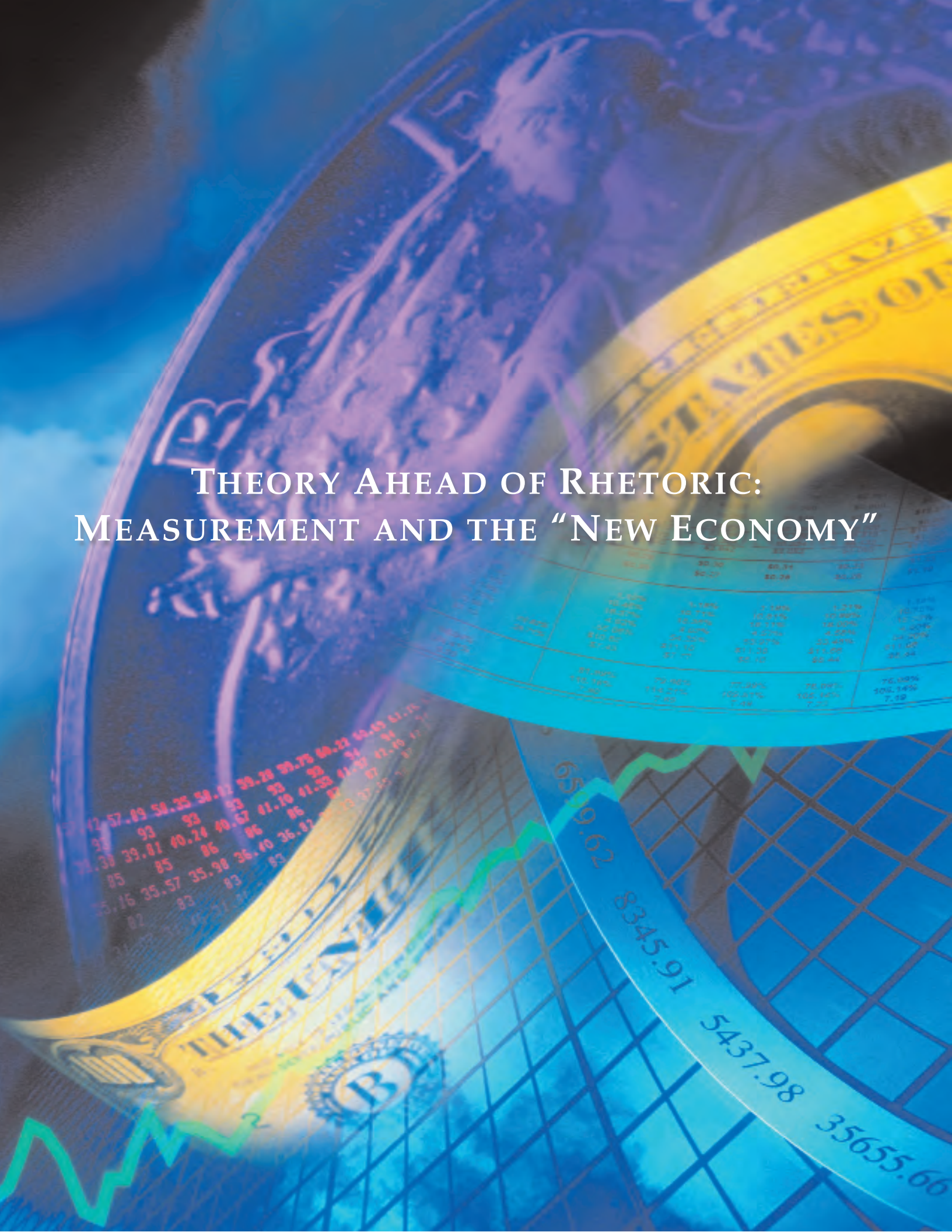

Theory Ahead of Rhetoric: Measurement and the "New Economy"

"[Chairman Greenspan] said yesterday that investor optimism and a bullish stock market have 'to date… more than offset' the effects of higher interest rates… There is, he said, 'little evidence that the American economy… is slowing appreciably.'"

—*Wall Street Journal*, February 18, 2000

"[Chairman Greenspan] told a House panel that recession poses a greater risk than inflation as consumer confidence continues to slide…"

—*Wall Street Journal*, February 28, 2001

In February 2000, the economic expansion that began in March 1991 became the longest cyclical upturn in U.S. history. Growth in real gross domestic product had topped 4 percent in four of the previous six years, and by the end of 2000, the string was five out of seven. On February 17, 2000, the day of Federal Reserve Chairman Alan Greenspan's testimony before Congress, the NASDAQ composite index closed just above 4500.

Though few are prepared to concede the expansion just yet, the ebullient mood of last spring has vanished. Despite impressive growth for 2000 as a whole, GDP in the fourth quarter advanced at a mere 1 percent, and for the first quarter of this year, GDP was only 1.3 percent according to current estimates. Few professional forecasters expect 2001 to yield anything near the average growth performance for the expansion as a whole. On the day of Chairman Greenspan's congressional testimony on February 28, 2001, the NASDAQ closed just over 2200.

What a difference a year makes.

Sometime between May 2000 (when the Federal Open Market Committee implemented the last in a year-long string of federal funds rate increases) and January of this year (when the Committee initiated the current string of rate decreases), the economic conversation shifted from New Economy wonder to very Old Economy anxiety. Exhortations for central bankers to throw off their traditional ways of thinking and "let growth happen" have been replaced by retrograde appeals for the Fed to *make* growth happen.

In this Bank's *1999 Annual Report*, we placed our sympathies in the let-growth-happen camp.[1] In that essay, we expressed skepticism about the value of such concepts as "potential output," particularly when they are brought into the macroeconomic policy process to represent a "normal" pace of economic growth that cannot be exceeded, lest inflation accelerate. Our complaint arose partly from advances in our understanding of economic dynamics and a growing appreciation of the interconnectedness of the long run and the short run of the economy. In other words, our skepticism derived from the very economic logic that explains and supports the idea of the New Economy in the first place.

As evidence accumulates that the U.S. economy has, after several years of robust expansion, entered a period of decidedly slower growth, an essay that invokes the New Economy may seem like yesterday's news. But in our view, the term "New Economy" is shorthand for one chapter of an integrated story of economic development—a story that historical experience and the evolution of modern growth and business cycle theory have brought to light. Although the rapid expansion that characterized the end of the millennium is part of this story, so too were the "jobless recovery" of the early 1990s, the wage inequality of the early 1980s, and the productivity slowdown of the 1970s.

Few believe the New Economy has ended, or that recent softness in the U.S. economy is anything more than a deviation from "extraordinary gains in performance—including rapid productivity growth, rising incomes, low unemployment, and moderate inflation—that have resulted from [a] combination of mutually reinforcing advances in technologies, business practices, and economic policies."[2] This point of view was articulated by Chairman Greenspan in his latest monetary report to Congress:

> ***The prospects for sustaining strong advances in productivity in the years ahead remain favorable. As one would expect, productivity growth has slowed along with the economy. But what is notable is that, during the second half of 2000, output per hour advanced at a pace sufficiently impressive to provide strong support for the view that the rate of growth of structural productivity remains well above its pace of a decade ago.***[3]

Some analysts interpret this observation to mean the central bank should get on the stick—by aggressively lowering the federal funds rate—and pump the economy back up to its potential. But those who hold this opinion are missing an important point about the New Economy.

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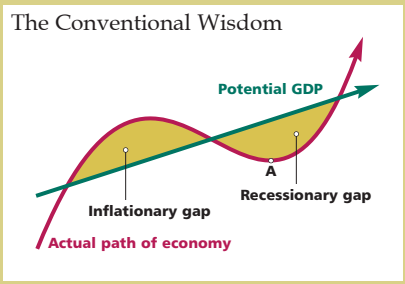
But those who hold this opinion are missing an important point about the New Economy.

To clarify this position, figure 1 illustrates the traditional view of monetary policy and its role in managing economic fluctuations. The straight green line represents the path of potential GDP as it moves through time, while the red wavy line represents the actual path of output. In the traditional view, a protracted period in which the red line is above the green line leads to inflation. When the red line is below the green line, the economy is performing at inefficiently low levels of output. In either case, a gap between the two is considered a problem to be managed by prudent and benevolent policymakers. The widely shared sense that the U.S. economy is operating in a region somewhere near point A is the impetus for the chorus of voices urging the Fed to get busy.

FIGURE 1



There is, to be fair, a respectable case to be made that something *like* potential GDP exists. Sometimes the economy deviates from its potential because of market frictions and inefficiencies, and monetary policy has a role in addressing those inefficiencies. What is clear, however, is that the growth of potential GDP is nothing like the straight green line depicted at left, and most of the cyclical movements (like the figure's wavy red line) represent the natural (and nonperverse) unfolding of economic activity. Consequently, the gaps depicted in figure 1 are not very useful to monetary policymakers.

In the midst of the recent expansion, we argued that advances in economics over the past three decades warrant skepticism that monetary policy should be deployed to resist above-potential economic growth, which traditional perspectives label inflationary. The converse of that argument seems appropriate today: Just as episodes of relatively rapid growth may be part of the natural ebb and flow of economic activity, so, too, are episodes of slower growth—and aggressive countercyclical monetary policy poses significant risk.

Certainly, advances in our understanding of dynamic macroeconomic phenomena dictate caution. Our plea here, however, focuses on a much longer-term problem: It's not just that gaps between potential and actual output—to the extent they exist—are difficult to perceive. Given our current inability to measure economic activity, they may be *impossible* to perceive.

To be more precise, developments we have come to associate with the New Economy have been made comprehensible by advances in the theory of economic growth (advances partly motivated by the real-world experience that the New Economy is a part of). The new growth theory highlights aspects of economic activity that are critical to future prosperity. Unfortunately, our current data-collection and measuring systems are not yet up to the task of providing the information we would like to have.

Our problem is similar to that faced by any business: If the central bank is to conduct monetary policy appropriately, then reasonable management information systems are imperative. But the past decade—the New Economy—should have taught us this: The apparatus we currently employ for making sense of the economy—that is, the measurements we employ to distill information about the American economic enterprise into a comprehensible form—are simply inadequate to the task. Until these systems reflect the accumulated lessons of economic theory and evidence, monetary policy will struggle to deliver the successful outcomes that characterized the last two decades.

Through a Glass, Darkly

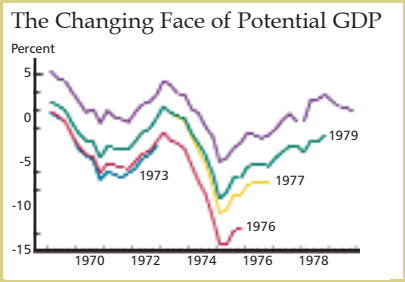
The conventional view of stabilization policy—the smoothing of the wavy line in figure 1—requires three critical elements. The first is a reasonably good assessment of the present state of the economy (where, exactly, are we on the red wavy line?). The second is an accurate sense of the "normal" trajectory to which monetary policy aspires (where, exactly, is the green line?). The third is the tools to actually minimize gaps that arise.

There is a readily available history with respect to the first requirement, and that history makes a good case for humility. Professional forecasters (including those of us in the policymaking business who participate in the exercise by necessity) have a poor track record of recognizing economic downturns, even well after they have begun. It is not unusual, for instance, to hear sources, official and otherwise, denying the existence of a recession as late as six months after one is under way.

Our inability to accurately assess the true condition of the economy has obvious operational consequences: The tools that central banks use to engage in monetary policy can be severely limited by difficulties in establishing the true state of the economy prior to the accumulation of a considerable amount evidence. The so-called "recognition lag"—the time it takes before the need for policy action becomes apparent—combines with oft-cited "long and variable" lags (the time it takes for a particular policy course to affect the economy) to undermine the central bank's ability to address economic problems while they are still problems.

The source of long and variable lags is not entirely clear. They are likely attributable to inflation expectations, as it is clear that public interpretation of policy actions can affect those actions substantially.[4] But there is another source, not mutually exclusive, that directly relates to the problem of identifying the presumed path of potential GDP. Figure 1 depicts the potential output path as stable and linear. In fact, this representation is not too far from the way the notion is applied in practice. But that is exactly the problem, because such a representation can be wildly misleading. So misleading, in fact, that gearing policy to a mistaken estimation of potential can have disastrous consequences.

FIGURE 2



SOURCE: Orphanides (2000).

Recall the stylized policy prescription of figure 1. When the actual level of GDP falls below its potential (as many conjecture has already happened), the monetary authority is supposed to engage in expansionary monetary policy to assist recovery to the "normal" trend (a step that many have been urging the Federal Open Market Committee to take). But what if the economy's true potential falls short of perceptions? Does aggressive easing of monetary policy, then, risk destabilizing rather than improving the situation?

The question is neither abstract nor hypothetical. Figure 2 replicates a graph first shown in Athanasios Orphanides' "The Quest for Prosperity Without Inflation."[5] The figure shows the perceived gap between actual and potential GDP throughout the 1970s, with zero being the benchmark of successful policy, conventionally defined. Negative values (particularly large ones) represent situations that call for expansionary monetary policy.[6] This picture makes it clear that the perceived shortfall of output from potential was much greater throughout the decade than was ultimately revealed over time.

Potential GDP was not, of course, treated as an unchanging constant. As figure 2 attests, the estimate of potential was often revised. Those who produced and relied on those estimates, however, believed that changes in the path of potential GDP would evolve fairly slowly and systematically.

The failure of the central bank (and others) to calibrate monetary policy in a manner consistent with noninflationary growth was partly due to the inherently problematic nature of potential GDP. We now understand that even short-run fluctuations in GDP are a part of the normal, dynamic path of the macroeconomy. In other words, the green line in figure 1 (or potential GDP, if you like) probably looks more like the red wavy line than the straight line depicted in the figure.

If the central bank is to conduct monetary policy appropriately,
then reasonable management information systems are imperative.

But the past decade—the New Economy—should have taught us this:
The apparatus we currently employ for making sense of the economy—that is, the measurements
we employ to distill information about the American economic enterprise into
a comprehensible form—are simply inadequate to the task.

Moreover, there is a deeper, related problem to contend with, even if we concede that some (or even a relatively large) residual gap exists between potential and actual GDP at any point in time. Overestimates of cyclical shortfalls in GDP growth in the 1970s were, bottom line, a failure to understand the fundamental forces driving the dynamic path of productivity. We saw the reverse of that confusion (but with much happier results) in the arrival of the New Economy and the "mystery" of lower-than-expected inflation even as GDP growth registered well above what was considered its potential. While the story of the 1970s was unexpected declines in sustained productivity growth, the story of 1990s was just the opposite.

Why do we tend to miss changes in productivity trends so badly? Nobel laureate Robert Fogel suggested the answer in his 1999 presidential address to the American Economic Association: "We are, to some extent, entangled in concepts of the economy and in the analytical techniques that were developed during the first third or so of the century."[7]

We Are What We Measure

The story of economic measurement in the United States really begins with the economist Simon Kuznets—the second Nobel Prize winner to enter our story—who joined the nascent National Bureau of Economic Research in 1927. Shortly thereafter, he began the efforts that led to the first systematic national income and product measures for the United States. Kuznets published his research in 1941 in *National Income and its Composition, 1919–38*, which articulated the foundation for measuring aggregate economic activity as we know it today.

In December 1941, the United States was drawn into World War II. Repeating a common theme in the history of national income accounting, the war accelerated the development of modern national income and product accounts in the United States and prompted the initiation of that development in Britain. Under the influence of the eminent John Maynard Keynes, the creators of the accounts—among them two future Nobel Prize recipients, James Meade and Richard Stone—led the way in approaching the measurement of aggregate production through the measurement of aggregate *expenditure*.

The "fundamental identity" of national income and product accounting—production equals income equals expenditure—had been well appreciated and exploited since the first recognizable national accounts were constructed in the seventeenth century. The Keynesian emphasis on measuring production by measuring expenditure, however, was not merely a matter of following historical precedent. Central to Keynes' interpretation of the world was the presumption that industrial economies could find themselves stuck at levels of production well below what we now call potential GDP, and such events are associated with deficiencies in consumer and business spending.

The Keynesian gestalt still dominates popular thinking about aggregate production. GDP reports are never complete without "experts" intoning nuggets of wisdom along the lines of "GDP growth fell to 2 percent last quarter because investment growth moderated from its previously torrid pace." The expenditure slant on measurement has led us into a mechanical and spuriously causal rhetoric about the dynamic evolution of the economy. Investment expenditure, for instance, is reduced to just one more element of aggregate demand, rather than a central contributor to the nation's productive capacity.

Keynes to Solow to Kydland and Prescott—The Long and the Short of It

The Keynesian emphasis on expenditure—articulated in that economist's *General Theory of Employment Interest and Money*—grew out of a worldview influenced by persistent economic distress in 1920s Great Britain and worldwide depression in the 1930s. That view harbored deep and, in the context of the times, understandable skepticism about the inherent stability of market economies. Keynes' interests were unabashedly focused on the short term, but doubts about market economies' ability to avoid sustained episodes of depression soon found expression in early models of long-run economic growth.[8] The importance of these issues, at a time when democratic governments were competing against socialism and communism as alternatives to market-based economic systems, cannot be overemphasized.

The view that even the long run of a market economy is inherently unstable was soon challenged (and largely vanquished) by Robert Solow, who went on to win the Nobel Prize for his theory of economic growth. Solow provided the theoretical basis for believing that market economies ultimately revert to long-run growth rates that are determined by population growth and the underlying pace of technological advance.

For the most part, Solow's theory of long-run growth[9] and Keynes' short-run business cycle theories remained segregated in the intellectual toolkits of economists and policymakers for nearly a quarter-century after Solow's work was published. Ironically, Solow's case for long-run stability reinforced the notion that cyclical fluctuations in GDP growth are somehow perverse. In the tradition that followed Keynes (which was not necessarily the tradition Keynes intended), the Solow growth path represented the benchmark—potential GDP, if you will—to which sound policy strove. Booms and busts came to be defined as fluctuations around the Solow trend, fluctuations that a talented, wise, and lucky policymaker could, and should, smooth.

The "real business cycle" theory challenged this perspective in the early 1980s. Writing in honor of Solow's Nobel award, Ed Prescott (who, with Finn Kydland, launched the real business cycle approach[10]), articulated the disintegrating distance between short-run and long-run explanations of how economies work: "While [Solow's] theory was developed to account for [long-run] growth observations…, it is surprisingly useful in organizing and understanding business cycle fluctuations as well. It leads us to focus on the co-movements of a particular set of variables: consumption, investment, labor input, capital input, factor incomes, and output."[11]

Kydland and Prescott's contributions helped us to see the possibility that business cycle fluctuations can and should be viewed as part of the same dynamic process that determines the economy's long-term growth. This is a critical insight, because it tells us that policymakers who focus on countercyclical stabilization policies may inadvertently interfere with long-term economic growth. Kydland and Prescott's perspective also reminds us that we can learn a great deal about economic performance by looking at factor inputs (labor, capital, and land) and factor returns (wages, interest rates, profits, and rents)—a lesson that is very different from the standard Keynesian output–expenditure bill of fare.

The idea that long-run growth, business cycle fluctuations, and economic measurement are fundamentally and inextricably linked is central to the real business cycle agenda. Coincidentally, almost as soon as Kydland and Prescott's work reintroduced the long run to the short run by wedding business cycle theory to the Solow growth framework, cracks began to appear in the latter. In the 1980s and 1990s, empirical anomalies and theoretical challenges modified the Solow model's applicability in important ways. The accumulation of economic theory and evidence during the past few decades indicates that we must pay much closer attention to capital than we ever did before, though not in the way we are accustomed.

New Economy, New Theory

In truth, the Solow model is a pretty spare story of economic growth. The source of technological change is left unexplained, bestowed upon the agents of the model economy as manna from heaven. This is hardly a criticism, as the model's purpose was to focus attention on the long-term role of capital accumulation. The shortcuts in Solow's original formulation were well appreciated and intentional. It was not long before economists, Solow included, began to investigate growth and development in richer contexts, including those in which technology adoption required the purposeful action of firms. Through the best part of the next three decades, however, these extensions did little to supplant the basic Solow model—now known as the "neoclassical growth model"—as the central organizing structure for thinking about long-run economic dynamics. In essence, scant evidence existed that the growth phenomena of interest were all that sensitive to the simplest model's simplifying assumptions.

That changed in the 1980s, when Robert Summers and Alan Heston constructed a large and consistent data set on cross-country postwar GDP. One of the neoclassical growth model's key predictions had been that countries should grow at similar rates in the long run. After all, once the exogenous force of Providence has made technological know-how available, it is available to all.[12] Summers and Heston's data were not kind to this prediction, nor to its corollaries.

Analyses of the Summers–Heston data revealed anomalies that coincided with a revival of theoretical challenges to the neoclassical benchmark. The most influential challenge was mounted by Robert Lucas, who emphasized the role of human capital, and Paul Romer, who emphasized the role of research and development.[13] The ideas of Lucas and (especially) Romer were soon extended by others.[14] By emphasizing innovation and technology adoption, these models formalized the ideas of Austrian economist Joseph Schumpeter and helped to launch what is reasonably referred to as neo-Schumpeterian growth theory.[15]

Schumpeterian perspectives received two substantial boosts from the real world in the 1990s. First, a unique source of manufacturing plant–level data collected by the Census Bureau became available; the data provided stark and explicit evidence of the magnitude of job reallocation—especially job destruction—underlying the pattern of cyclical fluctuations in the U.S. manufacturing sector.[16] In other words, the Schumpeterian notion of creative destruction appeared to have solid rooting in evidence from the microeconomic structure of the U.S. economy.

The second shot in the arm was the heralded arrival of the New Economy itself. The rapid and accelerating pace of innovation tempted economists, policymakers, and pundits to speculate about the dawning of a Third Industrial Revolution. That designation, if correct, suggests analogies to the First and Second revolutions and, sure enough, comparisons to previous episodes of major technological advance indicate the designation is apt.[17]

These two streams of empirical observations suggest the economy is best viewed from the vantage of a growth theory in which research and development, the acquisition of labor skills, and new-capital adoption take center stage. It is a story that presents real challenges for measuring—and hence understanding—the world in which we operate.

New Economy, New Measurement

Solow's growth model emphasized capital accumulation. The New Economy, and the new growth theory that appropriately describes it, does not require us to change this focus. What is required, however, is a much broader view of capital, along with a recognition that insights gained from this broader view must expand how economists and policymakers think about measuring investment and output and, more generally, how they think about the way the economy works.

The U.S. economy's rapid evolution—which we associate with the arrival of the New Economy—has exacerbated longstanding difficulties in dealing with quality changes, the introduction of new goods, and so on.[18] It is extremely important, for example, to identify the *effective* stock of capital. The most obvious example is computers—that is, a new 1.5-gigahertz computer has substantially more computing speed and power than a 266-megahertz machine. Therefore, "two" would not be a very satisfactory answer to the question, "how many computers do you have?"

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we have yet to operationalize methods of measuring organizational capital.

If technological progress alters organizational capital, as it does physical and human capital,
then it is subject to same the process of creative destruction,
with consequences for both the long- and short-run paths of economic activity.

While this measurement problem is obviously most difficult for capital that directly embodies new or rapidly evolving technologies, it can make just as much of a difference when measuring nonequipment capital such as buildings or structures. New technologies such as fast elevators, new techniques for heating, ventilation, and air conditioning, and high-speed communication lines, for example, have all greatly increased the productivity of structures that are a part of the capital stock.

These difficulties, however, are well known and seemingly amenable to solutions that do not stray too far from familiar perspectives. The deeper tensions that the New Economy creates for traditional views of long-run dynamics—that is, for the Solow growth framework—may be far more subversive and far reaching. Machines and buildings constitute physical or *tangible* capital, but capital also comprises a vast amount of knowledge, or *intangible capital*. One type of intangible capital is *human capital*—that is, the capital embodied in the education and skills of a nation's workers. Just as a country can produce more output with more physical capital, it can also produce more (for the same quantity of labor) if its workers have more human capital.

Another form of intangible capital is organizational capital: *How* we combine our resources changes as new production techniques drive out less efficient business practices. Imagine two firms with the same capital and labor inputs. They may differ in their management structures or how labor and capital are combined, and, as a result, their productive capacities will differ. Unlike other types of capital, we have yet to operationalize methods of measuring organizational capital. If technological progress alters organizational capital, as it does physical and human capital, then it is subject to the process of creative destruction, with consequences for both the long- and short-run paths of economic activity. How can we understand the creation of new firms and merger activity among existing firms without understanding organizational capital?

Perhaps the most important class of intangible capital is the collection of legal, political, and cultural institutions that defines a coherent society. Hernando de Soto, in his book *The Mystery of Capital*, draws a distinction between assets and capital. Consider, for example, a house. In its simplest form, a house is an asset that provides shelter. In de Soto's view, the house becomes capital when social conditions exist that fix property rights, that provide a mechanism for the property to serve as collateral to support additional economic activity, that allow the property to serve as a centralized location to collect and disperse information that is central to economic exchange, and so on.

It is precisely those intangible conditions, de Soto argues, that have allowed Western industrial countries to prosper where other economies have lagged (in fact, he subtitled the book *Why Capitalism Triumphs in the West and Fails Everywhere Else*). There is a growing body of research in growth and development to support de Soto's thesis. In evaluating the various sources of intangible capital, Prescott concludes:

> ***Adding [private] intangible capital does not make the neoclassical growth model a theory of international income differences… A model with a human capital producing sector fails for similar reasons… My candidate for the factor [that accounts for these differences] is the strength of adoption of new technologies and to the efficient use of currently operating technologies, and this resistance depends upon the policy arrangement a society employs.***[19]

If we are far from incorporating human and private organizational capital into our standard measures of productivity, then we are also far from the larger concepts to which de Soto and Prescott appeal. As debates about global economic integration intensify, it is clear that legal, regulatory, and trade policies can affect economic performance and long-term growth among nations in important ways.

Why Measurement Matters

Understanding the true magnitude of physical, human, and organizational capital stocks—and the processes by which they evolve—is crucial to understanding differences in incomes and wealth across countries. But it is also crucial for understanding the economy's short-run cyclical fluctuations, a point that is often less appreciated and bears emphasis.

To appreciate how appropriate capital measurement might alter our perceptions of short-run economic performance, consider the case of human capital or, more specifically, the cyclical behavior of labor inputs. During expansions, more people enter the workforce, causing employment to rise, while the reverse occurs during contractions. It would be inappropriate, however, to consider each new worker or each hour worked identical to other workers or hours at any other time. As the economy moves from one point in the cycle to the next, the quality of the workforce changes, meaning that effective labor hours will differ over the cycle even if measured hours do not. This happens as less skilled workers are drawn into the workforce during the expansion, and they are typically the first to exit during a contraction. So a measure that simply aggregates total hours of labor is not an accurate measure of true labor input, thus producing errors when calculating labor productivity.[20]

One way that such errors can leach into policy is the much-scrutinized unit labor cost statistics. Unit labor costs are essentially a productivity-adjusted measure of labor compensation. Although the Federal Reserve Bank of Cleveland has strongly cautioned to the contrary,[21] unit labor cost is still widely perceived to be a real-time indicator of potential inflationary pressures. Quite apart from our skepticism about its value, proponents of the measure readily admit that systematic cyclical errors in productivity calculations seriously distort its value.

In particular, failure to accurately measure effective labor inputs causes productivity to be underestimated in periods of rapid growth (because there are fewer effective hours than measured hours) and overestimated in periods of slower growth (because there are more effective hours than measured hours). On the flip side, perceived inflationary pressures will be overestimated in periods of rapid growth and underestimated in periods of slower growth. The policy implication here is that the central bank may be too restrictive when the economy is picking up, or too expansionary when the economy is slowing down.

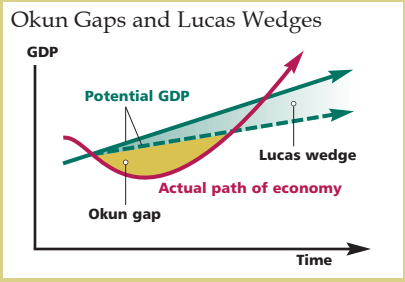
It Takes a Heap of Okun Gaps to Fill a Lucas Wedge

Clearly, productivity mismeasurement has contributed to egregious policy mistakes in the past—monetary policy in the 1970s appears to be the classic case study. Although discussion of that era has tended to focus on short-run cyclical issues, the key insight offered by the new business cycle and growth theories is that the distinction between the long run and the short run is blurry.

The new perspectives that we review here—including the very growth perspectives that question our ability to measure productivity today—raise the stakes on policy missteps considerably. If the interplay of institutions and public policy alters the incentives to innovate, adopt new technologies, develop human capital, and so on (as de Soto, Prescott, and others claim), then they are intrinsic to the economy's growth potential. Small annual changes in the economy's growth trend can accumulate to very large differences over the course of a generation.

FIGURE 3

Okun Gaps and Lucas Wedges



Although the rhetoric of modern central bankers never strays too far from a self-proclaimed focus on inflation and the purchasing power of money, their short-term actions are not far removed from the path of output growth relative to some presumed potential. The so-called "Taylor-rule," for instance, which purports to capture the actual behavior of the Federal Open Market Committee, assigns equal weight to an "inflation gap" and an "output gap."[22]

The central bank's aversion to output fluctuations (represented by the Taylor rule) has a long tradition and has, at times, trumped longer-run worries about inflation. Such behavior is not rooted in ignorance, but in monetary policy's acknowledged role in maximizing the well-being of the citizenry. Because deviations of income and output growth from their long-run trends—sometimes referred to as "Okun gaps"—are perceived as costly to that well-being, it seems irresponsible not to risk the (presumably smaller) costs of a bit of inflation to align the economy with its potential.[23]

The objective of eliminating Okun gaps has dubious value, if most cyclical fluctuations represent the economy's largely efficient dynamic allocation of resources. But even if there is a residual role for stabilization policy—even passive stabilization policy, by which we mean policies aimed at "doing no harm"—the realities of the New Economy are, at least minimally, troubling.

Taken seriously, the new growth theory indicates that existing measures of capital and labor are simply inadequate to the task—which is difficult in the best of circumstances—of accurately assessing the "trend" rate of output at any point in time. Simply put, you can't close gaps that you can't fully conceptualize, let alone can't see.

The stakes are higher if mistakes feed back, in a negative fashion, to the growth path itself. There is a growing body of evidence, for example, that financial market performance is important for economic growth and development, and that inflation has a deleterious effect on both intermediation and equity markets.[24] If a misplaced or imperfectly executed emphasis on smoothing output increases the price level or financial instability and lowers the trend path of the economy even a little bit, the negative consequences could overwhelm any reasonable costs that we could estimate as a result of short-run weakness in the economy.

Figure 3 illustrates the point. We have replicated, as in figure 1, a negative deviation from "potential" of the sort that policymakers are often asked to eliminate. The yellow shaded area represents the output gains from eliminating the downside gap. But suppose the cost of doing so (or attempting to do so) is increased inflation, which reduces the trend to the dotted green line in figure 3. Clearly, the long-run costs of that reduced trend (the green shaded area) can quickly vanquish whatever gains might be enjoyed from short-run stabilization efforts.

We might call the green shaded area in figure 3 a "Lucas wedge," as Robert Lucas put the point plainly: "[E]conomic instability at the level we have experienced since the Second World War is a minor problem,…certainly relative to the costs of modestly reduced rates of economic growth." Modern growth theory (for which Lucas is partially responsible) is unambiguous that we lack the information and measurement systems to effectively stabilize the economy in the short run. Not only that, the negative long-run effect of attempting to do so is a much larger gamble than is generally acknowledged.

Conclusion

In 1927, the same year that Simon Kuznets joined the National Bureau of Economic Research and embarked on the journey that would create the U.S. national income accounting system, the great Austrian physicist Werner Heisenberg published his celebrated Uncertainty Principle. Roughly speaking, the principle proved that the behavior of measured objects is not independent of the measurement process itself.

Heisenberg was, of course, describing a physical phenomenon, so analogies to the realm of social science are necessarily inexact. But economic policy is joined at the hip to economic measurement, and policy itself will, in turn, affect the future course of the economy being measured today. If the New Economy has any validity at all, those who wish to chart its course must find better ways of gauging the effects of new technologies, business practices, and economic policies on the value of land, labor, and capital. Otherwise, we are unlikely to realize the full benefits that rapid innovation can bring to our economy.

When growth was exceptional, we argued against those who saw "excessive" growth as an inflationary threat, representing prima facie evidence of the need for a relatively restrictive monetary policy…

But our argument about heavily discounting the concept of potential output is symmetric; its current implication is for caution against overly aggressive easing in light of slower-than-expected growth.

The lessons of economic theory and hard experience have taught policymakers to mistrust arguments that realized economic growth rates are—when they deviate from average experience—imperfections to be hammered out by an industrious central bank. When growth was exceptional, we argued against those who saw "excessive" growth as an inflationary threat, representing prima facie evidence of the need for a relatively restrictive monetary policy. Our position stemmed from a recognition that the boom was driven largely by firms' desire to install new technologies by modernizing their capital stocks.

In hindsight, it is apparent that the Federal Open Market Committee bent more in this direction during the late 1990s than it would have, if it had still been in the thrall of the Keynesian orthodoxy. But our argument about heavily discounting the concept of potential output is symmetric; its current implication is for caution against overly aggressive easing in light of slower-than-expected growth. Investors, apparently, have signaled they need some time to sort out which technologies and business practices are likely to be profitable going forward. Policies designed to force growth to conform to a predetermined path may prove to be painfully optimistic.

Many theoretical advances of the past several decades have led to better monetary policy. Contemporary understandings of economic growth trace their lineage to some of the earliest writings in economics, but during the Keynesian revolution, growth theory and stabilization theory became uncoupled. Just as the public has come to recognize that complex ecological relationships can be upset as a result of damming a river or polluting a watershed, so too should it appreciate the long-term consequences of attempting to closely manage the business cycle.

Remember the buoyant state of the U.S. economy less than a year ago? Remember those who claimed the New Economy meant the end of the business cycle? We cannot emphasize too strongly that such a prospect was never credible, and it is beside the point. The critical point of the New Economy is that the role once played by land in an agricultural economy, superceded by physical capital in the industrial economy, is rapidly being replaced by human capital and information management in the knowledge economy. New firms arise on a foundation of new capital and business practices, forcing old firms to follow suit. Creative destruction has been unleashed on a global scale, bringing manifest challenges and commensurate opportunities to everyone.

Monetary policymakers already recognize the importance of better output and price measures in a knowledge-driven economy. Equally important, we contend, will be broadening our understanding of *how* we produce in a knowledge-driven economy. The New Economy intuition that benefited U.S. monetary policy in the last decade is unlikely to persist indefinitely without a willingness and ability to measure economic activity not as gaps to be closed today, but as springboards to tomorrow.

Footnotes

1 This should not be confused with any particular opinion as to what these sympathies might imply about the appropriate level of the federal funds rate target at any particular time.

2 This passage is taken from the definition of "New Economy" offered in the *Economic Report of the President*, January 2001 (Government Printing Office, 2001), p. 23.

3 Testimony of Chairman Alan Greenspan, *Monetary Policy Report to the Congress*, Senate Committee on Banking, Housing, and Urban Affairs, February 13, 2001. The full text of Chairman Greenspan's remarks is available at http://www.federalreserve.gov/boarddocs/hh/2001/february/testimony.htm.

4 This view is evidenced in several of the papers presented at the Federal Reserve Bank of Cleveland's Workshop on Learning and Model Misspecification, held February 2–3, 2001. Those papers can be found at http://www.clev.frb.org/Research/conf2001/learning/index.htm.

5 We are indebted to Athanasios Orphanides for providing us with the data for figure 2, which appears as figure 11 in his paper (European Central Bank, Working Paper no. 15, March 2000). That paper provides a detailed analysis of the policy record of the 1970s and carefully assesses the relative impact of misunderstanding the state of the economy versus miscalculating potential GDP. Orphanides concludes the latter was the more critical source of policy errors.

6 A similar interpretation is applied to the recently released Index of National Economic Activity, developed by the Federal Reserve Bank of Chicago. It differs from the measures in figure 2 in that potential output is calculated relative to a broad measure of economic activity. See Jonas Fisher, "Forecasting Inflation with a Lot of Data," Federal Reserve Bank of Chicago, *Chicago Fed Letter*, no. 151, March 2000.

7 Robert W. Fogel, "Catching Up with the Economy," *American Economic Review*, vol. 89, no. 1 (March 1999), pp. 1–21.

8 These models, associated with the economists Evsey Domar and Richard Harrod, are generally referred to as Harrod–Domar growth models.

9 Solow did not, of course, develop his ideas in isolation. David Cass, Trevor Swan, and Edward Denison, in particular, are also associated with the invention of modern growth theory. Still, Solow's name tends to be the common denominator, and we will persist in modifying the model with his name, without prejudice to other contributors.

10 The other seminal contribution to real business cycle theory was John Long and Charles Plosser, "Real Business Cycles," *Journal of Political Economy*, vol. 91, no. 1 (March 1983), pp. 39–69. The Long–Plosser analysis was conducted in an input–output framework, the modern variation of which was developed as a national accounting framework in 1941 by the Nobel-honored economist Wassily Leontieff. Although Leontieff's system shared a conceptual foundation with Kuznets' work (and that of Nobel laureates Sir Richard Stone and James Meade in the United Kingdom), Kuznets' survived as the standard for measuring aggregate economic activity. In the real business cycle literature, Long and Plosser's modeling approach was largely abandoned in favor of that used by Kydland and Prescott, which became the standard largely because it was better suited to considering more general classes of problems. However, Kydland and Prescott's model was also more tightly connected to the familiar tools and techniques for measuring national economic activity inherited from Kuznets.

11 Edward C. Prescott, "Robert M. Solow's Neoclassical Growth Model: An Influential Contribution to Economics," *Scandinavian Journal of Economics*, vol. 90., no. 1 (1988), pp. 7–12.

12 In her book, *Inventing the Industrial Revolution* (Cambridge, U.K.: Cambridge University Press, 1988), historian Christine Macleod notes: "Concepts of technical progress among intellectuals in the late seventeenth century were fatalistic. Improved methods of discovery gave every confidence of a wealth of new inventions to come, but progress could only be as fast as Providence allowed or dictated." Late-eighteenth-century economists—with the notable exception, perhaps, of Adam Smith—abandoned this view in favor of one in which technological progress arises from the purposeful actions of inventors and entrepreneurs. Ironically, then, the representation of technology growth in the neoclassical framework is a throwback to ideas that had existed prior to the Enlightenment.

13 Extending our streak of Nobel name dropping, Lucas' model builds on Gary Becker's groundbreaking research on human capital.

14 Notably, Gene Grossman and Elhanen Helpman, and Phillip Aghion and Peter Howitt.

15 Schumpeter coined the phrase "creative destruction" in his 1950 book *Capitalism, Socialism, and Democracy*, wherein he described capitalism as a system "that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one." For an overview of Schumpeter's ideas, see "Theory Ahead of Rhetoric: Economic Policy for a 'New Economy,'" Federal Reserve Bank of Cleveland, *1999 Annual Report*, p. 14.

16 See, in particular, Steven J. Davis, John C. Haltiwanger, and Scott Schuh, *Job Creation and Destruction* (Cambridge, MA: MIT Press, 1996).

17 See Jeremy Greenwood, "The Third Industrial Revolution: Technology, Productivity, and Income Inequality," Federal Reserve Bank of Cleveland, *Economic Review*, vol. 35, no. 2 (1999 Quarter 2), pp. 2–12.

18 These themes were emphasized in Chairman Alan Greenspan's remarks at the Washington Economic Policy Conference on the Challenge of Measuring and Modeling a Dynamic Economy, sponsored by the National Association for Business Economics, March 27, 2001. The full text of Chairman Greenspan's remarks is available at http://www.federalreserve.gov/boarddocs/speeches/2001/.

19 Edward C. Prescott, "Needed: A Theory of Total Factor Productivity," *International Economic Review*, vol. 39, no. 3 (August 1998), pp. 525–52.

20 For a detailed analysis, see Finn E. Kydland and Edward C. Prescott, "Cyclical Movements of the Labor Input and Its Implicit Real Wage," Federal Reserve Bank of Cleveland, *Economic Review*, vol. 29, no. 2 (1993 Quarter 2), pp. 12–23.

21 See Gregory D. Hess and Mark E. Schweitzer, "Does Wage Inflation Cause Price Inflation?" Federal Reserve Bank of Cleveland, *Policy Discussion Papers*, no. 1, April 2000.

22 See Orphanides (2000) for a critical interpretation of the historical record with respect to the Taylor rule.

23 The costs of inflation are often represented as the loss in surplus value that a consumer suffers when the inflation rate is higher than the optimal (surplus-maximizing) level. In a simple money-demand graph, this loss is represented as a segment of the area under the demand curve, known as a "Harberger triangle." The sentiment that the losses involved in such an analysis are too small for government work was famously expressed by Nobel laureate James Tobin, who proclaimed, "it takes a heap of Harberger triangles to fill an Okun gap."

24 See, for example, Thorsten Beck, Ross Levine, and Norman Loayza, "Finance and Sources of Growth," *Journal of Financial Economics*, vol. 58, no. 1/2 (October/November 2000), pp. 261–300; and John H. Boyd, Ross Levine, and Bruce D. Smith, "The Impact of Inflation on Financial Sector Performance," *Journal of Monetary Economics*, forthcoming.