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Countering Uncertainty in Budget Forecasts

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Federal budget procedures in the United States require forecasts and projections over several distinct periods of time: short term (18-24 months ahead), medium term (both 5- and 10-year horizons), and long term (as much as 75 years in the future). In the United States, the intermediate estimates have taken on increased significance with many press accounts referring to 10-year estimates.

In addition to various time periods, the forecasts include the outlook for both the economy and the budget. Economic forecasts not only drive the budgetary outlook, they also provide the basis for developing economic policy. And despite the linkage between economic and budgetary performance, the relationships are neither perfect nor constant.

The status of these two requirements has evolved, particularly since the enactment of the Budget Act in 1974 creating the Congressional Budget Office (CBO). The Executive branch forecasts (done mainly by the Office of Management and Budget, OMB) tend to parallel the time periods. Often many of the economic results are similar, especially over a 10-year forecast; the budget estimates vary more widely.

At least one difference is important to note, however. The estimates and forecasts of the Executive branch, while developed with similar economic assumptions, are created by several distinct institutions. Revenue estimates, for example, are developed largely by the United States Treasury. Estimates for federal health programmes, such as Medicare and Medicaid, are developed by actuaries within the Department of Health and Human Services (HHS). Long-term estimates for Social Security are the responsibility of actuaries of the Social Security Administration.

In contrast, CBO is solely responsible for virtually all economic forecasts, as well as the revenue and spending projections used by Congress. The notable exception is the requirement that the Joint Committee on Taxation (JCT), a congressional entity separate from CBO, develop estimates of changes in tax law. That is, CBO forecasts revenues under current law (the "baseline") and the JCT estimates changes to the baseline.

Thus CBO is the one institution responsible for economic estimates and forecasts as well as forecasts for baseline or current-law revenues and spending for the short, medium, and long run. CBO also develops estimates for the costs of legislation that changes current laws affecting spending – both appropriations and entitlements – as well as estimates of the effects on state

and local governments and the private sector. While there are several separate divisions within the agency that support the process, CBO is nonetheless in the best position to evaluate both the accuracy of its past forecasts and, in turn, the reliability of its forecasts for the future.

Much of what follows is an examination of some of the processes CBO uses to develop estimates and forecasts, the retrospective analyses to measure accuracy and refine models, and some of the techniques employed to estimate and depict uncertainty.

It is worth noting at the outset the well-known requirement for point estimates in the budget process. As much as analysts might wish to impress on policy-makers the uncertainty of their labours, the process requires the ability to essentially sum a wide range of estimates, all with varying confidence intervals, to reach a single "bottom line". In an ideal analytical world, some sense of uncertainty would be explicit in the use of the estimates.

Finally, all too often critics of budget forecasts and projections fail to recognise the nature of the exercise. The most simplistic criticism overlooks the fact that legislation and regulation have been implemented between the time of the forecast and the time of the critic's analysis – failing to recognise that the law has changed between forecast and actual outcome.

Other, slightly more sophisticated critics charge that the exercise of estimating the budgetary outcomes of current laws and policies is "unrealistic" because the analysis fails to account for future events that, at least in the critic's mind, are virtually certain to happen. The extension of tax provisions that are scheduled to expire in the future, for example, happens more often than not and, the critics say, should be included in the baseline estimates.

Their criticism misses the point of the exercise. Budget forecasts are not typically presented as predictions of future budget outcomes, but only forecasts of what would happen if current laws and policies were maintained over the forecast period; *e.g.* if no laws were enacted for 10 years. Certainly that is "unrealistic" in some sense. But the baseline is constructed to measure policy changes – the effects of legislation – not predict them. To do otherwise would not only obviate the purpose of the exercise and introduce arbitrary adjustments, but also necessitate the adoption of political assumptions about how Congress will act, and when.

1. Forecasting process

CBO has traditionally provided Congress with an analysis of the economic and budgetary outlook in January of each year. The process begins typically in September or October with a preliminary forecast for the economy – both near and long-term – and the budgetary implications of that forecast.

CBO's macroeconomics division prepares the economic forecast. Several models are used to formulate the draft forecast – several developed by CBO as well as two commercially available models. A central feature of both the process and the forecast is the estimation of the economy's potential for growth over the various periods. After accounting for business cycles (for the first two years of the forecast), the economy is expected to adjust back to potential over several years.

The implied budget outcomes are prepared by several other divisions within CBO: revenues by the division of tax analysis, discretionary spending by the budget analysis division. A meeting of CBO's outside economic advisors (a panel of over 20 macroeconomists from around the country) is convened to critique the proposed forecast and other technical aspects of CBO's models.

The economic forecast is finalised near the beginning of December, and the remainder of the month is spent translating the new forecast into many micro-components and deriving the spending and revenue outlook for the next fiscal year and the next five and 10 fiscal years. For the past several years, this January report has also included a chapter devoted to analysing past forecast errors as well as the uncertainty inherent in the current forecast. The report is published by the end of January and testimony is often given to the House and Senate Budget Committees. Subsequently, the President's budget, presented the first Monday in February, is analysed using all the assumptions in CBO's January report. Finally, an update of the January report is prepared (usually in August) that reflects changes in the economic forecast and incorporates any legislation that has been passed since January.

2. Short-run estimates

In many respects, short-run estimates are the hardest to fashion. Usually, these forecasts are required months in advance of the beginning of the next fiscal year. In the United States, the forecasts made in January of this year (with minor updates in March in conjunction with the analysis of the President's budget) apply to the fiscal year beginning in October. While these forecasts are updated, typically in August, much of the budget formulation is predicated on the January numbers.

It is even difficult to know how the economy is performing at the time the forecast is made – contemporary data are often hard to come by and subject to large errors and large corrections. Real events are not known until well after the fact. Economists are notoriously bad at calling turning points in the economy. And public officials, including budget officials, are loath to forecast a recession or a weakening economy even in the face of persuasive evidence.

Nonetheless, CBO attempts to incorporate cyclical developments in the first two years of its forecast, but not beyond. The distinction is important

because errors in forecasting the business cycle do not affect trends underlying the rest of the forecast. However, errors in the estimation of non-cyclical trends may well grow indefinitely and have compound effects as the forecast period lengthens.

Often, budgetary data are the best contemporaneous and leading indicator, if not of the economy at least of the state of fiscal affairs. Even then, while broad aggregates are informative, the phenomena underlying changing trends may not be known with precision for several years, thus leaving an insufficient basis for forecasting.

Revenues, for example, may be increasing as the Treasury tracks its accounts, but it takes several years to compile data from relevant individual returns. At some level these data lags are inevitable – taxes are collected on last year's income and not reported until at least April of the following year. For the largest taxpayers, returns are often not filed until August or even October of the following year. It takes another full year to compile detailed return data.

Similarly, for many of the largest entitlement programmes in the United States, aggregate results are available on a real-time basis, but underlying changes may not be known for several years. In fiscal year 1999, for example, Medicare spending in the United States actually declined for the first time ever. While this result was manifesting itself as the fiscal 2000 budget was being formulated, it was impossible, and would have been imprudent, to assume there had a been a change in the long-term trend. Nonetheless, these short-run estimates and forecasts are important for discerning the current stance of fiscal policy as well as the near-term prospects for the economy – which will drive policy-makers – and the budget.

CBO has analysed its short-term track record over the last 20 years. Table 1 contains the average difference between CBO's budget projections made in January of each year and actual outcomes since 1981, adjusted for the passage of legislation. It includes data for the current fiscal year, the next fiscal year (the budget year), and two years later. As one would expect, average differences are much smaller than average absolute differences, differences tend to increase over time, and the differences for near-term projections – while potentially large in dollar terms – are small relative to the size of the economy.

Slightly more interesting, but perhaps no more surprising, is the fact that the largest errors occur in estimating revenues – the average absolute errors are over twice as large as those for outlays. Obviously, revenues diverge from the plan whenever the economy performs other than forecast. In addition, in the United States the multiple sources of revenue and the ability of taxpayers to alter both the timing and the nature of their income make revenue

Table 1. **Year for which the projection was made**

	Current Year	Budget Year	Budget Year + 1
Difference as a % of GDP			
Surplus or deficit			
Average difference	0.2	0.1	0
Average absolute difference	0.5	1.2	1.6
Revenues			
Average difference	0	–0.1	–0.1
Average absolute difference	0.4	0.9	1.3
Outlays			
Average difference	–0.2	–0.2	–0.2
Average absolute difference	0.3	0.5	0.6
Difference as a % of actual outcome			
Revenues			
Average difference	0	–0.5	–1.2
Average absolute difference	1.9	4.6	6.8
Outlays			
Average difference	–0.9	–0.8	–0.9
Average absolute difference	1.4	2.1	3.0

Source: CBO.

estimation particularly problematic. For example, there are literally trillions of dollars in capital gains outstanding in financial and real assets. The timing of the realisation of those gains and thus the timing of capital gains revenues is not well understood.

Similarly, taxes on wage income do not apply to fringe benefits, generally encouraging the latter over the former. But the split between the two can change for non-obvious reasons, *e.g.* the move to managed care in the 1980s and early 1990s.

Outlays, on the other hand, are somewhat less affected by economic changes and exhibit generally more stable behavior. However, the budget rules also dictate certain assumptions that promote errors. For example, discretionary, appropriated spending in the United States budget, which accounts for approximately 40% of all spending, is assumed to grow by the rate of inflation. Historically, that assumption has been universally incorrect, with discretionary domestic spending typically growing faster than inflation and defense spending growing faster (as in the 1980s) or slower (as in the 1990s). Likewise, the periodic use of appropriations "caps" to impose spending control is, by budget convention, assumed to be successful – but it rarely is in practice.

3. Forecasts for the medium term

Forecasts for years three through five in the five-year outlook are assumed to be free of business cycle variations, but likely will be years of adjustment back to the assumed potential growth rate of the economy. Years five through 10 are largely straight-line extrapolations with one exception: changes in demographics are explicitly incorporated. So, for example, the anticipated ageing of the United States population is reflected in both the economic and the budget estimates – the economy is assumed to grow more slowly at the end of the decade as the growth in the workforce slows and the increasing costs of entitlement programmes for the elderly are reflected in the budget totals.

CBO has not been in the business of 10-year forecasts long enough to be able to calculate confidence intervals around the forecast. Five-year forecasts, however, have been developed in enough detail for most of the last 25 years to allow CBO to band the five-year outlook.

The set of panels in Figure 1 does exactly that. For the forecast of the primary surplus or deficit – that is, the surplus adjusted for interest payments – the black lines show the difference between forecast and actual, relative to GDP, for each of the five years in each panel. Lines below center indicate a forecast that overstated the surplus (or understated the deficit). The gray bands are the 90% confidence intervals around the forecast.

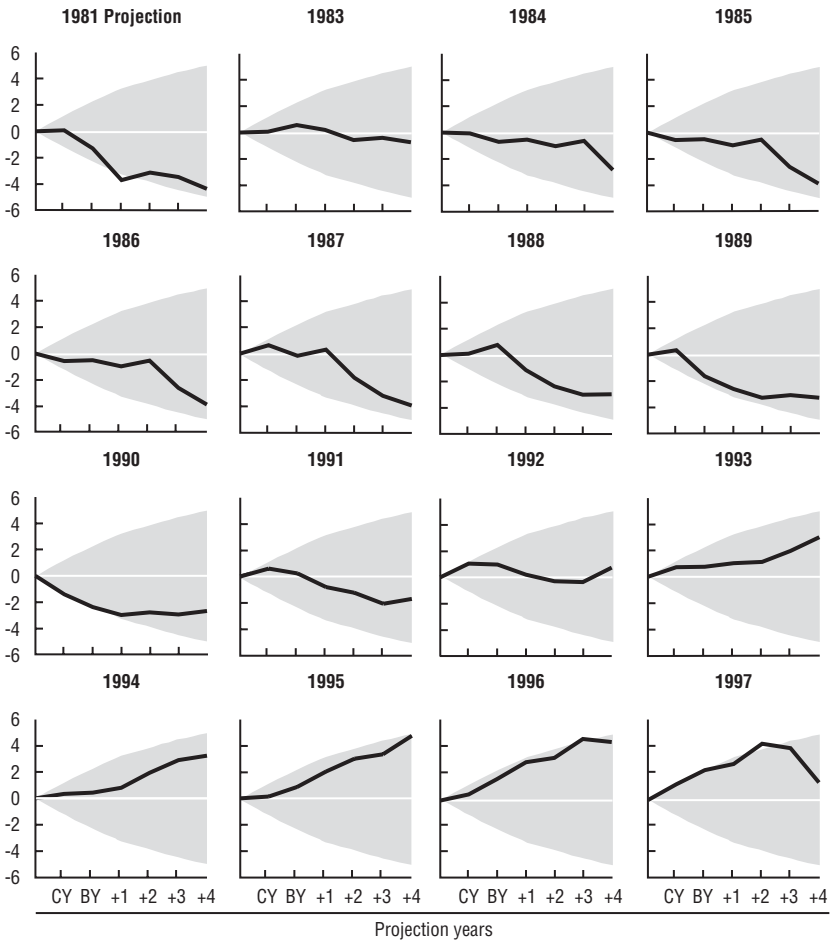
In retrospect, a good deal of the error is failure to accurately predict the economy. The very first panel, for example, shows the 1982 recession that was not in the forecast used in 1981 (nor in anyone else's forecast). Much the same is true for the 1989 and 1990 panels where the weakening economy and its effects on revenues were not foreseen. More recently, the last several panels are indicative of the better-than-expected economic performance and the even better revenue collections.

These same data can be used to estimate confidence intervals for current forecasts as well. Beginning three years ago, CBO began publishing (and publicising) what has become known for obvious reasons as the "fan chart" (Figure 2). This graphic depiction, which was essentially copied from the Bank of England (with their permission), has proven to be quite powerful in improving the understanding of the uncertainty in the five-year forecasts.

Since the mid-1990s, because of a change in the rules of the United States Senate, CBO has been required to produce 10-year estimates of the economy and budget similar to the five-year outlooks. For good or ill, most of the numbers now used in the public debate and by the media are 10-year totals.

In January 2001, when CBO projected surpluses for the decade, the sum of the point estimates for the 10 years was USD 5.6 trillion. President Bush's

Figure 1. **Uncertainty of five-year forecasts**

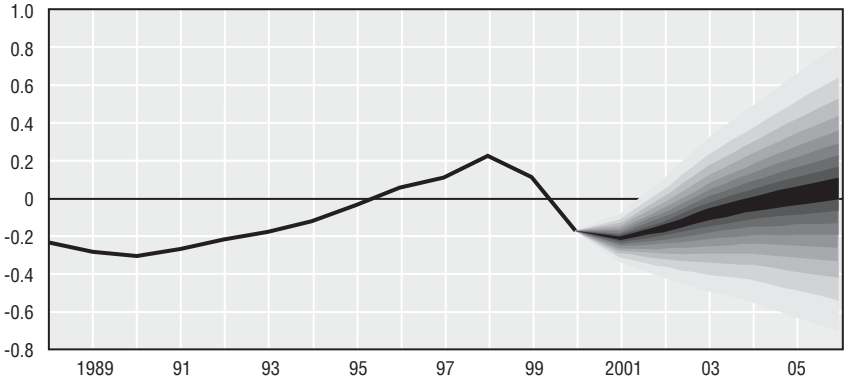


Source: CBO.

proposed tax reduction in his first budget totaled USD 1.2 trillion over 10 years. These large numbers, fraught with estimation errors of all kinds, became the currency of the debate. Few bothered to note the extremely wide confidence intervals around the estimates. Nor did anyone point out that while these are certainly large numbers, the economy was expected to generate USD 120-130 trillion in output over the same 10 years. There was little perspective.

The use of 10-year numbers persists, compounding many of the earlier misperceptions. Congress recently enacted a tax package variously estimated

Figure 2. **Uncertainty of CBO's projections of the total budget surplus**
Trillions of dollars



Source: CBO.

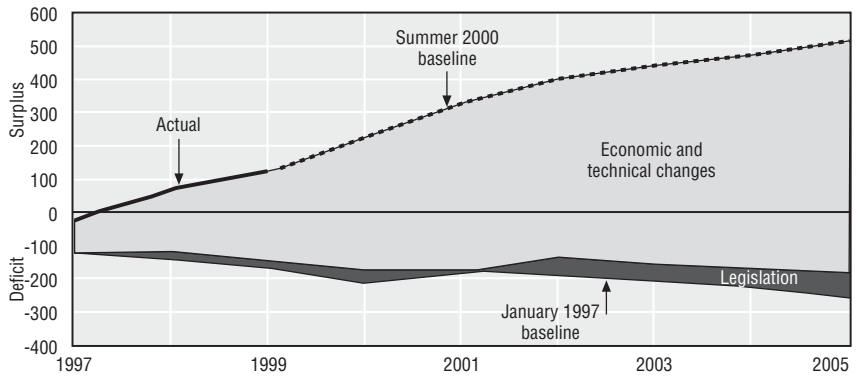
to cost USD 350 billion over 10 years. The President had requested roughly USD 750 billion, and the House had passed a package said to be USD 550 billion. Again, while these are large numbers, any version of the legislation is small relative to the size of the economy. Over the same 10 years the United States economy will generate somewhere in the neighborhood of USD 150 trillion. Put another way, these tax packages are the equivalent of 35¢, 55¢, or 75¢ out of USD 150. Proponents and opponents alike greatly overstated the expected effects of such a small fiscal change. Ten-year numbers promote such rhetoric.

More to the subject at hand, the following figures depict the misestimates both in the apparent development of surpluses and their subsequent demise. In Figure 3, the bottom line represents the forecast made by CBO in January 1997 – persistent but consistent deficits for the 10-year period. Subsequent legislation, aimed at reducing the deficits, had a significant but small impact in changing the outlook, as shown by the dark band just above the baseline. The primary factor in the difference between the outlook in January 1997 and January 2001 was the economy.

This dramatic change occurred in two parts. First, the economy grew much faster than anyone had expected, largely due to substantial increases in productivity. Second, as noted earlier, tax receipts grew even faster than the economy. Taxpayers moving into higher tax brackets caused a portion of the revenue increase. Much of the remainder was due to a temporary increase in capital gains taxes.

Picking up in January 2001, the top line in Figure 4 represents the high point of CBO's forecasts of budget surpluses. The bottom line in this case marks the actual and forecast surplus or deficit as of March 2003. The reduction in

Figure 3. **Misestimating the surpluses 1**
Billions of dollars

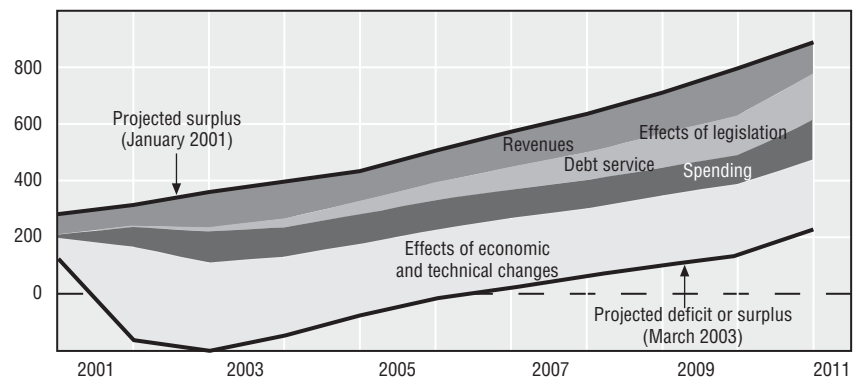


Source: CBO.

revenues assigned to the tax bill of 2001 and a subsequent smaller action in a "stimulus" package (but not the most recent legislation) is the top band. The third band represents additional spending since January 2001 and the middle band the additional debt service costs of changes in both outlays and revenues.

Again, the single largest factor in the changed outlook, particularly in the near term, is due not to legislation but to the performance of the economy. Proportionally, the revenue reductions account for 20% of the change over 10 years, the outlay increases 20%, debt service just under 15%, and changes in the economy account for 45%. What the economy gives, the economy can take away.

Figure 4. **Misestimating the surpluses 2**
Billions of dollars



Source: CBO.

4. Long-term forecasts

CBO has dedicated substantial resources in the last four years to develop much more sophisticated models to assist with 25- and 75-year projections. The primary focus of these models is programmes with substantial inter-generational effects, namely Social Security, Medicare, and Medicaid.

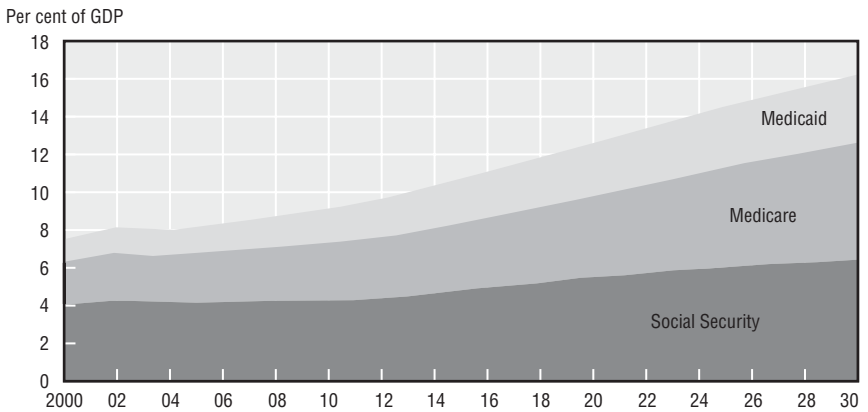
There is an obvious air of futility in this exercise: picture yourself in the year 1925 attempting to predict the year 2000 and all the events that occurred in between. Nonetheless, there is some additional information that can be gleaned from the effort, and the important capability may be the estimation of the effects of changes in current law rather than the precision of establishing a baseline.

The next 25 years are especially important for many of the industrialised nations as the post-World War II generation retires. Even if all the variables are not precisely right, the demographic phenomena alone translated into budget consequences are critical to understand.

Figure 5 captures the effects of the baby-boomers' retirement on the federal budget (only). The proportion of the economy devoted to just these three programmes will more than double and amount to almost as much as the entire (non-interest) budget today. In rough terms the extreme options are: eliminate much of the rest of government as we know it; borrow a USD trillion a year; raise taxes by upwards of 10% of GDP (payroll tax rates of 35%); or "freeze" these programmes despite the doubling of beneficiaries and the growth in healthcare costs.

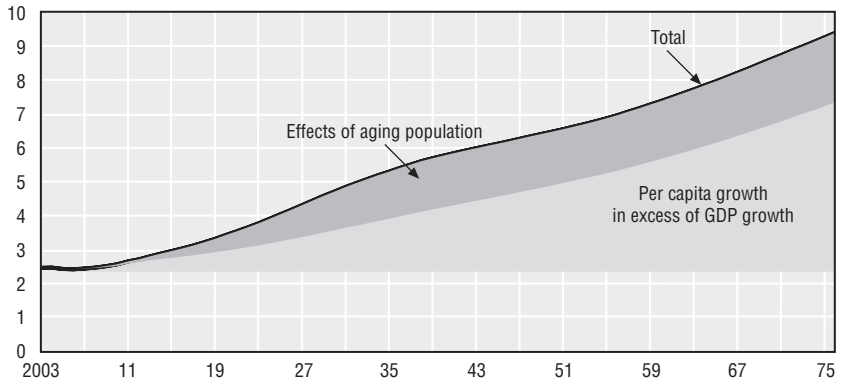
Figure 6 separates the effects of demographics on the forecasts for Medicare from the anticipated "excess" cost growth. Despite the fact that per capita cost growth has averaged nearly 3% since 1970, even after numerous

Figure 5. **Federal spending for retirees**



Source: CBO.

Figure 6. **Projected long-term growth of Medicare spending**
% of GDP



Source: CBO.

changes in the law to reduce spending, both the Executive branch actuaries and CBO assume the excess to be just 1% over this time period. Even with this conservative assumption, Medicare spending alone will put severe strains on future budgets and generations.

The 75-year projections required of the Executive branch actuaries for Social Security and Medicare are used to assess long-term viability of the underlying trust funds. As the trust funds and their status have little or nothing to do with actually financing the programmes, the exercise might be viewed as not only futile but unnecessary. Nonetheless, 75-year projections appear routinely and are unfortunately cited as though terribly meaningful.

The actuaries use various methods and models to estimate and project variables that tend to drive the programmes in question. They generally use their best estimates of these inputs as their "intermediate cost" scenario. They then supplement their forecast with an optimistic and a pessimistic scenario. In addition to other limitations, these scenarios are not generated in any statistical sense – they are only "illustrative" and not subject to the estimation of confidence intervals.

CBO's models do allow the development of confidence intervals of programmatic outcomes using stochastic analysis. Probability distributions for the various factors directly affecting Social Security's financing are calculated using time-series estimation. Monte Carlo simulation can then be employed by making random draws of the values for these input variables. (A more complete explanation can be found in the 2001 CBO report, *Uncertainty in Social Security's Long-Term Finances: A Stochastic Analysis*.)

The more important aspects of these long-term models are their abilities to assess both the macroeconomic consequences of policy changes as well as estimate the effects of micro-economic changes (through micro-simulation techniques) on these programmes and on the economy.

5. Conclusion

There are two ongoing aspects of accounting for uncertainty in public budgeting: *i)* properly recognising and incorporating uncertainty in the policy process; and *ii)* striving to improve estimation techniques to reduce uncertainty. For the first task, CBO has attempted to develop more and better explanatory devices. The results of some of those efforts have been examined above. Other efforts include the expanded use of alternative scenarios, both for the economy and the budget outcomes, and repeated publication of rules-of-thumb that highlight the sensitivity of, say, budget totals to changes in the economy.

For the second task, CBO like many other modelers continues to refine and test new approaches to the basic efforts. Retrospective error analysis remains probably the strongest analytical tool for fine-tuning existing models. Large-scale model development, like the efforts at long-term modeling undertaken by CBO, takes a great deal of time but is ultimately worth the effort.

Another area of improvement for the United States is the development of better and timelier data. The lag in revenue detail mentioned previously could be addressed by sampling tax returns and estimating collections, rather than waiting for "actuals" to be developed. Likewise, outlay detail for some of the largest entitlement programmes is created as benefits are paid, but remain for long periods of time first with the financial agents and then with the administering agency.

Much of it comes down to this: a better job needs to be done of forecasting the economy. The largest errors stem from unanticipated changes in economic performance. Fortunately, there are many other entities pursuing the objective of better forecasting as well – it is not necessary to rely exclusively on the public sector.

Finally, there will always be uncertainty in the budget processes. Empirical research can only take us so far. Policy-makers need to account for uncertainty in their decision-making. However, we need to recognise a fine line as we expose the uncertainty inherent in our estimates – at some point policy-makers will be tempted to wonder why we bother to do it at all. We do not want our masters to align themselves with the great skeptic David Hume who famously told us the future is under no obligation to repeat the past.

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