Appendices to the Income- and Expenditure-Side Estimates of U.S. Output Growth

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Appendix A: More Basic Data Facts

Appendices A, B and C dig into the composition of the estimates and their source data. Although the main sections of the paper focus on real growth rates, these appendices focus on the source data underlying the nominal estimates, because any divergence between the estimates must arise because of measurement errors in the nominal data. Price index measurement cannot be part of the explanation, because GDP(E) and GDP(I) use exactly the same price deflator to convert nominal values into real units.

Tables A.1.1 and A.1.2 examine the composition of GDP(I) and GDP(E), to get a sense of the importance of their different subcomponents. The sample employed here is the same one as in section 4 of the paper, and coincides with the period of maximum divergence between the estimates. The basic identity for the expenditure side will be familiar to most readers—GDP(E) = C + I + G + NX. GDP(I) adds up income flows from production, which is essentially labor income plus capital income plus taxes on production paid to the government. Depreciation is subtracted from the measures of capital income in GDP(I), so it must be added back to arrive at the gross domestic product concept. For more, see Abel and Bernanke (2001).

Table A.1.1 shows that the key components for GDP(I) are, in decreasing order of importance, employee compensation, corporate profits, and proprietors's income. Compensation accounted for most of the nominal value of GDP(I) in from the mid-1980s through 2006, and almost half of its quarterly variance from 1984q3 to 2006q4.[1] Corporate profits represented only 9 percent of the nominal value of GDP(I), but about a quarter of its quarterly variability. Proprietors' income accounted for about 7 percent of nominal value and 8 percent of quarterly variability. The remaining components are less important. Consumption

[1] The variance share of a component is computed as the covariance of its contribution to GDP(I) growth with GDP(I) growth. This covariance captures the covariation between components as well as the variance of the component appropriately weighted by its nominal value, and ensures the variance contributions sum to one. Too see this, note that GDP(I) growth can be written as the sum of the contributions to growth,

of fixed capital (CFC) accounts for a large part of the nominal value of GDP(I) but only 3 percent of its quarterly variability. Taxes on production and imports less subsidies[2] accounts for 8 percent of nominal value, but this paper has little to say about measurement of this category; the same is true of net factor income. Net interest is not a category that can explain the discrepancies between the estimates—see below.

For the composition of GDP(E), table A.1.2 shows nominal shares and the quarterly variance shares computed using contributions to both nominal and real growth. Personal consumption expenditures (PCE) on services comprises the largest share of the nominal value of GDP(E) by far, and this share has been steadily growing over time (see section 4.1). However, PCE services has accounted for a much smaller share of the variance of GDP(E). The fixed investment categories (residential structures, nonresidential structures, and equipment and software) accounted for only 16 percent of the nominal value of GDP(E) but close to 30 percent of its real variability. Changes in private inventories have zero mean, on average, but account about 30 percent of the quarterly variability of GDP(E) over this sample.[3] Exports are strongly procyclical, adding to the variability of GDP(E), but imports are also strongly procyclical, and since they are a subtraction from GDP(E), they reduce

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so: $\Delta GDP(I) = \sum_j C^j_{\Delta GDP(I)}$, where $C^j_{\Delta GDP(I)}$ is the jth component's contribution to growth. Then:

$$\begin{aligned}
\operatorname{var}(\Delta GDP(I)) &= \operatorname{cov}(\Delta GDP(I), \Delta GDP(I)) \\
&= \operatorname{cov}\left(\Delta GDP(I), \sum_j C^j_{\Delta GDP(I)}\right) \\
&= \sum_j \operatorname{cov}\left(\Delta GDP(I), C^j_{\Delta GDP(I)}\right) \\
&= \sum_j \left(\operatorname{var}\left(C^j_{\Delta GDP(I)}\right) + \sum_{k \neq j} \operatorname{cov}\left(C^j_{\Delta GDP(I)}, C^k_{\Delta GDP(I)}\right)\right).
\end{aligned}$$

[2] I've added business transfer payments to this category as well.

[3] This variance share does drop sharply if we switch to year-over-year or annual growth rates, suggesting much of this variation is high-frequency noise that vanishes in aggregation.

its variance. Government comprises a fifth of the nominal value of GDP(E), it contributes less to its variability.

Aside from its lack of variability, government expenditures can be downplayed for our purposes because the majority of those expenditures are employee compensation and consumption of fixed capital. These components match exactly the government portion of the CFC and compensation on the income side, so they obviously cannot explain any discrepancies between GDP(E) and GDP(I). Other components of the accounts that match exactly across the income and expenditure sides include the housing services, financial services furnished without payment, and insurance services components of PCE. The PCE estimates for housing services are spread across consumption of fixed capital, net interest, rental income of persons, and taxes on production and imports, among other components of GDP(I) - see BEA table 7.4.5. Much of financial and insurance services appears in net interest, which is a component which mostly nets out exactly with GDP(E).

Summing the various components that are identically equal on the income and expenditure sides of the accounts shows they account for about 26 percent of the nominal value of GDP(E) or GDP(I) in 2008. Appendices B and C hunt for the discrepancies between the two estimates in the remaining 74 percent of the nominal value of the accounts.

Appendix B: Source Data Used to Construct the Initial Estimates

While a thorough review of the source data used to compute the initial "third" estimates is beyond the scope of this paper,[4] a brief summary highlighting some key issues may be useful. Starting first with GDP(I), the BEA estimates the growth rate of wage and salary accruals, which account for more than 80 percent of employee compensation, using data from the Current Employment Statistics (CES) establishment survey produced by the Bureau of Labor Statistics (BLS). The CES is a survey of businesses drawn from the universe of firms participating in the unemployment insurance (UI) system, which covers 98 percent of employees in the U.S. Compared to other business surveys, this sample of firms is relatively large. The survey is voluntary, although BLS requests that all firms of a certain size (over 250 employees) participate in the survey each month; smaller firms are selected into the sample randomly, with the size strata reweighted to reflect the assumed distribution of firm sizes in the population. Firm response rates are usually around 90 percent, but they did dip down to around 80 percent from 1999-2003.[5] To the extent that the unobserved characteristics of non-responders differ from the those of responders, non-response can impart bias to the estimates, particularly problematic if these unobserved characteristics vary over the business cycle. Also, as with any random sample, sampling errors add some noise to the CES estimates.

Until a few months ago, the CES reported data on total employment, and the average weekly hours and hourly earnings of a subset of the workforce—production or nonsupervisory workers. So the initial estimates missed variation arising from payments to managers or from irregular payments such as bonuses, a potentially serious issue given rising income inequality. The BLS recently addresssed some of these problems in rolling out new CES

[4]Much of this information is contained in "Updated Summary of NIPA Methodologies", *Survey of Current Business*, November 2008, as well as the NIPA Handbook, 2008-2009.

[5]http://www.bls.gov/web/cesregrec.htm

estimates of the compensation of all employees, which the BEA began using immediately; unfortunately these estimates still do not include irregular payments. Another perennial and much-discussed issue with the CES is the procedure for updating the sample of establishments participating in the survey. Firm births and deaths are incorporated into the sample with a lag, and while the BLS has an explicit statistical birth-death model that tries to correct for this, the adjustments are imperfect, and there are occasionally notable revisions to the employment counts when they are benchmarked to the comprehensive census counts from UI records, called the Quarterly Census of Employment and Wages (QCEW).

The BEA's initial estimates of corporate profits are based on firms' earnings releases, reports from regulatory agencies, and data from the Census Bureau's Quarterly Financial Reports.[6] The BEA must make numerous adjustments to these initial estimates. For example, the concept of output the BEA attempts to measure is the value of current production, and does not include capital gains or losses on assets acquired in previous periods. Firms' earning releases include such gains and losses in profits, and the BEA does not always have all the information they need to strip out these gains and losses. Furthermore, firms have considerable latitude in their financial reporting on their public earnings releases, which can introduce measurement error. For whatever reason, when the BEA profits data are revised to match data from official tax records from the IRS, the revisions can be quite sizable.

The BEA estimates of proprietors' income are ultimately based on IRS tax data as well, but BEA extrapolates the growth rates of the initial estimates using various indicator variables. The indicators vary by industry; but many appear to be based on the CES employment and earnings data. Of the remaining components of GDP(I), a fair amount are extrapolated using what the BEA calls "judgmental trends", typically averages of recent growth rates. These components are of less interest to us here. As discussed above, most

[6] See the BEA's Methodology Paper "Corporate Profits", September 2002.

of net interest and the rental income of persons falls within the 26 percent of GDP(I) that nets out exactly with GDP(E), as does a sizable chunk of consumption of fixed capital, which also accounts for little of the variability of GDP(I).

The initial growth rates of several important components of GDP(E) are constructed using monthly surveys from the Census Bureau, often surveys of businesses with paid employees. Estimates of PCE for durable and nondurable goods are based on Census's Monthly Surveys of Retail Trade (MRTS),[7] as are estimates of food service sales and retail inventories. Wholesale inventories and manufacturers' inventories are based on the Monthly Wholesale Trade Survey (MWTS) and the monthly M3 survey of manufacturers' orders, shipments, and inventories, which also provides shipments estimates used to compute most of equipment and software.[8] Samples are drawn from Census Bureau's universe count of businesses with paid employees, updated with the Economic Censuses every five years and in between with tax records. Firms are organized by their Employer Identification Number (EIN), and sole proprietors are not included in the surveys, a potential source of bias. Like the CES survey, these surveys ask firms above a certain size to participate each month, and smaller firms are sampled randomly with voluntary participation. The response rate in the MRTS covers about 77 percent of sales and 71 percent of inventories;[9] the November 2009 MWTS reported a response rate of 75 percent. The M3 does not describe itself as a probability sample. The November 2009 M3 report describes the survey as a panel of several thousand manufacturing firms with sales of $500 million or more, and notes that smaller companies are underrepresented, again a potential source of bias.

[7]The major exceptions are for auto sales, where data on unit counts are derived from trade source data that are census counts, and for sales of gasoline and oil, which are estimated from the Energy Information Administration.

[8]Software is the major exception; the third estimates of software currently are based, in part, on data from Census' Quarterly Services Survey (QSS).

[9]http://www.census.gov/retail/mrts/how_surveys_are_collected.html.

Note that while firm births and deaths receive much more attention in the CES employment data, they are just as much an issue for these Census surveys employed in the initial estimates of GDP(E).[10] New firms are added to the surveys of retail trade with a lag of about nine months, too late to be included in the initial quarterly estimates. Firm deaths are an issue as well. When a firm currently in a survey does not report for a given month, Census may not be able to distinguish between firms that are still in business but not reporting, where imputing an average growth rate would be appropriate, and firms that are no longer in business, where imputing a growth rate of minus 100 percent would be appropriate. Some misclassifications are inevitable, and both firm births and deaths are likely to be systematically related to the business cycle.

The initial estimates for residential and nonresidential construction are contructed somewhat differently; the sampling units are not firms. The new residential contruction estimates are based on a random sampling from a universe of 20,000 permit-issuing places in the U.S., which are geographic designations covering about 98 percent of new residential construction.[11] The variance of the sampling errors for housing units started and completed are very large, but Census spreads the spending over 12 months by "applying fixed patterns of monthly construction progress", which tends to smooth out the dollar estimates and reduce sampling variability.[12] Note that the timing here does not necessarily match that on the income side: if a builder starts a new home and books the income at that

[10]Firm births and deaths may receive more attention in the CES survey because the BLS has an explicit birth-death model, facilitated by the availability of quarterly benchmarks from the QCEW. The surveys employed by GDP(E) do not have quarterly or even annual universe counts to which they benchmark, hampering explicit birth-death modelling. This suggests that the CES may do a better job than the Census surveys in making birth-death corrections, but this is a speculative point.

[11]In contast to the surveys of businesses described above, which include all the sales, shipments, or inventories of the large firms included in the sample with certainty, these estimates will include only a fraction of the sales of any large firm. However, many permit-issuing places are included in the sample with certainty, to ensure broad coverage.

[12]http://www.census.gov/const/C30/methodology.pdf

point, it shows up in profits or some other component of GDP(I) immediately, instead of being spread out over several quarters as in GDP(E). The value of improvements to existing residential structures are estimated using a regression model based on single-family construction expenditures, among other things; BEA calls this a "judgemental trend". The nonresidential construction estimates are based on surveys of construction projections above a certain value from the list of projects compiled by F.W. Dodge of the McGraw-Hill Information Systems company. This list is not comprehensive, with Census Bureau comparison studies putting its coverage rate at about 75 percent.[13] The non-response rates to these construction surveys can be considerable; for example, in 2008, only about 67 percent of the value of construction put in place was based on directly-measured data.[14] As noted earlier, such non-response and undercoverage can produce biases if these unrepresented projects differ in systematic ways from the projects represented in the sample.

Net exports of goods and services are compiled from U.S. Customs and Border Protection data, while net exports of services are based on surveys conducted by the BEA. This paper will have little to say about the quality of these numbers, but transfer pricing is an important issue, and systematic biases in the trade numbers are certainly a possibility. As noted above, the GDP(E) estimates for government are of comparatively little concern in this paper.

Regarding services PCE, the BEA lacks reliable source data for much of this category at the quarterly frequency, and as such, they must resort to a variety of methods in computing their initial current quarterly estimates. We can break down the third current quarterly estimates of services PCE as follows. About 7 percent is food services, which is based on the MRTS surveys like most of goods PCE. About 31 percent is the categories where the

[13] The list tends to miss things like natural gas pipelines and wind farms, but not office buildings or retail projects.

[14] http://www.census.gov/const/C30/reliability.pdf

BEA ensures consistency between the income and product side. About 17 percent is now based on the Quarterly Services Survey (QSS), but growth rates based on the QSS did not exist until the last few years, so the initial quarterly estimates from prior years (i.e. most of the sample examined here) must have been based on some combination of the next three types of estimates. Currently, about 22 percent of services PCE is based on "judgmental trends", which surely miss a substantial portion of the variation in true services PCE. About 14 percent is extrapolated using the CES estimates of total employment and the earnings of nonsupervisory workers. This may be a reasonable approximation for some parts of PCE services, but for others such as the "portfolio management" component of financial services, sales are likely to be much more variable than the CES estimates. This is because the bonuses and payments to management missed by the CES are likely more variable than employment or hourly wages, and because the part of sales that shows up as corporate profits is likely much more variable than compensation, as shown in the aggregate in table 2. Finally, about 9 percent is based on a variety of trade-source and administrative data, which is generally not gathered through standard statistical sampling techniques, so these data may have biases. Given that much of this source data may miss true variation in services PCE, it is not surprising that Dynan and Elmendorf (2001) find that, among the major categories of GDP, the initial estimates of services are particularly prone to missing accelerations and decelerations.

Thus, all the components of initial estimates of GDP(I) and GDP(E) growth face measurement challenges to one degree or another, and sorting through the merits of each and aggregating is a difficult challenge. Sampling errors are an issue, it is not clear whether they add more noise to the initial growth rates of GDP(I) or GDP(E). One factor favoring GDP(E) is that more of initial GDP(I) growth appears based on trends.[15] But much of this trending in GDP(I) occurs within CFC, the least variable major component

[15]See Grimm and Weadock (2006) and Holdren and Grimm (2008).

of GDP(I), so a judgmental trend may not miss much variation. There is little reason to suspect the smoothness in the latest estimates of private CFC is spurious, because it is ultimately based on reasonably-reliable tax data, and because CFC is a function of an inherently slow-moving stock of capital. Much of the trending in GDP(E) occurs within services PCE, which is also quite smooth. But in contrast to CFC, and as discussed below, there is good reason to suspect that some of the smoothness in services PCE is spurious, because the BEA has not had access to particularly good data on services PCE even after their annual revisions. Based on *a priori* considerations, I would expect some categories of services PCE, such as medical care, to face demand that is less elastic than nondurable goods, but other categories, perhaps parts of travel or recreation services, might face more elastic demand; overall, it is not obvious that services PCE should be much less variable than nondurable goods PCE. The lack of data coverage for much of services PCE is one factor suggesting the initial GDP(I) growth estimates may have been more accurate over most of recent history.

Appendix C: Source Data Incorporated at Revisions, to Construct the Latest Estimates

Annual revisions

The initial estimates for any given year t are revised in three annual revisions, typically in the summers of years $t + 1$, $t + 2$ and $t + 3$. But since 2002, the BEA incorporates information from the Quarterly Census of Employment and Wages (QCEW) into wages and salaries for each quarter before those annual revisions, typically two months after the release of that quarter's third estimate. The BEA does make some adjustments for misreporting and for payments to private employees not covered by the unemployment insurance (UI) system. But these adjustments total only a few percent of the overall wage and salary estimate, between 1.6 and 1.9 percent of GDP(I) from 1993 to 2008 (see NIPA table 7.18), so the QCEW estimates are very close to a full universe count.[16] That a quarterly universe count can be incorporated so quickly is remarkable and important, not least because wages and salaries account for such a large share of both the nominal value and variability of GDP(I). Table A.1.1 shows that private wages and salaries represented 38 percent of nominal GDP(I) from 1984 to 2006, roughly half of the 74 percent of GDP(I) that does not cancel out with the expenditure side, as well as 40 percent of the variability of quarterly GDP(I) growth.

According to these metrics, the availability of the QCEW data is a huge advantage for the income side compared to the expenditure-side, where the data suffer from sampling errors and various non-sampling errors because universe counts are unavailable. The one main exception on the expenditure side is the universe counts of auto sales, but this is a substantially less-important part of output by any metric. However, the early incorporation of the QCEW data has caused a few glitches in the accounts. The QCEW data include

[16]For more on the misreporting adjustments, see the proprietors' income paragraph below.

gains from exercising nonqualified stock options, and when these gains appear as wage and salary income, proper accounting dictates they should be expensed by firms and subtracted from corporate profits. The quarterly financial reports used by the BEA to compute the initial estimates of profits do not necessarily have this information, potentially introducing some distortions into the estimates. This issue is discussed forthrightly in Moylan (2008).[17] However, firms do expense the option gains in the IRS tax data the BEA incorporates into profits at annual revisions. The IRS tax data are not the same data as the QCEW data used to compute wages and salaries, but the BEA's position is that the definition of wages and salaries is very similar across the two data sources, so this problem largely disappears at the annual frequency once the tax data are incorporated into the estimates. Since the tax data are not available quarterly, some distortions may remain in the distribution of the annual data across quarters.

The IRS tax data used to compute profits are incorporated in the second and third annual revisions. These are annual data, so they are not helpful for interpolating quarterly growth patterns, but the annual frequency is generally high enough to pick up broad business cycle patterns. The IRS obviously has access to the entire universe of tax filings, but the data employed by the BEA are from the IRS's Statistics of Income (SOI), which are samples drawn from the universe of tax filings. However, the coefficients of variation around the top-line estimates of corporate net income are tiny, numbers like 0.36 of one percent for 2006 and 0.13 of one percent for 2005.[18] Given the variability of corporate profits, these sampling errors are negligible, and obviously are not part of the explanation for the cyclicality of the statistical discrepancy.

One example of measurement error potentially related to the business cycle was high-

[17]Moylan (2008) notes that, in a perfect world, options should be expensed when they are granted, not when they are exercised.

[18]http://www.irs.gov/taxstats/article/0,,id=170543,00.html

lighted by the BEA at the end of 2007: the difficulty of removing bad debt expenses and asset write-downs, which are capital losses not to be included in the BEA's concept of output, from their initial estimates of profits at financial services companies. However, the IRS tax forms include specific lines for bad debt expenses and capital gains and losses, which should make these subtractions easy, and it is not clear whether corporations could, or why they would, misreport capital gains and losses as other types of income.

Widespread underreporting of income on the IRS tax forms is another problem, but the BEA has detailed data on tax settlements recommended by IRS auditors that it uses to adjust for misreporting. Those adjustments are large, ranging between 1.0 and 2.2 percent of GDP from 1984 to 2006 (see BEA table 7.16), but the BEA does base these corrections on some hard data available at the annual frequency.

The BEA also uses the IRS tax data to estimate proprietors' income.[19] The adjustments for misreporting are again large, ranging between 2.6 and 4.0 percent of GDP(I) from 1984 to 2007 (see BEA table 7.14).[20] Unfortunately, the BEA has fairly limited source data upon which it bases these corrections, certainly not enough to accurately identify the cyclicality of the unreported income.[21] The growth rates of the current corrections are uncorrelated with $\Delta GDP(I)$ from 1985 to 2007, so the BEA is essentially assuming that the unreported

[19] The BEA also uses tax data to estimate most of private CFC, making adjustments for conceptual differences. Note that the depreciation expenses used as the starting point for computing CFC are subtracted from corporate profits and proprietors' income on tax returns. Since it is the sum of CFC, corporate profits, and proprietors' income that matters for computing GDP(I), mismeasurement of CFC should not affect GDP(I), because it nets out of this sum.

[20] The sum of the misreporting adjustments to wages and salaries, corporate profits, and proprietors' income range from 4.5 to 6.5 percent of GDP(I) from 1984 to 2006.

[21] The BEA actually makes two adjustments, one for underreporting of income based on audits of individual tax returns, and one for nonreporting of income based on exact-match studies (see Krakower, 2007 and Seskin and Smith, 2009). For a set of individuals who responded to the CPS household survey, the exact-match studies compare their individual tax returns with the income they reported to the CPS. Exact-match studies were conducted in 1977, 1990, 1996, 1999, and 2003-2007. The last 5 surveys actually provide a short panel which might shed some light on cyclicality. However, the estimates suggest that nonreported income is much smaller than underreported income, perhaps around 10 percent. For underreported income, the two most recent IRS studies are 1988 and 2001.

income has no cyclical component. If this unreported income is actually counter-cyclical, then GDP(I) would be too cyclical - i.e. more cyclical than true output. Note that this unreported income is where much of the income earned in the underground economy should appear.[22] This underground income might be counter-cyclical if individuals move to less formal means of generating income when they lose jobs in the formal sector during bad economic times. On the other hand, economic activity in the underground economy may benefit from good economic times in the rest of the economy. Over the relevant sample period, proprietors' income as a whole is more pro-cyclical than GDP(I); a regression using annual growth rates from 1985 to 2007 of proprietors' income on GDP(I) yields a coefficient of about 1.65 (with a standard error of about 0.47, and an adjusted R^2 of 0.34).[23] So if unreported income is similar to other types of proprietors' income, that would suggest procyclicality, in which case GDP(I) would not be cyclical enough.

Misreporting of capital gains as ordinary income is another potential explanation for the pro-cyclicality of the statistical discrepancy. For example, many people made lots of money flipping houses at the peak of the housing bubble in the mid-2000s and then lost a lot of money later in the decade. Most of this income should properly be classified as capital gains, and would be stripped out of the tax data used in proprietors' income and GDP(I) if reported as such. But gains misreported by individuals as ordinary income would likely show up in proprietors' income. Long-term capital gains on houses held more than a year are generally subject to a lower tax rate than ordinary income, so individuals would have no tax incentive to misreport these types of gains, but I know of no study of this issue, so I

[22]We should distinguish between underground activity that should appear in the BEA's definition of output and income that should not. Legal market transactions that are not reported to the IRS should appear in the BEA's definition of output. Illegal transactions should not, and non-market transactions such as the value of home production should not.

[23]We stop in 2007 because that is the last year where tax data is available. Using a longer 1930 to 2007 sample yields a somewhat smaller coefficient of 1.36, but a tighter standard error of 0.11, allowing us to reject the hypothesis that proprietors' income is not more procyclical than GDP(I). The adjusted R^2 is 0.68. A similar result obtains when we use GDP(E) as the explanatory variable.

cannot rule out the hypothesis that capital gains from house flipping are currently biasing up proprietors' income in the mid-2000s.[24] However, this is a speculative point, and overall, the evidence that GDP(I) is likely to be too cyclical seems a bit thin.

Moving to the expenditure side of the accounts, most of the monthly surveys of businesses discussed in the previous section revise to incorporate more-comprehensive surveys at the annual frequency. For example, the Monthly Surveys of Retail Trade (MRTS) revise to incorporate information from the Annual Surveys of Retail Trade (ARTS), which the BEA then uses to construct revised PCE and inventory estimates at annual revisions. The ARTS employs a noncertainty sample about twice as large as the MRTS. Businesses are legally required to respond to the ARTS, and although not all do so, the response rate is about 94 percent, much higher than the 77 percent response rate to the MRTS. In addition, the ARTS incorporates information from tax records on firm births and deaths into the sampling frame and estimation. Overall, these improvements would seem to substantially reduce the scope for biases in the estimates. Data from the ARTS remain subject to sampling variability, but the variance from sampling errors is quite small, and as discussed earlier, sampling errors obviously do not explain the cyclical measurement errors that are our primary interest. The universe from which the sample is drawn remains restricted to establishments with paid employees, and to correct this problem, Census receives data on sales of nonemployer businesses from IRS tax records, and adds these sales to its estimates. These data are essentially the same data the BEA uses to estimate proprietors' income in GDP(I), so the prior discussion of underreporting is applicable to these estimates. The tax data do not provide information on inventories, so Census imputes inventories to nonemployers using the inventory-sales ratio for employers from its sample.

Of the other surveys of businesses, the MWTS revises to incorporate information from

[24] One could make the same argument about day-trading in the 1990s, but that argument holds less water. These capital gains are subject to a quick computer audit, since the traders use brokers who must file tax forms which can be checked against the gains reported by the traders.

the Annual Survey of Merchant Wholesale Trade (AWTS), the M3 incorporates information from the Annual Survey of Manufacturers (ASM), and the QSS (and PCE for services more generally) incorporates information from the Services Annual Survey (SAS). The main characteristics of these annual surveys are similar to the ARTS: the samples are larger than the monthly surveys, response rates are higher, and the samples are updated to incorporate firm births and deaths. In each case, however, certain firms remain out of the scope of the sampling universe. The May 2008 M3 revision reports: "Nonemployers are defined as out of scope of the ASM," while the 2007 SAS reports: "To be eligible for selection, a birth ... must meet certain criteria regarding its number of paid employees or quarterly payroll." Sole proprietors' and some small businesses are out of the scope of these annual surveys, but the SAS makes corrections similar to the ARTS, adding to their estimates the revenues of nonemployer businesses which they obtain from IRS tax records. Some small businesses with employees may be missed by the SAS, however.

The annual revisions to the residential and nonresidential structures components of GDP(E) do not incorporate information from any new, improved surveys. The construction put in place surveys are based on the same relatively small and noisy samples as the initial estimates; the only information incorporated at annual revisions is from any additional responses to the surveys that have continued to trickle in. The response rate increases from 67 percent to 79 percent, but the non-response rate remains quite high compared to other surveys like the ARTS, leaving greater scope for biases. This is particularly true for nonresidential structures, where the 75 percent project coverage rate of the universe combined with a response rate of about 79 percent yields coverage of below 60 percent. Unfortunately, the extent of any biases and their effect on the cyclicality of GDP(E) is unclear. The mismatched timing across the income and expenditure sides remains an issue in the fully revised data, with construction spending spread out over several quarters in GDP(E), and income from construction probably not as spread out in GDP(I).

Perhaps the most poorly estimated component of structures is improvements to residential structures. The Census Bureau estimates are ultimately based on data from the Consumer Expenditure Survey, a relatively small survey of a few thousand households.[25] These data are likely to be quite noisy, given the small sample size and the fact that large home improvement projects tend to be infrequent and lumpy. Perhaps for this reason, the BEA takes a "weighted 3-year moving average" of the Census Bureau data. While such averaging is sensible from the standpoint of minimizing the variance from sampling errors, it has the negative side effect of cutting down the true cyclical variation in the underlying data, especially around business cycle turning points such as the most recent one - see section 5. Such smoothing will tend to make GDP(E) less cyclical than it should be.

Finally, as noted earlier, the annual revisions incorporate the Service Annual Survey (SAS) data into the BEA's estimates of services PCE. However, the coverage of the SAS is incomplete, even at the annual frequency. About 36 percent of the nominal value of 2008 services PCE was based on the SAS after the data was incorporated, more than half of the 62 percent of the nominal value that neither nets out with the income side nor is estimated with ARTS data (i.e. food services). This coverage rate improved considerably with the 2009 benchmark revision, which expanded the use of the SAS to hospitals and telecommunication services, and the SAS for those categories extends back to 2003 only. Excluding these categories, the SAS covers only 24 percent of the nominal value of services PCE. As of the third annual revision, about 4 percent is currently based on judgmental trends or employee compensation (down from about 12 percent as of the first annual revision), and about 7 percent is based on estimates from the annual surveys of government finances (which are only fully available as of the third annual revision, and require adjustments from fiscal years to calendar years).

[25] The BEA uses this Census Bureau data for improvements to owner-occupied housing. For rental units, the BEA used to employ a survey of landlords that is now discontinued.

The remaining roughly 26 percent of services PCE has been largely based on administrative data and trade source data, which can suffer from numerous drawbacks. Indeed, the recent shift of the estimates of hospital services to SAS data from trade source data from the American Hospital Association (AHA), was motivated by the following: "... the AHA data are fiscal year data which must be converted to a calendar year basis. In addition, the receipts of taxable hospitals used for the PCE estimates must be derived by converting AHA expenses data using fixed ratios, while the SAS directly provides receipts data for taxable hospitals."[26] So the trade source data likely missed some variation in outlays to hospitals that resulted in profits, which may have been more variable than expenses. For telecommunications providers, BEA used FCC data prior to the SAS, but "... the SAS data capture broadband telephone services, which the FCC data on regulated carriers do not."[27] More generally, since the trade source and administrative data are not necessarily gathered for the purpose of producing consistent estimates of the quantities of interest, for the most part, they likely do not do things like reweighting to correct for lack of coverage of sole proprietors or small firms. For example, the SAS corrections using IRS tax data to capture the revenues of some nonemployer businesses are the type of thing that is surely not done in trade source data and some administrative data. As pointed out earlier, proprietors' income was more cyclical than output from 1985 to 2008, so not including the sales of these businesses in the annual growth rates of GDP(E) should tend to make GDP(E) less cyclical than "true" output. These and other biases could result in excessive smoothness for services PCE and GDP(E).

One industry where use of the trade source and administrative data likely has been particularly problematic is financial services.[28] For securities commissions, the BEA must

[26] McCully and Payson, 2009, p.10

[27] McCully and Payson, 2009, p.10

[28] Beaulieau and Bartelsman (2004) attempt to allocate the statistical discrepancy across industries, and

make assumptions about the share of trading done by individuals, which may have varied considerably over the past couple of decades with the rise of day trading in the 1990s and subsequent stock market collapse. Moreover, the BEA estimates rely heavily on administrative data from the Securities and Exchange Commission (SEC), which likely has serious coverage problems. Many banks were using off-balance sheet entities (i.e. SIVs) to deal in structured credit products, which may not have been covered by the SEC data. Many financial companies, particularly hedge funds and private equity firms, appear to have avoided registering with the SEC, at least until recently, which may have biased down the estimates of commissions.[29]

Most of the fees and charges of these types of firms would likely fall under the BEA's "portfolio management and investment advice services" line, instead of securities commissions. The BEA uses SAS data here, whose sample of firms may include some hedge funds and private equity firms, but it seems doubtful that these estimates captured the boom in financial services over the past couple of decades. The SAS data extend back to 1998 only, and so would have missed the boom in financial services through most of the 1990s. Moreover, the magnitudes reported by the BEA seem too small. Trade sources estimate that, globally, hedge fund assets were reported to have reached around $2 trillion before the financial collapse, and the typical "2 and 20" fee structure would imply $40 billion in base fees and an additional $40 billion in return fees assuming a 10 percent return. The total PCE for "portfolio management and investment advice services" reported by the BEA in 2006 was $90 billion; adding in mutual funds (who manage more than five times the assets of hedge funds) and the investment advisory services of commercial banks and

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their methodology places much of the discrepancy in financial services.

[29]In particular, it has been widely reported in the media that hedge funds and private equity firms have used exemptions 3(c)(1) and 3(c)(7) to the Investment Company Act of 1940 to avoid SEC registrations. In early 2009, senators Grassley and Levin introduced a bill that would require firms that use these exemptions to register with the SEC.

other financial services companies, and it seems the number should be much higher. The majority of these fees were probably charged to wealthy individual investors and non-profit institutions serving households (NPISHs) such as colleges and universities, so they should count as services PCE. The BEA has limited data on other components of financial service charges and fees as well; for credit card fees, the BEA constructs annual estimates using bank card dollar-volume data from a trade source, essentially assuming the ratio of credit card fees to dollar-volume usage is constant. Any variation in credit card fees charged by banks is missed.

Overall, there seems ample reason to believe that GDP(E) missed much of the boom and bust cycles in financial services over the past couple of decades, while GDP(I), which relies on IRS tax data, probably picked up much more of this activity. More systemic measurement problems also suggest GDP(E) has missed some business cycle variation, and is likely not cyclical enough.

Benchmark revisions

Every five years GDP(E) is benchmarked to data from the quinquenial Economic Censuses that are close to comprehensive, and the BEA's internally consistent input-output tables. Not all the categories employ data from the Censuses; residential investment does not, and a very small portion (less than 10 percent) of PCE services does not. Of course, no data source is fully comprehensive, and the Censuses probably face underreporting issues similar to those faced by the comprehensive data used in GDP(I). Nevertheless, the GDP(E) estimates are undoubtedly of much higher quality in the years where they are benchmarked to the Economic Censuses. The availability of the Censuses is part of the reason the BEA has taken an official position that "... the source data for the expenditure components are considered more reliable than those for the income components ..." (Concepts and Methods of the U.S. National Income and Product Accounts, July 2008, p

2-10).

Unfortunately, those benchmarks do not provide much aid for business cycle analysis, the focus of this report. They provide no information about the past 7 to 12 years, depending on the timing of the last benchmark; for example, the last year to which GDP(E) is currently benchmarked is 2002, and that benchmark was implemented in the summer of 2009. Nor are the benchmarks particularly informative about earlier business cycles. The level of true output may be more accurately measured by GDP(E) in 2002, as may the average growth rate between 1997 (the last prior benchmark) and 2002, but the benchmarks provide no information about how to distribute the growth between those years. How fast was output growing in the late 1990s? How deep was the 2001 recession, and when did it start and end? Answers to these questions require higher-frequency growth rates, at least annual and preferably quarterly, and it is hard to see how the BEA's arguments for the superiority of GDP(E) apply to these growth rates. Instead, we must look at the quality of the annual and quarterly data the BEA uses to interpolate growth rates between benchmark years, and compare that to the quality of the annual and quarterly data used to compute GDP(I).

Appendix D: Further Regression Results

Table A.2.1 shows the same set of regression results as table 2, using "advance" vintage estimates instead of "third" vintage, while table A.3 reports some additional results on revisions. As discussed in section 3, unofficial "advance" $\Delta GDP(I)$ estimates are constructed using the components of GDP(I) that are available with the "advance" release, and forecasts of the missing corporate profits and net factor income components. See Nalewaik (2007b) for details on how these are constructed; no information from the companies that have reported their quarterly profits numbers at the time of the "advance" release is employed here; using such information may produce a much-improved "advance" $\Delta GDP(I)$ estimate. Table A.2.1 shows that "advance" $\Delta GDP(E)$ better predicts most of the business cycle variables examined in the paper, although the constructed "advance" $\Delta GDP(I)$ estimates retain some predictive power, above and beyond that contained in "advance" $\Delta GDP(E)$, for output growth next period and the contemporanous changes in the labor market variables. But "advance" $\Delta GDP(E)$ largely dominates; most importantly, the best forecast of latest $\Delta GDP(I)$ places about two-thirds weight on "advance" $\Delta GDP(E)$ and only about one-third weight on the constructed "advance" $\Delta GDP(I)$ estimate. Table A.3 shows that this result holds over the more recent 1994Q1 to 2006Q4 sample as well, although over this shorter sample, the best forecast of latest $\Delta GDP(E)$ does places about one third weight on the constructed "advance" $\Delta GDP(I)$ estimate.

Table A.2.2 shows the a similar set of regressions as table 2, using "second" vintage estimates instead of "third" vintage, with table A.3 reporting additional results on revisions. The samples employed here are restricted by the availability of the "second" $\Delta GDP(I)$ estimates.[30] Table A.3 shows that, from 1994Q1 to 2006Q4, a quite sizable weight of about

[30] For the regressions using the contemporaneous values of output growth, only 1st, 2nd, and 3rd quarters are in the sample. For regressions using output growth estimates lagged one quarter, only 2nd, 3rd, and 4th quarters are in the sample. For regressions using the output growth estimates lagged two quarters, only 3rd, 4th, and 1st quarters are in the sample.

0.6 should be placed on "second" $\Delta GDP(I)$ when predicting latest $\Delta GDP(E)$, although the standard errors here are large. The results in table A.2.2 are quite similar to those reported in table 2.

Table A.2.3 repeats the results in table 2 using the "third" estimates, but as a robustness check, we used past issues of the Survey of Current Business to extend the sample back to 1966Q4.[31] Some of the initial estimates from the earlier period appear a bit odd, certainly not behaving like efficient initial estimates. For example, the "third" estimates of $\Delta GDP(E)$ and $\Delta GDP(I)$ in 1974Q4 and 1975Q1 were both around minus 10 percent at an annual rate, and these were subsequently revised to show declines of half that size. So these results should also be taken with a grain of salt, but as noted in the main paper, the revision results are certainly of note. In predicting latest $\Delta GDP(E)$ in the second specification, it is optimal over this 43 year sample to place more weight on current and lagged values of "third" $\Delta GDP(I)$ than on current and lagged values of "third" $\Delta GDP(E)$. The remainder of the results are broadly similar to those reported in table 2.

Table A.2.4 reports results using estimates that have passed through one annual revision. Again, these are very similar to the results using the "third" estimates, with the revisions evidence providing a notable exception. Over the full 1978Q3 to 2008Q4 sample, there is statistically significant evidence that the first annual revision estimates of $\Delta GDP(E)$ revise towards the first annual revision estimates of $\Delta GDP(I)$, so an optimal forecast of latest $\Delta GDP(E)$ would place some weight on $\Delta GDP(I)$ after the estimates have passed through one annual revision. Indeed, the second specification shows that, in predicting latest $\Delta GDP(E)$, it is optimal to place as much weight on current and lagged values of $\Delta GDP(I)$ as on current and lagged values of $\Delta GDP(E)$.

Table A.4 repeats the results in table 4 using annual growth rates of the output variables, and annual average levels and growth rates of all the explanatory variables (here we drop

[31]The information required to convert GNP to GDP was not always available farther back.

the specification using the non-manufacturing ISM, because the sample is too short, and the specification using NBER recession dates). As noted in the text, the annual growth rate of the stock market is contemporaneously more highly correlated with annual $\Delta GDP(E)$ than annual $\Delta GDP(I)$, but the growth rate of the stock market the previous year is much more highly correlated with annual $\Delta GDP(I)$. The remainder of the variables are all more correlated with annual $\Delta GDP(I)$, and the regression coefficients are all larger in absolute value using $\Delta GDP(I)$, with F-tests rejecting the equality of these coefficients.

Table A.1.1: Composition of GDP(I)

GDP(I) Components	Nominal Share 1984-2006	Nominal Variance Share quarterly % changes, 1984Q3-2006Q4
Employee Compensation	57%	42%
Corporate Profits	9%	25%
Proprietors' Income	7%	8%
Net Interest	6%	9%
Rental Income of Persons	2%	1%
Consumption of Fixed Capital	12%	3%
Taxes on Production and Imports, plus misc	8%	4%
Net Factor Income	-1%	7%
memo: Wages and Salaries, excluding government	38%	40%

Table A.1.2: Composition of GDP(E)

GDP(E) Components	Nominal Share	Nominal Variance Share	Real Variance Share
	1984-2006	quarterly % changes, 1984Q3-2006Q4	
PCE, durable goods	9%	8%	13%
PCE, nondurable goods	16%	13%	9%
PCE, services	42%	12%	11%
Nonresidential stuctures	3%	7%	6%
Equipment and Software	8%	11%	14%
Residential Structures	5%	7%	10%
Change in Private Inventories	0%	30%	29%
Exports	10%	18%	14%
Imports	-12%	-13%	-15%
Government	19%	6%	8%

Table A.2.1: Predictive Content of Initial Growth Rates, 1978Q3-2009Q3

	Explanatory Variables							
	$\Delta GDP(E)$, initial (advance)			$\Delta GDP(I)$, initial (advance)			Constant	Adj. R^2
Dependent Variable	t	$t-1$	$t-2$	t	$t-1$	$t-2$		
$(GDP(E)_t/GDP(E)_{t-1})^4$,	**0.86**			**0.11**			**0.34**	0.71
latest	(0.11)			(0.10)			(0.21)	
	0.86	**-0.06**		**0.07**	**0.16**		**0.20**	0.71
	(0.11)	(0.10)		(0.10)	(0.09)		(0.21)	
		0.20			**0.31**		**1.42**	0.18
		(0.14)			(0.12)		(0.37)	
$(GDP(E)_t/GDP(E)_{t-1})^4$,		**0.23**			**0.23**		**1.40**	0.17
initial (3rd)		(0.12)			(0.12)		(0.35)	
			0.10			**0.13**	**1.98**	0.03
			(0.17)			(0.22)	(0.42)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,	**0.60**			**0.36**			**0.30**	0.62
latest	(0.15)			(0.13)			(0.30)	
	0.60	**-0.02**		**0.32**	**0.11**		**0.18**	0.62
	(0.14)	(0.13)		(0.14)	(0.15)		(0.36)	
		0.22			**0.29**		**1.41**	0.16
		(0.14)			(0.16)		(0.51)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,		**0.31**			**0.25**		**1.28**	0.23
initial (3rd)		(0.11)			(0.13)		(0.40)	
			0.18			**0.09**	**2.00**	0.04
			(0.16)			(0.22)	(0.50)	
$(UR_t - UR_{t-1}) * 4$	**-0.22**			**-0.15**			**1.06**	0.56
	(0.06)			(0.06)			(0.22)	
		-0.21			**-0.09**		**0.86**	0.35
		(0.07)			(0.05)		(0.24)	
			-0.21			**-0.01**	**0.66**	0.19
			(0.07)			(0.09)	(0.28)	
$\left(E_t^{household}/E_{t-1}^{household}\right)^4$	**0.27**			**0.23**			**-0.03**	0.49
	(0.09)			(0.09)			(0.31)	
		0.25			**0.15**		**0.17**	0.34
		(0.07)			(0.10)		(0.38)	
			0.17			**0.08**	**0.56**	0.12
			(0.07)			(0.13)	(0.46)	
$ISM_t^{manuf.}$	**1.55**			**0.02**			**47.36**	0.50
	(0.22)			(0.19)			(0.72)	
		1.57			**-0.23**		**47.91**	0.39
		(0.23)			(0.24)		(0.71)	
			0.95			**-0.13**	**49.20**	0.13
			(0.37)			(0.38)	(0.84)	
$log\left(SP500_t - SP500_{t-4}\right)/4$	**0.47**			**0.27**			**-0.00**	0.19
	(0.28)			(0.28)			(1.13)	
$r_{t-8}^{Treas(10yr)} - r_{t-8}^{Treas(2yr)}$	**0.15**			**-0.09**			**0.57**	0.05
	(0.08)			(0.07)			(0.17)	
$\Delta \widehat{GDP(E)}_{t,t}$, SPF forecast	**0.55**			**0.01**			**0.68**	0.56
current quarter	(0.10)			(0.08)			(0.24)	
$\Delta \widehat{GDP(E)}_{t,t-1}$, SPF forecast	**0.22**			**0.05**			**1.65**	0.20
1 quarter ahead	(0.09)			(0.12)			(0.30)	
$\Delta \widehat{GDP(E)}_{t,t-2}$, SPF forecast	**0.09**			**0.07**			**2.20**	0.10
2 quarters ahead	(0.07)			(0.07)			(0.33)	

Table A.2.2: Predictive Content of Initial Growth Rates, 1978Q3-2009Q3

	Explanatory Variables							
	$\Delta GDP(E)$, initial (2nd)			$\Delta GDP(I)$, initial (2nd)			Constant	Adj. R^2
Dependent Variable	t	$t-1$	$t-2$	t	$t-1$	$t-2$		
$(GDP(E)_t/GDP(E)_{t-1})^4$,	**0.85**			**0.05**			**0.31**	0.70
latest	(0.21)			(0.20)			(0.29)	
		-0.51			**0.93**		**1.67**	0.18
		(0.35)			(0.33)		(0.31)	
$(GDP(E)_t/GDP(E)_{t-1})^4$,		**-0.40**			**0.77**		**1.43**	0.15
initial (3rd)		(0.23)			(0.22)		(0.29)	
			-0.66			**0.93**	**1.94**	0.11
			(0.30)			(0.34)	(0.46)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,	**0.03**			**0.84**			**0.42**	0.61
latest	(0.22)			(0.23)			(0.33)	
		-0.38			**0.80**		**1.45**	0.15
		(0.31)			(0.27)		(0.46)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,		**-0.24**			**0.71**		**1.30**	0.20
initial (3rd)		(0.21)			(0.21)		(0.36)	
			-0.88			**1.17**	**1.91**	0.16
			(0.27)			(0.29)	(0.52)	
$(UR_t - UR_{t-1}) * 4$	**0.00**			**-0.35**			**1.03**	0.54
	(0.09)			(0.08)			(0.24)	
		-0.00			**-0.28**		**0.89**	0.35
		(0.11)			(0.10)		(0.25)	
			0.14			**-0.34**	**0.64**	0.18
			(0.14)			(0.15)	(0.28)	
$\left(E_t^{household}/E_{t-1}^{household}\right)^4$	**0.18**			**0.28**			**-0.04**	0.46
	(0.13)			(0.13)			(0.34)	
		-0.03			**0.42**		**0.10**	0.33
		(0.14)			(0.18)		(0.40)	
			-0.15			**0.40**	**0.57**	0.14
			(0.17)			(0.16)	(0.49)	
$ISM_t^{manuf.}$	**0.54**			**0.93**			**47.34**	0.47
	(0.50)			(0.47)			(0.76)	
		0.37			**0.97**		**47.55**	0.36
		(0.52)			(0.49)		(0.82)	
			-0.81			**1.59**	**48.97**	0.14
			(0.65)			(0.66)	(1.02)	
$log\left(SP500_t - SP500_{t-4}\right)/4$	**-0.34**			**1.03**			**0.02**	0.18
	(0.46)			(0.48)			(1.20)	
$r_{t-8}^{Treas(10yr)} - r_{t-8}^{Treas(2yr)}$	**-0.14**			**0.18**			**0.57**	0.02
	(0.07)			(0.10)			(0.17)	
$\Delta \widehat{GDP(E)}_{t,t}$, SPF forecast	**0.07**			**0.46**			**0.71**	0.52
current quarter	(0.22)			(0.23)			(0.31)	
$\Delta \widehat{GDP(E)}_{t,t-1}$, SPF forecast	**0.01**			**0.32**			**1.41**	0.29
1 quarter ahead	(0.15)			(0.19)			(0.32)	
$\Delta \widehat{GDP(E)}_{t,t-2}$, SPF forecast	**0.04**			**0.18**			**1.99**	0.20
2 quarters ahead	(0.10)			(0.15)			(0.34)	

Table A.2.3: Predictive Content of Initial Growth Rates, 1966Q4-2009Q3

	Explanatory Variables							
	$\Delta GDP(E)$, initial (3rd)			$\Delta GDP(I)$, initial (3rd)			Constant	Adj. R^2
Dependent Variable	t	$t-1$	$t-2$	t	$t-1$	$t-2$		
$(GDP(E)_t/GDP(E)_{t-1})^4$,	**0.61**			**0.22**			**0.66**	0.66
latest	(0.15)			(0.12)			(0.28)	
	0.57	**-0.26**		**0.24**	**0.27**		**0.66**	0.66
	(0.14)	(0.15)		(0.12)	(0.17)		(0.28)	
		-0.51			**0.91**		**1.76**	0.19
		(0.24)			(0.27)		(0.35)	
$(GDP(E)_t/GDP(E)_{t-1})^4$,		**-0.36**			**0.84**		**1.35**	0.25
initial (3rd)		(0.24)			(0.26)		(0.31)	
			-0.38			**0.62**	**2.02**	0.06
			(0.30)			(0.30)	(0.38)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,	**-0.05**			**0.89**			**0.55**	0.71
latest	(0.15)			(0.14)			(0.23)	
	-0.06	**-0.01**		**0.88**	**0.05**		**0.50**	0.71
	(0.15)	(0.14)		(0.15)	(0.15)		(0.25)	
		-0.18			**0.63**		**1.64**	0.20
		(0.25)			(0.26)		(0.37)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,		**-0.22**			**0.72**		**1.38**	0.25
initial (3rd)		(0.23)			(0.25)		(0.34)	
			-0.36			**0.64**	**1.99**	0.08
			(0.29)			(0.28)	(0.41)	
$(UR_t - UR_{t-1}) * 4$	**-0.03**			**-0.28**			**1.00**	0.59
	(0.07)			(0.08)			(0.14)	
		0.07			**-0.33**		**0.87**	0.43
		(0.06)			(0.07)		(0.16)	
			0.10			**-0.28**	**0.67**	0.22
			(0.11)			(0.12)	(0.18)	
$\left(E_t^{household}/E_{t-1}^{household}\right)^4$	**0.11**			**0.28**			**0.45**	0.43
	(0.10)			(0.12)			(0.27)	
		0.01			**0.33**		**0.56**	0.35
		(0.11)			(0.13)		(0.28)	
			-0.23			**0.47**	**0.83**	0.18
			(0.14)			(0.15)	(0.30)	
$ISM_t^{manuf.}$	**0.23**			**1.02**			**48.63**	0.43
	(0.33)			(0.37)			(0.95)	
		0.42			**0.80**		**48.71**	0.41
		(0.35)			(0.34)		(0.74)	
			0.12			**0.76**	**49.62**	0.21
			(0.53)			(0.49)	(0.66)	
$log\left(SP500_t - SP500_{t-4}\right)/4$	**-0.05**			**0.64**			**-0.27**	0.21
	(0.26)			(0.30)			(0.76)	
$r_{t-8}^{Treas(10yr)} - r_{t-8}^{Treas(2yr)}$	**-0.14**			**0.21**			**0.51**	0.08
	(0.07)			(0.08)			(0.15)	
$\Delta \widehat{GDP(E)}_{t,t}$, SPF forecast	**0.20**			**0.33**			**0.86**	0.61
current quarter	(0.12)			(0.12)			(0.20)	
$\Delta \widehat{GDP(E)}_{t,t-1}$, SPF forecast	**0.15**			**0.16**			**1.84**	0.31
1 quarter ahead	(0.09)			(0.09)			(0.23)	
$\Delta \widehat{GDP(E)}_{t,t-2}$, SPF forecast	**0.10**			**0.08**			**2.45**	0.15
2 quarters ahead	(0.08)			(0.08)			(0.27)	

Note: Specification using the slope of the yield curve spread $\left(r^{Treas(10yr)} - r^{Treas(2yr)}\right)$ uses a 1978Q2 to 2009Q3 sample. Specifications using SPF forecasts use a 1969Q3 to 2009Q3 sample. Standard errors are Newey-West with 8 lags.

Table A.2.4: Predictive Content of Initial Growth Rates, 1978Q3-2008Q4

	Explanatory Variables							
	$\Delta GDP(E)$, 1st annual revision			$\Delta GDP(I)$, 1st annual revision			Constant	Adj. R^2
Dependent Variable	t	$t-1$	$t-2$	t	$t-1$	$t-2$		
$(GDP(E)_t/GDP(E)_{t-1})^4$,	**0.67**			**0.23**			**0.49**	0.79
latest	(0.12)			(0.10)			(0.17)	
	0.64	**-0.19**		**0.23**	**0.22**		**0.46**	0.79
	(0.11)	(0.11)		(0.09)	(0.12)		(0.18)	
		-0.42			**0.88**		**1.53**	0.25
		(0.27)			(0.26)		(0.28)	
$(GDP(E)_t/GDP(E)_{t-1})^4$,		**-0.31**			**0.78**		**1.27**	0.24
1st annual rev.		(0.26)			(0.23)		(0.29)	
			-0.33			**0.60**	**1.82**	0.08
			(0.17)			(0.20)	(0.34)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,	**0.05**			**0.81**			**0.59**	0.69
latest	(0.14)			(0.15)			(0.17)	
	0.07	**0.09**		**0.77**	**-0.04**		**0.50**	0.69
	(0.13)	(0.19)		(0.16)	(0.15)		(0.22)	
		-0.04			**0.54**		**1.45**	0.22
		(0.28)			(0.21)		(0.39)	
$(GDP(I)_t/GDP(I)_{t-1})^4$,		**-0.15**			**0.69**		**1.13**	0.27
1st annual rev.		(0.25)			(0.21)		(0.34)	
			-0.27			**0.57**	**1.76**	0.09
			(0.19)			(0.21)	(0.40)	
$(UR_t - UR_{t-1}) * 4$	**-0.06**			**-0.24**			**0.81**	0.55
	(0.05)			(0.06)			(0.12)	
		-0.01			**-0.25**		**0.72**	0.37
		(0.08)			(0.08)		(0.14)	
			0.02			**-0.22**	**0.58**	0.22
			(0.06)			(0.06)	(0.17)	
$\left(E_t^{household}/E_{t-1}^{household}\right)^4$	**0.04**			**0.34**			**0.32**	0.47
	(0.09)			(0.10)			(0.16)	
		0.11			**0.24**		**0.39**	0.34
		(0.11)			(0.10)		(0.23)	
			-0.09			**0.32**	**0.68**	0.16
			(0.10)			(0.07)	(0.27)	
$ISM_t^{manuf.}$	**0.41**			**1.04**			**47.57**	0.54
	(0.24)			(0.28)			(0.62)	
		0.50			**0.92**		**47.50**	0.48
		(0.41)			(0.38)		(0.57)	
			0.09			**0.88**	**48.69**	0.22
			(0.33)			(0.31)	(0.68)	
$log\left(SP500_t - SP500_{t-4}\right)/4$	**-0.28**			**0.88**			**0.49**	0.20
	(0.29)			(0.29)			(0.84)	
$r_{t-8}^{Treas(10yr)} - r_{t-8}^{Treas(2yr)}$	**-0.07**			**0.14**			**0.53**	0.05
	(0.04)			(0.05)			(0.17)	
$\Delta \widehat{GDP(E)}_{t,t}$, SPF forecast	**0.12**			**0.33**			**0.96**	0.48
current quarter	(0.07)			(0.06)			(0.29)	
$\Delta \widehat{GDP(E)}_{t,t-1}$, SPF forecast	**0.04**			**0.18**			**1.84**	0.17
1 quarter ahead	(0.06)			(0.07)			(0.33)	
$\Delta \widehat{GDP(E)}_{t,t-2}$, SPF forecast	**0.09**			**0.03**			**2.32**	0.07
2 quarters ahead	(0.07)			(0.07)			(0.35)	

Table A.3: Regressions explaining Revisions, 1994Q1-2006Q4

	Explanatory Variables, Initial (2nd, 3rd) or 1st Annual				
	$\Delta GDP(I)_t - \Delta GDP(E)_t$	$\Delta GDP(E)_t$	$\Delta GDP(I)_t$	Constant	Adj. R^2
$Y_t = \Delta GDP(E)_t$, revision	**0.33**			**-0.01**	0.05
latest - initial (advance)	(0.13)			(0.14)	
		-0.36	**0.27**	**0.32**	0.04
		(0.15)	(0.12)	(0.33)	
$Y_t = \Delta GDP(E)_t$, revision	**0.60**			**-0.39**	0.06
latest - initial (2nd)	(0.29)			(0.25)	
		-0.69	**0.46**	**0.41**	0.07
		(0.30)	(0.30)	(0.43)	
$Y_t = \Delta GDP(E)_t$, revision	**0.42**			**-0.29**	0.06
latest - initial (3rd)	(0.16)			(0.20)	
		-0.44	**0.28**	**0.31**	0.07
		(0.16)	(0.16)	(0.35)	
$Y_t = \Delta GDP(E)_t$, revision	**0.46**			**-0.04**	0.16
latest - 1st annual revision	(0.14)			(0.18)	
		-0.52	**0.41**	**0.32**	0.16
		(0.15)	(0.14)	(0.27)	
$Y_t = \Delta GDP(E)_t$, revision	**-0.64**			**0.28**	0.19
latest - initial (advance)	(0.19)			(0.28)	
		0.62	**-0.68**	**0.50**	0.18
		(0.24)	(0.19)	(0.97)	
$Y_t = \Delta GDP(E)_t$, revision	**-0.16**			**0.05**	-0.02
latest - initial (2nd)	(0.35)			(0.30)	
		0.12	**-0.22**	**0.41**	-0.04
		(0.35)	(0.35)	(0.55)	
$Y_t = \Delta GDP(E)_t$, revision	**-0.15**			**-0.16**	-0.01
latest - initial (3rd)	(0.24)			(0.26)	
		0.13	**-0.26**	**0.31**	-0.02
		(0.23)	(0.22)	(0.59)	
$Y_t = \Delta GDP(E)_t$, revision	**-0.11**			**0.15**	-0.01
latest - 1st annual revision	(0.18)			(0.27)	
		-0.07	**-0.26**	**1.22**	0.09
		(0.16)	(0.16)	(0.45)	

Table A.4: Regressions of Annual $\Delta GDP(I)$ and $\Delta GDP(E)$ on Various Alternative Business Cycle Indicators, 1985-2006

Explanatory Variable	Adjusted R^2		β		
	$GDP(I)_t$	$GDP(E)_t$	$GDP(I)_t$	$GDP(E)_t$	p-val., equal βs
$log(SP500_t/SP500_{t-1})$	**0.18**	**0.19**	**5.58**	**4.64**	0.30
			(2.32)	(1.44)	
$log(SP500_{t-1}/SP500_{t-2})$	**0.27**	**0.13**	**6.50**	**3.94**	0.00
			(1.51)	(1.43)	
$r_t^{HY corporate} - r_t^{Treas.(7yr)}$	**0.58**	**0.39**	**-0.74**	**-0.50**	0.00
			(0.10)	(0.11)	
$r_{t-1}^{HY corporate} - r_{t-1}^{Treas.(7yr)}$	**0.53**	**0.37**	**-0.73**	**-0.50**	0.00
			(0.13)	(0.15)	
$r_{t-2}^{Treas.(10yr)} - r_{t-2}^{Treas.(2yr)}$	**0.07**	**-0.00**	**0.68**	**0.34**	0.00
			(0.43)	(0.39)	
$U_t - U_{t-1}$	**0.64**	**0.49**	**-2.08**	**-1.48**	0.00
			(0.29)	(0.33)	
$E_t^{household}/E_{t-1}^{household}$	**0.62**	**0.59**	**1.30**	**1.02**	0.03
			(0.18)	(0.20)	
$ISM_t^{manuf.}$	**0.40**	**0.30**	**0.25**	**0.18**	0.00
			(0.05)	(0.05)	

Note: Specifications using the high yield bond spread ($r^{HY corporate} - r^{Treas.(10yr)}$) use a 1986-7 to 2006 sample. Standard errors are Newey-West with 2 lags.