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GDP Fluctuations: Permanent or Temporary?

Is the sluggish growth in U.S. GDP in recent years just a temporary cyclical downturn or a permanent reduction in the growth rate of the U.S. economy? Up to the late 1970s, the conventional view held that short-run fluctuations in the economy only reflect temporary cyclical shocks that leave the long-run trend in output unaffected. Since the early 1980s, however, an influential group of researchers has taken the view that short-run fluctuations also may reflect permanent changes in output and its trend. These researchers have developed methods for quantifying the extent to which fluctuations in output may be attributed to temporary cyclical factors or to changes in trend.

To shed light on the issues underlying this debate, this *Weekly Letter* discusses two alternative approaches to modeling the trend in GDP. The first assumes that the long-run rate of growth is constant; the second assumes that the trend varies randomly in response to shocks to the economy. The focus here will be on conceptual and methodological issues rather than on precisely quantifying the relative importance of long-run and short-run factors in the recent period of sluggish growth. Such a quantification was offered in a recent *Weekly Letter* (93-02).

Constant, or deterministic, trend

If a macroeconomist had been asked at the end of 1971 whether U.S. output would continue to fall at around 0.2 percent a year, the average rate observed over the preceding year, the most likely answer would have been "no." The macroeconomist probably would have responded that the contraction the U.S. economy experienced in 1970 was temporary. Output at some point would be expected to resume growing at a rate close to 4 percent, the average growth rate observed over the previous decade.

Unable to refrain from giving a lecture, the macroeconomist would have gone on to explain that the response involves two closely related assumptions about GDP behavior. First, *there is a long-run equilibrium trend in GDP associated with a constant trend rate of growth*. The trend is said to be *deterministic*, because GDP grows at the same fixed rate in each period. The deterministic trend is estimated by fitting a straight line to approximate the long-run tendency of GDP. The slope of that line provides a measure of the average rate at which GDP grows over time. In the traditional view, the stable GDP trend is determined by supply factors, such as the capital stock, the labor force, and technology.

Second, *any deviations from the level of GDP determined by the trend are temporary*. In particular, past disturbances to GDP do not affect its current level (only the unchanging trend does), or if they do, their effect dies down to zero as time passes. In this framework, short-run (cyclical) fluctuations in GDP reflect shocks to aggregate demand that temporarily move the economy away from the long-run trend, and are independent of the supply factors that determine this trend.

This intuitively appealing approach to modeling GDP behavior underlies the Keynesian textbook treatment of business cycle fluctuations, as well as the approach followed by a large number of empirical macroeconomic models developed between the 1950s and the 1970s that are still widely used for forecasting and policy analysis.

The deterministic trend model has a verifiable implication. If the trend in GDP is indeed unchanging, a forecast of 1989 U.S. GDP made at the end of 1973 based on data for 1959.Q1–1973.Q3 (before the first oil price shock) would be similar to the forecast made at the end of 1985 with data for 1973.Q3–1985.Q4. It is easy to verify that this implication is contradicted by the data. In 1973, our macroeconomist would have forecast U.S. GDP for 1989 by assuming an annual growth rate of nearly 4 percent, based on the best estimate of the deterministic trend according to data available up to that time. In 1985, however, because of the much slower rate of growth experienced between 1975 and 1985, the estimate of the deterministic trend would have

fallen to just over 2 percent. The greater accuracy of the 1985 forecast, in comparison to the forecast made in 1973, suggests that there was a decline in the trend rate of growth in U.S. GDP during the postwar period.

Variable, or stochastic, trend

The time-varypmg characteristic of forecasts of GDP, which is common to many economies, has prompted a large number of researchers to propose a model where the trend on average grows by some fixed amount, but is subject to random shocks in every period that cause growth to deviate from this average by an unforecastable amount. A trend that varies in every period in response to shocks is known as a "stochastic (or random) trend." In contrast to a model where the trend in GDP is unchanging, in this framework all past shocks to GDP affect its current level; that is, all shocks have some *permanent* effect that does not die out over time. For this reason, some researchers refer to the stochastic trend in GDP as the permanent component of GDP.

There are several ways to model a stochastic trend. One popular approach, suggested by Beveridge and Nelson (1981), models the trend as the long-run forecast level of GDP, using all available information on GDP's behavior up to the present. This model is intuitive, as the long-run forecast level of GDP provides information on the long-run tendency in its behavior. Also, under this definition, the trend in GDP changes every period in response to shocks to the economy.

The deterministic and stochastic trend models of GDP can convey quite different impressions of long-run and short-run behavior. Chart 1 compares the log of real GDP in the U.S. to a linear deterministic trend and to the stochastic trend based on the Beveridge–Nelson method. Chart 2 illustrates the temporary cycles (the differences between actual GDP and the estimated trends) associated with these two trend measures. As can be seen in Chart 1, the deterministic time trend is smooth, while the stochastic trend tends to follow the actual path of GDP quite closely. Conversely, Chart 2 shows that the cycle implied by a deterministic time trend is very persistent (movements away from the trend last a relatively long time), with large peaks and troughs. The cycle associated with a stochastic trend exhibits much less persistence, and peaks and troughs are much smaller.

Chart 1
GDP Trends

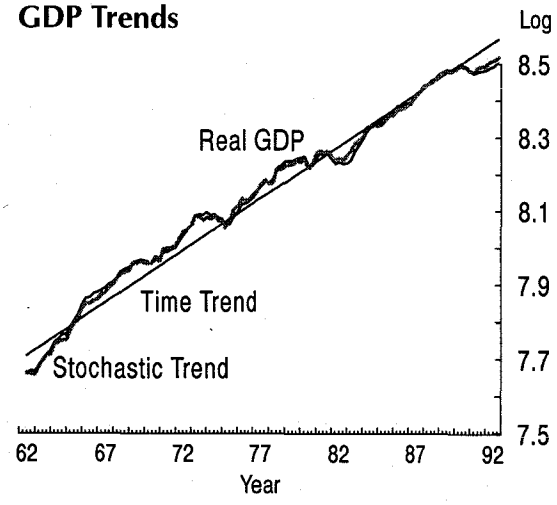
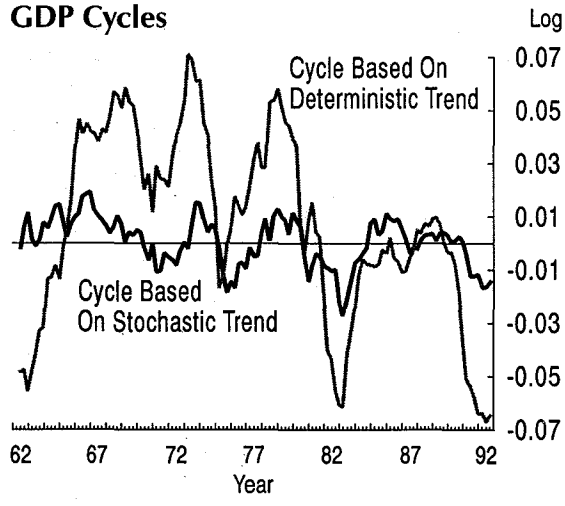


Chart 2
GDP Cycles



The smoothness of the deterministic trend, as well as the high degree of persistence in its associated cycle, reflects the fact that shocks to GDP do not change the trend in this model. In contrast, shocks to GDP always result in a change in the stochastic trend in every period. It is worth reiterating that these differences significantly alter the way we interpret specific business cycle episodes. For example, as can be seen in Chart 1, the deterministic trend model suggests that sluggish growth in the early 1990s reflects a purely temporary (although persistent) cyclical downturn. In contrast, the stochastic trend model suggests that much of the recently observed sluggishness in U.S. growth is permanent. This last

interpretation would only be revised if the U.S. experiences several quarters of more rapid growth that lead to upward revisions in the estimated stochastic trend.

The key feature of the stochastic trend model that distinguishes it from the deterministic trend model is that it may vary in response to shocks in each period. The extent to which the trend will vary however, will depend on the particular model of GDP and of its stochastic trend. For example, another way of modeling a stochastic trend was discussed in a recent *Weekly Letter* (93-02). A macroeconomic model with two variables is estimated, and some shocks are assumed to have permanent effects on output (supply shocks), while other shocks are assumed to have temporary effects (demand shocks). The stochastic trend in this framework can be thought of as that component of GDP that is attributable to shocks with permanent effects. This method of modeling a stochastic trend has several advantages, as it uses information from other macroeconomic variables (not just GDP, as in the Beveridge–Nelson method). Also, the decomposition into trend and cycle is based on an explicit macroeconomic model, which facilitates economic interpretation. This alternative model of the trend also attributes much of the recent slowdown in GDP to permanent changes in the trend, but its description of the trend and cycle in GDP differs in a number of respects from that reported here.

Why do we care?

The ability to distinguish between permanent and temporary movements in output is important in deciding whether it is appropriate to use macroeconomic policies that have temporary effects or to focus on long-run policies that may permanently affect trend behavior. For example, if the current sluggish pace in economic activity is due to temporary but highly persistent shocks, a case may be made in favor of expansionary macroeconomic policies that will bring the level of economic activity back to the long-run trend more quickly. However, if the sluggishness in output reflects a permanent decline in the trend rate of growth of the economy, expansionary macroeconomic policies may not be effective in the long run, as there is no reason to expect that such policies can raise the trend rate of growth. Instead, policies to raise productivity or labor skills may be more appropriate.

Unfortunately, there is no consensus on which of the two models of the trend is superior. Proponents of the deterministic trend model believe it is appropriate because the long-run path of GDP depends on supply factors (such as capital, labor skills, and natural resources) that change very little in the short run. They argue that any changes in the trend are infrequent, and can be incorporated by adjusting the deterministic trend model once the evidence accumulates that such a change in the trend has occurred. Also, it is not clear what stochastic trend model, if any, is to be preferred to the deterministic trend model. As discussed earlier, there are a number of ways of modeling a stochastic trend and there is disagreement on how well these various models reflect the impact on output of permanent changes in labor productivity or technology.

Proponents of the stochastic trend model believe that the assumption that the trend is unchanging, or equivalently, that short-run fluctuations in output have no permanent effects is implausible. They also point out that the stochastic model is more general, because it allows researchers to measure the extent to which short-run fluctuations in output are due to permanent or temporary shocks, rather than rule out permanent shocks entirely, as in the deterministic trend model. In particular, the stochastic trend model may approximate the deterministic trend model, if the data and the particular specification of the stochastic trend call for it, to any degree of closeness.

As no known statistical method is available to establish the superiority of either of the two trend models, disagreement on this question will not be easily resolved. Further research is needed to determine which model will ultimately prove to be more satisfactory.

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Reference

Beveridge, Stephen, and Charles R. Nelson. 1981. "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the 'Business Cycle.'" *Journal of Monetary Economics* 7 pp. 151–174.

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The *FRBSF Weekly Letter* appears on an abbreviated schedule in June, July, August, and December.