purchases makes it clear that virtually all of this shrinkage occurred at the federal level, which contributed only 2.2 per cent of that 11.0 per cent average growth, with the slightly-shrunken state and local government sector responsible for the remainder of the diminished governmental contribution to the average GDP growth rate.

Other important patterns in the components show that: (1) in the consumption sector, durables and services were growing in importance while nondurables were shrinking; (2) fixed investment was the major force behind the growth in the investment sector, with growth of investment in equipment (which nearly doubled over the period) constituting roughly 90 per cent (14.6 per cent out of 16.3 per cent) of the growth accounted for by fixed investment as a whole; and (3) both exports and imports grew significantly, with the 2 per cent difference in their growth rates equal to the difference in their levels (as a percentage of GDP).

Separating the output of the economy into its major products focuses attention on the total quantities of goods, services and structures produced, as well as separating inventories from sales.

Table 7.4 shows the overall historical patterns in the production of these categories of goods. The data confirm that production of goods has become a slightly larger part of overall output and output growth, while production of services has constituted more than half of the growth in output, and production of structures has been shrinking. Within the goods category, production has been shifting from nondurables to durables, while inventories appear to have been volatile over this time period (as indicated by the ‘Average’ being smaller than either the ‘Last’ value or the ‘First’ value).
4.3 Results of Regressions on Disaggregated GDP Components

Tables 7.2 and 7.5 report the results of ordinary least squares regressions. These tables are produced for several purposes: to demonstrate which regressions show evidence of serial correlation, to demonstrate the adding-up property of the estimated coefficients (subject to rounding errors), and to allow the corrected regressions (in Tables 7.3 and 7.6) to be compared with the OLS regressions. Tables 7.2 and 7.5 make it clear that most of the interesting statistical results are already evident even in the OLS regressions. Correction for serial correlation only strengthens those results. Therefore, in the discussion of regression results below, I will refer exclusively to Tables 7.3 and 7.6, which summarize the results of the AR(1) regressions.

The expenditure disaggregation

Based on the patterns discerned in Table 7.1, and turning to the regression results in Table 7.3, the places to look for impact on GDP growth would seem to be consumption (especially durables and services) and investment (especially equipment investment).

One way to analyse these results is to look only at those estimates that are statistically significant, concentrating on the most detailed level of disaggregation possible. When there is not a gap, the only subcomponents of GDP that one can be highly confident will respond to deficits are durables consumption and state and local government purchases, since no other linear coefficients are statistically significant at even a 90 per cent level of confidence. Among the interactive coefficients, the response of durables consumption, equipment investment and imports are significant, and nondurables consumption is near the borderline of the 95 per cent level of confidence.

Viewed in this way, the statistical support for a positive effect of deficits on GDP growth at NAIRU is supported, as are the additionally positive effects of deficits during recessions – although the size of the interactive coefficient in the import equation diminishes the overall impact of deficits during recessions. Crowding out is not supported by any of these results, while the accelerator hypothesis on equipment investment is supported.

The simple Keynesian consumption function appears to be operative as well, with consumption rising in response to deficits (which means that consumption is higher when GDP is higher). Finally, the fact that much of the response to deficits comes from durables consumption lends support to the consumption-as-investment view.

These results support an activist Keynesian view of the effects of deficits on the economy. The numerical estimates, and their meanings in the context of the theoretical questions at issue here, are discussed below.
The point estimates tell some interesting stories; but, as noted, most of the results are not statistically significant. Following this discussion of point estimates, therefore, a more complete description of statistical significance will be useful. First, however, a discussion which takes the point estimates seriously will facilitate a discussion of the implications of the various estimated coefficients.

In the course of that discussion, in order to alert the reader to those results that are statistically significant, the following convention will be adopted: for those results that are significant at a 90 per cent level of confidence (that is, with a p-value of 0.10 or less), I will put an asterisk in parentheses (*) immediately after first mentioning the estimate. For estimates which are significant at a 95 per cent level of confidence, I will put two asterisks in parentheses; and for a 99 per cent level of confidence, I will put three asterisks in parentheses.

According to the linear coefficients in Table 7.3, running a deficit while the economy is at NAIRU raises the growth of consumption (***), government purchases (**) and net exports. Indeed, each of those three components individually responds by at least two-thirds as much as the total response of aggregate GDP growth (which outweighs the large drag created by the response of investment, discussed at some length below).

Among types of consumption, each of the three categories accounts for roughly one-third of the overall impact on consumption, with durables consumption increasing by 0.07 per cent (***), due to a 1 per cent deficit and nondurables and services each increasing by 0.08 per cent. For government spending, the state and local sector accounts for two-thirds of the growth (**). Interestingly, exports seem to respond quite strongly, while imports paradoxically decrease as the deficit rises (and, therefore, as the economy strengthens).

Investment, and nearly every category of investment, is crowded out. Indeed, the linear coefficients in \( c \) and \( nx \) barely compensate for the decrease in investment growth. Since investment’s average growth rate over this time period (from Table 7.1) was 20.6 per cent of the GDP growth rate, and the GDP growth rate averaged 2.6 per cent over this time period, this means that we might have expected that investment growth (as a percentage of GDP) would have been about 0.52 per cent. Subtracting 0.34 per cent from that (the point estimate of the linear coefficient in the \( i \) equation) means wiping out two-thirds of average investment growth for the sample period.

This result takes on a somewhat different interpretation, however, if one looks for the source of the crowding out. The only component of investment that is not crowded out at all is residential construction, which shows a very small increase due to the strengthening economy. Perhaps more important, though, the estimates show that two-thirds of the crowding out is actually a decrease in inventory accumulation growth, a result that could quite easily be reconciled with a surge in all types of consumption (private, government and foreign) in
an economy that is already at GDP*. However, equipment investment growth shows a large decline of 0.11 per cent of GDP, which is precisely the type of investment that is most important for future economic growth. Investment in plant, on the other hand, is not affected by the deficit.

Overall, the analysis of the linear coefficients indicates that, when a deficit is incurred while the economy is at NAIRU, all types of private consumption rise (with the inexplicable exception of imports), government spending and exports rise, residential construction rises by a small amount, and inventories and equipment investment are significantly crowded out. Imports aside, there is nothing else in those results that runs counter to standard Keynesian assumptions about consumer or investor behaviour, with the crowding-out result supporting those who believe that deficits are harmful at NAIRU. The logic of the standard Keynesian textbook consumption function also is supported, with consumption of all types responding positively to the deficit at the same time that income rises due to the deficit.

It is not unimaginable that state and local governments respond to higher federal deficits with greater spending of their own, in a case of spending complementarity. On the other hand, there is little reason to believe that exports or federal spending should be increased by real federal structural deficits; so there are definitely some mysteries to be explored.

Looking at the \( p \)-values of the exclusion tests for the linear coefficients in Table 7.3 begins to shed light on some of these mysteries, and to bring into question some of the seemingly believable results discussed above. While the \( p \)-value of the \( c \) equation is 0.01, this appears to be a textbook case of Type 2 Disaggregation, with the \( p \)-value in the \texttt{cdur} equation estimated at 0.00 (that is, a level of confidence greater than 99.5 per cent) while \texttt{cdn} and \texttt{cs} have relatively low \( p \)-values (0.24 and 0.18, respectively). This indicates that we can only have high confidence that durables consumption responds to deficits, while nondurables and services consumption are much less likely to respond at all.

Looking at the \( p \)-values in the disaggregations of investment is even more interesting. While the \texttt{i} equation shows a \( p \)-value of 0.14, which is not statistically significant at standard levels of the tests, it is interesting to note that even this level of confidence apparently derives from three basic components of investment: investment in plant (which has a point estimate of \(-0.00\) and a \( p \)-value of 0.14), residential investment (which appears to respond positively to deficits, with a \( p \)-value of 0.12), and inventories (with a \( p \)-value of 0.11). The \( p \)-value for the large, negative coefficient in the \texttt{ie} equation is 0.60, indicating that there is only a two-in-five chance that equipment investment falls (that is, that the linear coefficient is non-zero) in response to deficits at NAIRU.

The only element of investment that has both a large negative point estimate and an even moderately significant exclusion test, therefore, is inventories. The
crowding-out story, therefore, looks less compelling and gives less reason for concern about the impact of deficits on future macroeconomic performance, since the most important parts of investment for future economic growth (plant and equipment investment) seem – for different reasons – to be relatively impervious to deficits.

This result contrasts markedly, however, with the reported results in Eisner and Pieper (1988). Using annual data and a somewhat different specification of the growth equation (the most important difference being the lack of an interactive term), they report that regressions for i and ifix show a strong positive response to deficits. The increase in aggregate investment due to higher deficits comprises more than 80 per cent of the overall effect on GNP growth\(^{17}\) (although that is somewhat of an overstatement since their results, which are based on regressions with Cochrane–Orcutt correction, do not add up to the estimates for the aggregate gnp equation nearly as closely as the results summarized here); and the increase in fixed investment comprises nearly 69 per cent of the change in GNP growth.

Moreover, their reported results are statistically significant: the \(t\)-statistics for the two estimates (that is, for the coefficients on the deficit variable in the i and ifix equations) are 3.25 and 3.74, respectively, indicating significance levels in excess of 99 per cent. The difference with the results reported here is attributable in the first instance to the use of quarterly data rather than annual data, since preliminary tests for this chapter showed that a linear equation similar to that used in Eisner and Pieper (that is, excluding the interactive term) confirmed their results in tests with annual data but failed to detect significant coefficients on the deficit variable in tests with quarterly data. (This was true for the overall gdp regression as well as for the i and ifix regressions.)

Inclusion of the interactive term, however, showed that a statistically significant effect of deficits can be found, even using quarterly data. Therefore, the estimated coefficients on the interactive term (the \(\delta_j\)’s) lend confirmation to standard Keynesian results, but with the added information that the Keynesian effect of deficits arises due to a weak economy.

Looking at the \(p\)-values in the government and foreign sectors also helps to clarify some of the mysteries discussed above. While the linear coefficient in the g equation is significant at the 95 per cent level, it turns out that the source of that statistical correlation is the state and local government sector. Since the \(p\)-value in the gfed equation is 0.26, while that in the gsl equation is 0.03, this tends to support the notion that state and local government purchases follow federal deficits, whereas federal purchases very likely do not. While it is imaginable that a deficit in one year could lock in federal spending the following year, the complementarity story at the state and local level is much more plausible, given the explicit links between federal spending and state and local spending (seed money, in-advance matching grants, and so on).
In the foreign sector, both of the puzzles mentioned above are fairly definitively put to rest by the levels of the \( p \)-values. In the \textit{ex} equation, the \( p \)-value of the linear coefficient is an astounding 0.91, indicating that exports almost certainly do not respond to domestic economic conditions. Similarly, the negative coefficient on imports has a \( p \)-value of 0.46. When the economy is at GDP*, therefore, it appears that the foreign sector does not create a significant part of the response of GDP growth to the deficit.

Turning now to the interactive coefficient, and again concentrating on the point estimates, the most obvious result in Table 7.3 is that only three point estimates are positive: for the \textit{gsl}, the \textit{nx} (***) and the \textit{ex} equations. The \textit{gsl} result can be ignored based both on its size (0.01) and its \( p \)-value (0.58), while the \textit{ex} result can be ignored mostly on the basis of theory (that the export sector should not respond to changes in GDP) – but again also because of the relatively statistically insignificant \( p \)-value. The positive value of the interactive coefficient (and its low \( p \)-value) in the \textit{nx} equation, therefore, derive from the \textit{im} equation (**), which will be discussed below.

The negative value of the interactive coefficient in each of the other equations tested supports the notion described earlier, in which a negative value of GAP (a recession) means that a positive deficit is more stimulative (or less contractionary) than it would be at GDP*. In the \textit{e} equation, for example, a 1 per cent DEF and a \(-1\) per cent GAP would indicate a 0.28 per cent increase (***i) in consumption growth (rather than the 0.20 per cent growth predicted at NAIRU), while a +1 per cent GAP would cause consumption's response to the deficit to be only 0.12 per cent. Therefore, for each of the components and subcomponents of GDP (with the exception of the three already discussed), the interactive coefficient indicates a greater response to deficits (or a less negative response) during a recession than otherwise.

Looking at the range from a \(-1\) per cent GAP to a 1 per cent GAP, therefore, the response of consumption growth to a 1 per cent deficit is 0.20 \( \pm \) 0.08, while investment growth’s response is \(-0.34 \pm 0.24\), government purchases growth’s response is 0.22 \( \pm \) 0.04, and net exports growth’s response is 0.16 minus-or-plus 0.19.\textsuperscript{18}

Applying similar arithmetic to the possibility of a \(-2\) per cent GAP, the most notable change is that aggregate investment now responds positively to a deficit, since \(-0.34 + 0.48 = 0.14\), which means that a 1 per cent DEF with a \(-2\) per cent GAP creates 0.14 per cent of extra investment growth, with the acceleration effect now so strong that it wipes out the crowding-out effect. Businesses and new home buyers respond so positively to having a surge in GDP growth, therefore, that they expand their capital stock in anticipation of better times. The composition of that investment growth is extremely interesting, as the discussion now turns to the sub components of consumption, investment, government purchases and net exports.
The results for consumption and its components are very similar for the interactive coefficient to the results for the linear coefficient, in that the point estimates are about equal to each other (with the estimate equal to −0.02 for \textit{cdur} (**), −0.03 for \textit{conon} (*) and −0.03 for \textit{cser}). The overall story for consumption indicates that people respond to expansionary fiscal policy even at NAIRU; and they respond even more strongly during a recession, quite likely due to a consumer confidence effect, with consumers responding to positive movements in their income (and in the economy in general) by buying more goods.

The breakdown of the investment statistics shows that the various types of investment respond to deficits during a recession or a boom in theoretically-plausible ways. Starting at the bottom of the table and working up, the results for the inventories regression show that the interactive response is positive during a recession, which means that businesses start thinking about building up their inventories when they see a positive movement in a weak economy. Thus, while inventories are drawn down when there is a deficit at GDP*, the sum of the linear coefficient and the interactive coefficient indicates that this response is dampened during a recession — and it is even reversed if the recession is deep enough. Conversely, during a boom, businesses apparently view the good times as temporary, as they draw down inventories at an even faster rate.

The response of residential investment was already positive, even with no gap. Therefore, the interactive coefficient (*) indicates that new home buyers become conservative during a boom (where the net effect of a 1 per cent DEF with a +1 per cent GAP is −0.08 per cent) and more confident during a recession. One potential explanation for this is that the initiation of expansionary fiscal policy during a recession brings new home buyers into the market who had been holding back because of the weak state of the economy.

The results for plant and equipment investment (together and separately) tend to confirm an accelerationist story. When GAP is positive, the economy is operating above some concept of capacity, in which case higher deficits will further crowd out investment spending. On the other hand, during a recession, the slack in the economy causes the deficit to act as an impetus to demand and subsequently investment, which is what the concept of acceleration describes.

If, for example, the economy is in a recession at 2 per cent below potential (as it was in the third quarter of 1993), raising the deficit by 1 per cent of GDP (roughly $51 billion at that time) would have caused equipment investment growth to be 0.06 per cent higher as a percentage of GDP (**), or approximately $3 billion more than the $16.6 billion increase in equipment investment that actually occurred during that quarter (at an annual rate, from the previous quarter).

Based on the point estimates, however, it will take a deep recession (on the order of a −2.25 per cent GAP) for the total of plant and equipment investment to have a net positive response to deficits. The necessary size of GAP to turn the growth in \textit{le} positive is larger still (in absolute value). Note also that plant
investment remains largely unresponsive to deficit spending (given its linear coefficient estimate of –0.00 and its interactive coefficient estimate of –0.01), leaving the majority of the response of plant and equipment investment to be explained by equipment alone.

As discussed above, it is generally not appropriate to infer any meaning from the government purchases regression (g) or the federal government regression (gfed). It is not surprising that the estimated coefficients and adjusted \( R^2 \) for those two regressions (especially g) are insignificant.\(^{19} \) Again, these results are provided for completeness, simply to show that the estimated coefficients come close to adding up appropriately.

In the ex equation, the interactive coefficient is positive, which would mean (if exports were not likely – based on most theoretical models – to be exogenous) that the response of exports to deficits is weakened during a recession. In the im equation, the interactive coefficient is negative (\( ^{**} \)), which would mean that deficits during recessions cause increases in imports, and vice versa. Since higher imports are a drag on GDP, however, this means that both exports and imports respond to deficits so as to weaken overall economic growth. With a –1 per cent GAP, the foreign sector becomes a net drag on the economy, as the negative response of exports and the positive response of imports to deficits during a recession overwhelm their otherwise-expansionary impact (based on their linear coefficients).

Looking at the \( p \)-values of the interactive coefficients, the estimate for the cdur equation is statistically significant at a 98 per cent level, while the cnon equation almost meets the benchmark 95 per cent level of confidence and the cser estimate is insignificant. Note that only the cdur equation has statistically significant estimates for both the linear and interactive coefficients, indicating that people respond to deficits by increasing their purchases of durable goods and that this effect is even stronger during a recession. Moreover, the positive impact of deficits on durables consumption growth is not wiped out entirely unless the GAP is more than +3.5 per cent.

In the investment equations, the significant \( p \)-values for ffix andipe appear to arise from Type 2 Disaggregation in which the significance of the estimate in the ie equation carries over into the more-aggregated regressions. Note also that the linear coefficient in the ie equation had a very low level of confidence in rejecting the null hypothesis that it was equal to zero. On the other hand, the interactive coefficient is very statistically significant. Thus, if the linear coefficient really were equal to zero, the interactive coefficient would indicate that equipment investment responds positively to a deficit during a recession, rather than merely ‘less negatively’. This is an even stronger confirmation of the accelerator process.

None of the estimates of the interactive coefficients in the government purchases equations are statistically significant, while the significance of the
estimate in the \textit{nx} equation appears to be created mostly by the response of imports. The lack of a significant estimate for \textit{gfed}, \textit{gsl} and \textit{ex} confirms theoretical expectations, as does the significance of the interactive coefficient in \textit{im}, as discussed above.

The major conclusion from the expenditures disaggregation is that standard Keynesian predictions about consumption and investment are largely supported. When there is not a gap, the statistical results indicate support for the simple consumption function as a function of income, as well as support (without strong statistical significance) for crowding out of certain types of investment (mostly inventory investment). When the economy is below NAIRU, consumer confidence and accelerator effects appear to be operative.

\textbf{The major products disaggregation}

The results in Table 7.6 show that the most statistically significant results for the linear coefficient are those for the \textit{goodsale} and \textit{struc} regressions. However, neither the sale of durable goods nor of nondurable goods shows a significant linear coefficient; so it is hard to determine the source of the statistical strength in the aggregate series for sales of goods (and overall sales).

What is somewhat surprising, however, is that the durable goods regressions have such insignificant estimates. Given the results in the expenditures regressions (specifically, \textit{cdur}), it is somewhat disappointing that durables output is not significantly affected by deficits.

The interactive coefficient, however, in the \textit{dursale} regression does indicate statistical significance. Since durable goods are sold both to consumers and as equipment investment, this coefficient ought to mirror the statistical significance of the regression on the expenditures side of the accounts. However, the interactive coefficient has the opposite sign from the sign in those two regressions, deepening the mystery rather than resolving it.

There is also a large, significant linear coefficient in the \textit{durinv} equation, which is of the opposite sign and larger in absolute value than the estimate for the linear coefficient in the \textit{gdp} regression! This is inconsistent with virtually every other statistical estimate summarized here.

The results on Table 7.6 clearly do not match up well with those on Table 7.3. Given the differences in the two methods of disaggregation, this is (at least in retrospect) not surprising. The expenditures method separates purchases by particular groups of economic actors, and then further summarizes how each group divided their purchases among each type of good. The major products method, on the other hand, summarizes in each category the total production of each type of good, no matter the ultimate buyer.

For example, the variable \textit{CNON} (under the consumption category) includes only the nondurable goods which were actually purchased by households; but the \textit{NONDUR} variable includes nondurable goods which were sold to businesses
Table 7.1  Components of GDP relative to total GDP, in levels, averages and rates of growth – disaggregation by expenditure

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>First</th>
<th>Last</th>
<th>Average</th>
<th>Ave. growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>C</td>
<td>63.5</td>
<td>66.8</td>
<td>66.0</td>
<td>70.6</td>
</tr>
<tr>
<td>CDUR</td>
<td>7.1</td>
<td>10.2</td>
<td>8.3</td>
<td>13.5</td>
</tr>
<tr>
<td>CNON</td>
<td>24.2</td>
<td>20.6</td>
<td>22.4</td>
<td>16.2</td>
</tr>
<tr>
<td>SER</td>
<td>32.2</td>
<td>35.9</td>
<td>35.3</td>
<td>40.8</td>
</tr>
<tr>
<td>I</td>
<td>16.8</td>
<td>18.2</td>
<td>16.3</td>
<td>20.4</td>
</tr>
<tr>
<td>IFIX</td>
<td>16.2</td>
<td>17.3</td>
<td>15.8</td>
<td>18.5</td>
</tr>
<tr>
<td>IPE</td>
<td>9.9</td>
<td>13.0</td>
<td>11.2</td>
<td>16.3</td>
</tr>
<tr>
<td>IP</td>
<td>4.1</td>
<td>2.9</td>
<td>3.8</td>
<td>1.7</td>
</tr>
<tr>
<td>IE</td>
<td>5.8</td>
<td>10.2</td>
<td>7.3</td>
<td>14.6</td>
</tr>
<tr>
<td>IRES</td>
<td>6.4</td>
<td>4.3</td>
<td>4.6</td>
<td>2.2</td>
</tr>
<tr>
<td>INIV</td>
<td>0.6</td>
<td>0.9</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>G</td>
<td>21.7</td>
<td>17.0</td>
<td>19.0</td>
<td>11.0</td>
</tr>
<tr>
<td>GFED</td>
<td>9.6</td>
<td>6.1</td>
<td>7.8</td>
<td>2.2</td>
</tr>
<tr>
<td>GSL</td>
<td>12.1</td>
<td>10.9</td>
<td>11.2</td>
<td>8.8</td>
</tr>
<tr>
<td>NX</td>
<td>-2.0</td>
<td>-2.0</td>
<td>-1.3</td>
<td>-2.0</td>
</tr>
<tr>
<td>EX</td>
<td>5.6</td>
<td>12.8</td>
<td>8.7</td>
<td>20.8</td>
</tr>
<tr>
<td>(IM)</td>
<td>7.6</td>
<td>14.8</td>
<td>9.9</td>
<td>22.8</td>
</tr>
</tbody>
</table>

*Notes*

COM = component of GDP.
First = COM/GDP, in per cent, for first quarter of sample.
Last = COM/GDP, in per cent, for last quarter of sample.
Average = average(COM)/average(GDP), in per cent.
Ave. growth = average(ΔCOM/GDPt−1)/average(ΔGDPt), in per cent at annual rate.

*Component definitions:*

GDP = Gross Domestic Product, in 1987 fixed-weight dollars
C = Personal Consumption Expenditures
CDUR = Consumption of Durable Goods
CNON = Consumption of Nondurable Goods
CSER = Consumption of Services
I = Gross Private Domestic Investment
IFIX = Fixed Investment
IPE = Plant and Equipment Investment
IP = Investment in New Plant
IE = Investment in New Equipment
IRES = Residential Construction
INIV = Inventory Accumulation
G = Government Purchases of Goods and Services
GFED = Federal Government’s Purchases of Goods and Services
GSL = State and Local Governments’ Purchases of Goods and Services
NX = Net Exports
EX = Exports
(IM) = Imports

(Parentheses) indicate that component is subtracted from identity.

Effects of fiscal deficit on the composition of US GDP

(for example, meals in an executive dining room), governments (for example, janitorial supplies for the Smithsonian Institution), and foreign buyers (for example, sales of American beer in Germany), in addition to those sold to households. This creates a fundamental difference between the similarly-named categories in the two methods of disaggregation. Looking for similar responses by similar-named variables to deficits would nevertheless have been fruitful, had the variation in the pairs of series also been similar (that is, if the variation in NONDUR were similar to the variation in CNON, in this example). Unfortunately, the results here clearly indicate that they are not.

The major products disaggregation, therefore, is not at all helpful in confirming or contradicting the results in Table 7.3. Those results in Table 7.6 that are statistically significant are either of the wrong sign, too large to make sense (as in the linear coefficient for durinv), or too small to matter (as in the linear coefficient for struc). Therefore, this provides little or no information to complement what was learned from the Expenditures disaggregation.

Table 7.2 Regression results for the expenditures method of disaggregation

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient $\Sigma \gamma_i$</th>
<th>p-value of exclusion test: $\gamma_i = 0$</th>
<th>Interactive coefficient $\Sigma \delta_i$</th>
<th>p-value of exclusion test: $\delta_i = 0$</th>
<th>Durbin-Watson statistic</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdp</td>
<td>0.24</td>
<td>(0.03)</td>
<td>-0.16</td>
<td>(0.21)</td>
<td>1.47</td>
<td>0.24</td>
</tr>
<tr>
<td>c</td>
<td>0.22</td>
<td>(0.00)</td>
<td>-0.08</td>
<td>(0.01)</td>
<td>1.76</td>
<td>0.31</td>
</tr>
<tr>
<td>edur</td>
<td>0.06</td>
<td>(0.00)</td>
<td>-0.02</td>
<td>(0.01)</td>
<td>2.11</td>
<td>0.30</td>
</tr>
<tr>
<td>cnon</td>
<td>0.08</td>
<td>(0.20)</td>
<td>-0.03</td>
<td>(0.06)</td>
<td>1.50</td>
<td>0.19</td>
</tr>
<tr>
<td>cserv</td>
<td>0.08</td>
<td>(0.18)</td>
<td>-0.03</td>
<td>(0.27)</td>
<td>2.10</td>
<td>0.14</td>
</tr>
<tr>
<td>i</td>
<td>-0.37</td>
<td>(0.11)</td>
<td>-0.24</td>
<td>(0.11)</td>
<td>1.67</td>
<td>0.17</td>
</tr>
<tr>
<td>ifix</td>
<td>-0.18</td>
<td>(0.12)</td>
<td>-0.13</td>
<td>(0.01)</td>
<td>1.11</td>
<td>0.25</td>
</tr>
<tr>
<td>ip</td>
<td>-0.18</td>
<td>(0.39)</td>
<td>-0.05</td>
<td>(0.01)</td>
<td>1.17</td>
<td>0.18</td>
</tr>
<tr>
<td>ie</td>
<td>-0.05</td>
<td>(0.10)</td>
<td>-0.02</td>
<td>(0.02)</td>
<td>1.34</td>
<td>0.07</td>
</tr>
<tr>
<td>ires</td>
<td>-0.13</td>
<td>(0.41)</td>
<td>-0.03</td>
<td>(0.02)</td>
<td>1.48</td>
<td>0.29</td>
</tr>
<tr>
<td>iinv</td>
<td>-0.19</td>
<td>(0.18)</td>
<td>-0.08</td>
<td>(0.20)</td>
<td>1.23</td>
<td>0.23</td>
</tr>
<tr>
<td>g</td>
<td>0.22</td>
<td>(0.04)</td>
<td>-0.04</td>
<td>(0.11)</td>
<td>1.94</td>
<td>0.06</td>
</tr>
<tr>
<td>gfed</td>
<td>0.07</td>
<td>(0.26)</td>
<td>-0.05</td>
<td>(0.12)</td>
<td>1.99</td>
<td>0.03</td>
</tr>
</tbody>
</table>
### Table 7.2  
**Consumption, investment and government spending**

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient $\Sigma Y_t$</th>
<th>$p$-value of exclusion test: $\gamma_t = 0$</th>
<th>Interactive coefficient $\Sigma \delta_t$</th>
<th>$p$-value of exclusion test: $\delta_t = 0$</th>
<th>Durbin-Watson statistic</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>gsl</td>
<td>0.15</td>
<td>(0.01)</td>
<td>0.01</td>
<td>(0.53)</td>
<td>1.67</td>
<td>0.06</td>
</tr>
<tr>
<td>nx</td>
<td>0.18</td>
<td>(0.39)</td>
<td>0.19</td>
<td>(0.00)</td>
<td>1.69</td>
<td>0.24</td>
</tr>
<tr>
<td>ex</td>
<td>0.08</td>
<td>(0.90)</td>
<td>0.07</td>
<td>(0.27)</td>
<td>2.01</td>
<td>0.07</td>
</tr>
<tr>
<td>im</td>
<td>−0.10</td>
<td>(0.44)</td>
<td>−0.12</td>
<td>(0.02)</td>
<td>1.65</td>
<td>0.20</td>
</tr>
</tbody>
</table>

**Notes**
- All coefficients are expressed in per cent (i.e., 0.23 means 0.23%) at annual rates.
- Definitions of variables:
  - **Dependent Component**  
  - COM = component of GDP.
  - Component definitions: see Table 7.1.
  - All dependent variables are computed as follows: $\text{com}_t = \{4\text{COM}_{t-1}/\text{GDP}_{t-1}\}^*100$.
  - **Independent Component**  
  - MB = end-of-period real monetary base, as a percentage of real GDP.
  - DEF = Price-Adjusted Standardized-Employment Deficit, as a percentage of nominal GDP.
  - GAP = GDP gap = [(actual GDP - GDP at NAIRU)/(GDP at NAIRU)]*100.

### Table 7.3  
**Regression results for the expenditures method of disaggregation, corrected for serial correlation**

$$\text{com}_t = \alpha_0 + \alpha_1 \text{trend} + \sum_{i=1}^{4} \beta_i \Delta \text{MB}_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta \text{DEF}_{t-i} + \sum_{i=1}^{4} \delta_i \Delta \text{GAP}_{t-i} + \Delta \text{DEF}_{t-1} + \varepsilon_t$$

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient $\Sigma Y_t$</th>
<th>$p$-value of exclusion test: $\gamma_t = 0$</th>
<th>Interactive coefficient $\Sigma \delta_t$</th>
<th>$p$-value of exclusion test: $\delta_t = 0$</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdp</td>
<td>0.23</td>
<td>(0.02)</td>
<td>−0.17</td>
<td>(0.13)</td>
<td>0.27</td>
</tr>
<tr>
<td>c</td>
<td>0.20</td>
<td>(0.01)</td>
<td>−0.08</td>
<td>(0.01)</td>
<td>0.31</td>
</tr>
<tr>
<td>cdur</td>
<td>0.07</td>
<td>(0.00)</td>
<td>−0.02</td>
<td>(0.02)</td>
<td>0.29</td>
</tr>
<tr>
<td>cnon</td>
<td>0.08</td>
<td>(0.24)</td>
<td>−0.03</td>
<td>(0.03)</td>
<td>0.23</td>
</tr>
<tr>
<td>csr</td>
<td>0.08</td>
<td>(0.18)</td>
<td>−0.03</td>
<td>(0.28)</td>
<td>0.13</td>
</tr>
<tr>
<td>i</td>
<td>−0.34</td>
<td>(0.14)</td>
<td>−0.24</td>
<td>(0.12)</td>
<td>0.18</td>
</tr>
<tr>
<td>ifix</td>
<td>−0.08</td>
<td>(0.17)</td>
<td>−0.14</td>
<td>(0.01)</td>
<td>0.39</td>
</tr>
<tr>
<td>ipe</td>
<td>−0.09</td>
<td>(0.68)</td>
<td>−0.04</td>
<td>(0.04)</td>
<td>0.33</td>
</tr>
<tr>
<td>ip</td>
<td>−0.00</td>
<td>(0.14)</td>
<td>−0.01</td>
<td>(0.30)</td>
<td>0.21</td>
</tr>
<tr>
<td>ie</td>
<td>−0.11</td>
<td>(0.60)</td>
<td>−0.03</td>
<td>(0.02)</td>
<td>0.32</td>
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</table>
Effects of fiscal deficit on the composition of US GDP

Table 7.3 continued

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient $\Sigma \gamma_i$</th>
<th>p-value of exclusion test: $\gamma_i = 0$</th>
<th>Interactive coefficient $\Sigma \delta_i$</th>
<th>p-value of exclusion test: $\delta_i = 0$</th>
<th>Adjusted $R^2$</th>
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</thead>
<tbody>
<tr>
<td>ires</td>
<td>0.01 (0.12)</td>
<td>-0.09 (0.10)</td>
<td></td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>inv</td>
<td>-0.21 (0.11)</td>
<td>-0.11 (0.12)</td>
<td></td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>g</td>
<td>0.22 (0.05)</td>
<td>-0.04 (0.12)</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>gfed</td>
<td>0.07 (0.26)</td>
<td>-0.05 (0.11)</td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>gsl</td>
<td>0.14 (0.03)</td>
<td>0.01 (0.58)</td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>nx</td>
<td>0.16 (0.49)</td>
<td>0.19 (0.00)</td>
<td></td>
<td></td>
<td>0.26</td>
</tr>
<tr>
<td>ex</td>
<td>0.08 (0.91)</td>
<td>0.07 (0.19)</td>
<td></td>
<td></td>
<td>0.08</td>
</tr>
<tr>
<td>im</td>
<td>-0.09 (0.46)</td>
<td>-0.12 (0.02)</td>
<td></td>
<td></td>
<td>0.20</td>
</tr>
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</table>

Note: Definitions of variables: see Tables 7.1 and 7.2.

Table 7.4 Components of GDP relative to total GDP, in levels, averages and rates of growth – disaggregation by major products

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>First</th>
<th>Last</th>
<th>Average</th>
<th>Ave. growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>SALES</td>
<td>99.4</td>
<td>99.1</td>
<td>99.5</td>
<td>98.0</td>
</tr>
<tr>
<td>INVENV</td>
<td>0.6</td>
<td>0.9</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>GOOD</td>
<td>39.7</td>
<td>42.1</td>
<td>40.2</td>
<td>44.7</td>
</tr>
<tr>
<td>GOODSAIL</td>
<td>39.1</td>
<td>41.2</td>
<td>39.8</td>
<td>42.8</td>
</tr>
<tr>
<td>INVENV</td>
<td>0.6</td>
<td>0.9</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>DURARF</td>
<td>14.7</td>
<td>70.8</td>
<td>17.3</td>
<td>78.4</td>
</tr>
<tr>
<td>DURSALE</td>
<td>14.4</td>
<td>20.3</td>
<td>17.0</td>
<td>26.5</td>
</tr>
<tr>
<td>DURINV</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td>1.9</td>
</tr>
<tr>
<td>NONDUR</td>
<td>25.0</td>
<td>21.2</td>
<td>22.9</td>
<td>16.3</td>
</tr>
<tr>
<td>NONDSALE</td>
<td>24.7</td>
<td>20.9</td>
<td>22.8</td>
<td>16.3</td>
</tr>
<tr>
<td>NONDINV</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>SERV</td>
<td>47.2</td>
<td>49.0</td>
<td>49.4</td>
<td>51.1</td>
</tr>
<tr>
<td>STRUC</td>
<td>13.1</td>
<td>8.9</td>
<td>10.3</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Notes
COM = component of GDP.
First = COM/GDP, in per cent, for first quarter of sample.
Last = COM/GDP, in per cent, for last quarter of sample.
Ave. growth = average(ΔCOM/GDP$_{t-1}$)/ave.(%ΔGDP$_t$), in per cent at annual rate.
Component Definitions:
GDP = Gross Domestic Product, in 1987 fixed-weight dollars
SALES = Final Sales of Domestic Product
INVENV = Change in Business Inventories
GOOD = Total Goods Produced
Table 7.4 continued

GOODSALE = Final Sales of Goods
INVEN = Change in Business Inventories (same as INVEN above)
DURABLE = Total Durable Goods Produced
DURSALE = Final Sales of Durable Goods
DURINV = Change in Business Inventories of Durable Goods
NONDUR = Total Nondurable Goods Produced
NONDSALE = Final Sales of Nondurable Goods
NONDINV = Change in Business Inventories of Nondurable Goods
SERV = Total Services Produced
STRUC = Total Structures Produced


Table 7.5 Regression results for the major products method of disaggregation, ordinary least squares

\[ \text{com}_t = \alpha_0 + \alpha_1 \text{trend} + \sum_{i=1}^{4} \beta_i \Delta \text{MB}_{t-i} + \sum_{i=1}^{4} \gamma_i \text{DEF}_{t-i} + \sum_{i=1}^{4} \delta_i \text{GAP}_{t-i} \text{DEF}_{t-i} + \epsilon_t \]

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient $\Sigma \gamma_i$</th>
<th>$p$-value of exclusion test: $\gamma_i = 0$</th>
<th>Interactive coefficient $\Sigma \delta_i$</th>
<th>$p$-value of exclusion test: $\delta_i = 0$</th>
<th>Durbin–Watson statistic</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdp</td>
<td>0.24 (0.03)</td>
<td>-0.16 (0.21)</td>
<td>1.47 (0.21)</td>
<td>0.24 (0.21)</td>
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<td></td>
</tr>
<tr>
<td>sales</td>
<td>0.43 (0.02)</td>
<td>-0.05 (0.01)</td>
<td>1.62 (0.01)</td>
<td>0.27 (0.01)</td>
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<td></td>
</tr>
<tr>
<td>inven</td>
<td>-0.19 (0.18)</td>
<td>-0.11 (0.10)</td>
<td>2.46 (0.10)</td>
<td>0.05 (0.10)</td>
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<td></td>
</tr>
<tr>
<td>good</td>
<td>0.02 (0.13)</td>
<td>-0.06 (0.45)</td>
<td>1.90 (0.45)</td>
<td>0.15 (0.45)</td>
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<tr>
<td>goodsale</td>
<td>0.21 (0.03)</td>
<td>0.05 (0.00)</td>
<td>2.16 (0.00)</td>
<td>0.25 (0.00)</td>
<td></td>
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<tr>
<td>inven</td>
<td>-0.19 (0.18)</td>
<td>-0.11 (0.10)</td>
<td>2.46 (0.10)</td>
<td>0.05 (0.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>durable</td>
<td>-0.11 (0.17)</td>
<td>-0.07 (0.17)</td>
<td>1.89 (0.17)</td>
<td>0.18 (0.17)</td>
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<td></td>
</tr>
<tr>
<td>dursale</td>
<td>0.13 (0.12)</td>
<td>0.03 (0.01)</td>
<td>2.26 (0.01)</td>
<td>0.20 (0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>durinv</td>
<td>-0.24 (0.04)</td>
<td>-0.09 (0.04)</td>
<td>2.36 (0.04)</td>
<td>0.11 (0.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nondur</td>
<td>0.14 (0.72)</td>
<td>0.00 (0.64)</td>
<td>2.30 (0.64)</td>
<td>-0.04 (0.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nondsale</td>
<td>0.09 (0.29)</td>
<td>0.02 (0.06)</td>
<td>2.10 (0.06)</td>
<td>0.06 (0.06)</td>
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</tr>
<tr>
<td>nondinv</td>
<td>0.05 (0.99)</td>
<td>-0.02 (0.51)</td>
<td>2.58 (0.51)</td>
<td>-0.08 (0.51)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>serv</td>
<td>0.24 (0.16)</td>
<td>-0.00 (0.59)</td>
<td>2.25 (0.59)</td>
<td>0.11 (0.59)</td>
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<td></td>
</tr>
<tr>
<td>struc</td>
<td>-0.02 (0.02)</td>
<td>-0.10 (0.07)</td>
<td>1.31 (0.07)</td>
<td>0.21 (0.07)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7.5 continued

Notes
All coefficients are expressed in per cent (i.e., 0.23 means 0.23%) at annual rates.
Definitions of variables:
Dependent
COM = component of GDP.
Component definitions: see Table 7.4.
All dependent variables are computed as follows: \( \text{com}_i = \frac{[4(\text{COM}_i - \text{COM}_{i-1})/\text{GDP}_{i-1}]*100.} \)
Independent
MB = end-of-period real monetary base, as a percentage of real GDP.
DEF = Price-Adjusted Standardized-Employment Deficit, as a percentage of nominal GDP.
GAP = GDP gap = [(actual GDP – GDP at NAIRU)/(GDP at NAIRU)]*100


Table 7.6 Regression results for the major products method of disaggregation, corrected for serial correlation

\[
\text{com}_i = \alpha_0 + \alpha_1 \text{trend} + \sum_{i=1}^{4} \beta_i \Delta \text{MB}_{t-i} + \sum_{i=1}^{4} \gamma_i \text{DEF}_{t-i} + \sum_{i=1}^{4} \delta_i \text{GAP}_{t-i} \text{DEF}_{t-i} + \varepsilon_i
\]

<table>
<thead>
<tr>
<th>Component of GDP</th>
<th>Linear coefficient</th>
<th>p-value of exclusion test: ( \gamma_i = 0 )</th>
<th>Interactive coefficient</th>
<th>p-value of exclusion test: ( \delta_i = 0 )</th>
<th>Adjusted ( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdpr</td>
<td>0.23</td>
<td>(0.02)</td>
<td>-0.17</td>
<td>(0.13)</td>
<td>0.27</td>
</tr>
<tr>
<td>sales</td>
<td>0.39</td>
<td>(0.02)</td>
<td>-0.06</td>
<td>(0.00)</td>
<td>0.28</td>
</tr>
<tr>
<td>invr</td>
<td>-0.21</td>
<td>(0.11)</td>
<td>-0.11</td>
<td>(0.12)</td>
<td>0.09</td>
</tr>
<tr>
<td>good</td>
<td>0.02</td>
<td>(0.13)</td>
<td>-0.06</td>
<td>(0.45)</td>
<td>0.13</td>
</tr>
<tr>
<td>goodsale</td>
<td>0.22</td>
<td>(0.03)</td>
<td>0.05</td>
<td>(0.00)</td>
<td>0.24</td>
</tr>
<tr>
<td>invr</td>
<td>-0.21</td>
<td>(0.11)</td>
<td>-0.11</td>
<td>(0.12)</td>
<td>0.09</td>
</tr>
<tr>
<td>durable</td>
<td>-0.12</td>
<td>(0.17)</td>
<td>-0.07</td>
<td>(0.16)</td>
<td>0.17</td>
</tr>
<tr>
<td>dursale</td>
<td>0.15</td>
<td>(0.11)</td>
<td>0.03</td>
<td>(0.02)</td>
<td>0.20</td>
</tr>
<tr>
<td>durinv</td>
<td>-0.24</td>
<td>(0.05)</td>
<td>-0.09</td>
<td>(0.07)</td>
<td>0.14</td>
</tr>
<tr>
<td>nondur</td>
<td>0.11</td>
<td>(0.65)</td>
<td>-0.00</td>
<td>(0.71)</td>
<td>-0.02</td>
</tr>
<tr>
<td>nondsale</td>
<td>0.08</td>
<td>(0.30)</td>
<td>0.02</td>
<td>(0.06)</td>
<td>0.05</td>
</tr>
<tr>
<td>nondinv</td>
<td>0.02</td>
<td>(0.88)</td>
<td>-0.03</td>
<td>(0.45)</td>
<td>0.01</td>
</tr>
<tr>
<td>servr</td>
<td>0.25</td>
<td>(0.06)</td>
<td>0.00</td>
<td>(0.71)</td>
<td>0.11</td>
</tr>
<tr>
<td>strucr</td>
<td>0.01</td>
<td>(0.01)</td>
<td>-0.10</td>
<td>(0.09)</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Note: Definitions of variables; see Tables 7.4 and 7.5.

CONCLUSIONS

This analysis was based on a specification of a GDP growth equation with an interactive term— the product of the GDP gap and the fiscal deficit. This equation separates the response of GDP growth to deficits when the economy is at NAIRU from those responses that only arise when there is a recession or a boom. The results indicate that deficits are expansionary when there is no gap, more expansionary during a recession, and potentially contractionary during a strong enough boom—although the estimated effects during a recession and a boom have only an 87 per cent level of confidence.

The methods of disaggregating GDP in the National Income and Product Accounts provide an arithmetic framework for analysing the effects of fiscal deficits on growth of the gross domestic product. This chapter isolated the effects of federal fiscal deficits on individual components of output, which can then be evaluated relative to the overall responsiveness of GDP to deficits. While this arithmetic framework is somewhat compromised by statistical methods designed to correct for serial correlation, the differences are relatively trivial in the tests summarized here.

For the expenditure method of disaggregating GDP, the most notable inferences from the statistical tests are that consumption, particularly of durable goods, contributes strongly to the growth in output in response to deficits—both when the economy is at potential, and even more strongly when the economy is in a recession. This indicates that public dissaving is followed by an increase in private ‘investment’ in the form of accumulation of durable goods—although this increase is numerically smaller than the deficit itself.

When the economy is at NAIRU, the ‘crowding out’ of investment by deficits (which is not a statistically significant result, with only an 86 per cent level of confidence) is largely comprised of a draw-down of inventories, which is most likely caused by the increases in consumption that follow an increase in the deficit. When there is a gap, the statistically significant response is from equipment investment, with the results confirming the theoretical prediction that equipment investment is crowded out by deficits in booms but accelerated by deficits in recessions. Imports also appear to respond positively to deficits during recessions, weakening the expansionary impact of fiscal policy.

Overall, these results indicate that deficits are (as predicted by standard Keynesian theory) expansionary, that they are countercyclical, that durables consumption responds to deficits even when the economy is at GDP* (and even more strongly when it is below GDP*), and that business fixed investment is most likely to respond positively to deficits during a recession. While there is even some indication that deficits at NAIRU are not necessarily damaging to investment at all, at the very least the use of deficits as a countercyclical fiscal policy tool is supported by these results.
In the major products method of disaggregating GDP, the results are weak and inconsistent with both theory and the other statistical results. Little statistical support is lent even to the most basic theoretical insights.

NOTES

1. A related series (used in the cited studies by Fisner and Fisner and Pieper) is called the price-adjusted high-employment deficit, based upon a different (and, unfortunately, discontinued) structural deficit series from the Bureau of Economic Analysis. The two series can be thought of as essentially interchangeable, although an extensive investigation of their similarities and differences can be found in Buchanan (1996a). Both measure the structural deficit at the federal level only.

2. In all regressions discussed in this chapter, the deficit variable was derived by dividing nominal PASED by nominal GDP (to create a 'real structural deficit' variable).

3. An example of such a model, and the derivation of the reduced-form equations, is summarized in Buchanan (1996a).

4. In some of the equations tested in the referenced works, an exchange rate variable (specifically, the change in the real trade-weighted US exchange rate) is included as a right-hand-side variable. For the specification used in this chapter, however, inclusion of this variable not only indicated that the coefficients on the exchange rate variable itself were not significantly different from zero, but the other diagnostic tests (adjusted $R^2$, and so on) were slightly degraded by inclusion of the exchange rate on the right-hand side. Even a regression with import growth alone as the dependent variable was not improved by the exchange rate explanatory variable. Therefore, the exchange rate was dropped from the list of exogenous variables.

5. Definitions of NAIRU and GDP* are the same as those used by the Congressional Budget Office in estimating the standardized-employment deficit. Use of NAIRU-based series here should not be construed as acceptance or endorsement of the concept, but rather as an attempt to see what can be learned from using this official series. See Staiger et al. (1996) and Eisner's contribution to this volume for interesting empirical analyses of some shortcomings of the NAIRU concept.

6. While this is inaccurate grammatically, in that I am using singular terms to describe plural concepts, greater clarity and simplicity are ultimately achieved by referring to each distributed lag as if it were a single estimate.

7. The CBO only publishes the standardized-employment deficit (SED) for fiscal years, computed on a budget basis. (See, for example, Congressional Budget Office 1995.) This series was the basis of most of the variants of the structural deficit in Buchanan (1996b) and of half of those series in Buchanan (1996a). However, CBO also computes (but does not publish) quarterly, NIPA-based estimates of the SED. The results analyzed here are based on those quarterly, NIPA-based estimates.

8. Since GDP's long-term growth rate is determined by such variables as population growth and productivity growth, it is unlikely that an increase in the deficit will affect the permanent long-run GDP growth rate, unless the federal deficit is comprised largely of a very particular type of productivity-enhancing spending - a possibility that is the subject of future work. (If growth is path dependent, that could also create a link between long-run growth rates and current deficits.) In any case, the deficit can certainly affect the level of GDP at any point in time.

9. One can even imagine a special case in which the actual values of the four coefficients add up to exactly zero. In that case, testing a null hypothesis on the sum would be entirely misleading.

10. The displayed values of the $d_i$'s add up to $-0.17$, with the difference due to rounding error.

11. Having a negative coefficient on one of the lags of the deficit need not imply that the relationship between the deficit and GDP growth is inverse. Rather, it can simply mean that there is a combination of effects that involves both levels and changes of the deficit. For example,
Consumption, investment and government spending

the AR(1) regression above has estimated values of $\gamma$ of 0.36, 0.75, 1.00, and -1.88, as the lag increases. As only one of many examples, this could imply the following relationship:

$$\%\Delta GDP = 0.23(\text{DEF}_t) + 0.13(\text{DEF}_{t-1} - \text{DEF}_{t-2}) + 0.88(\text{DEF}_{t-2} - \text{DEF}_{t-3}) + 1.88(\text{DEF}_{t-3} - \text{DEF}_{t-4})$$

In this example, moreover, the $p$-values of the $t$-tests for the four estimated coefficients individually are 0.54, 0.20, 0.09 and 0.00. However, running a regression with only the fourth lag of the deficit degrades the results significantly (and has no apparent theoretical justification). Therefore, including the four lags as a group, and testing them for exclusion as a group, is the most appropriate statistical method.

12. For the particularly simple example displayed here, the test statistics for equations using the disaggregated variables would pass virtually any common test of statistical significance. For example, in a regression of $Y$ on a constant term and $X$, the estimated coefficient on $X$ has a $t$-statistic greater than 6.0. While this could be made to shrink with a sufficiently large number of subsamples of $Y$ that mimic this pattern of disaggregation, such a numerical example would be diagramatically uninformative.

13. The caveat in the previous note is also relevant here.

14. This is based on nothing more than the simple algebraic rule that:

$$\frac{x+y}{x+y} = \frac{x}{x+y} + \frac{y}{x+y}$$

15. The following discussion is based on Studenmund (1992: 349-50).

16. Net investment (gross investment minus depreciation), on the other hand, had the following values: First = 7.1%, Last = 7.8%. Average = 5.4%, Ave. growth = 8.2%. This indicates that net investment as a percentage of GDP stayed below both the first and the last values for long stretches of the sample period, such that the average value for the entire period was low (and the average growth rate was high due to the high growth rates during the period when net investment was climbing back to 7.8 per cent of GDP).

17. Since their study was undertaken before the 1992 NIPA revisions, they use data on gross national product rather than gross domestic product.

18. The estimates here ignore the theoretical reasons to ignore the estimated responses of $\text{gfed}$ and $\text{ex}$ described above, describing instead the straightforward implications of the point estimates.

19. The point estimates are fairly large, however, reflecting the historical pattern of deficits and spending, that is, the fact that both spending and deficits increased for a large part of this time period.

REFERENCES


Effects of fiscal deficit on the composition of US GDP