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Remarks by

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Chairman

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The increase in nonfarm business output per hour over the past year will almost surely be reported as one of the largest advances, if not the largest, posted over the past thirty years. We at the Federal Reserve, along with our colleagues in government and the private sector, are struggling to account for so strong a surge. We would not be particularly puzzled if the increases in output per hour were occurring during a period of very rapid economic growth, such as has often attended recoveries from steep recessions. Historically, such recoveries have allowed overhead and maintenance employee hours to be spread over a rapidly increasing level of production. But during the past year we averaged only modest economic growth.

The reported estimates of output per hour do not appear to have resulted principally from faulty data or measurement error. Whether output is measured from the expenditure side or from the independently estimated income side of the national accounts, and whether hours of work are measured from the survey of establishments or the survey of households, the same basic result is clearly evident: an impressive gain in output per hour over the past year. This conclusion is buttressed by recent sizable increases estimated for labor productivity for the manufacturing sector, derived from a data system that, for the most part, is independent of the national accounts.

To be sure, because the productivity feast of recent quarters has been so difficult to explain, many analysts expect a productivity famine in the period ahead. Others, however, are not so pessimistic. Regardless of how events unfold, we will need to confront difficult questions posed by the recent performance of productivity, if we are to properly evaluate economic developments going forward.

Indeed, if the recent surge in measured productivity is not a statistical mirage, or if it is not expunged by data revisions, then we need to ask about its possible causes.

Clearly, over the past year corporate managers, confronted with tepid demand and a virtual disappearance of pricing power, have struggled to maintain profit margins. With price increases largely off the table and demand soft, lowered costs have become the central focus of achieving increased profitability. On a consolidated basis for the corporate sector as a whole, lowered costs are generally associated with increased output per hour.

Much of the recent reported improvements in cost control doubtless have reflected the paring of so-called “fat” in corporate operations--fat that accumulated during the long expansion of the 1990s when management attention was focused primarily on the perceived profitability of expansion and less on the increments to profitability that derive from cost savings.¹ Managers, now refocused, are pressing hard to identify and eliminate those redundant or non-essential activities that accumulated in the boom years.

Now, with margins under pressure, businesses effectively have been reorganizing work processes and re-allocating resources so as to use them more productively. Moreover, for capital with active secondary markets, such as computers and networking equipment, productivity may also have been boosted by a reallocation to firms that could use the equipment more efficiently. For example, healthy firms reportedly have been buying equipment from failed dot-coms.

Businesses also may have managed to eke out increases in output per hour by employing their existing workforce more intensively. Unlike cutting fat, which permanently elevates the

¹There are those who point out, quite correctly, that a significant part of the output of the late 1990s was wasted in a misallocation of capital to pie-in-the-sky ventures. But that output was misused does not subtract from the evident capacity to produce that output, and it is this that our measures of structural productivity attempt to capture.

levels of productivity, these gains in output per hour are often temporary, as more demanding workloads eventually begin to tax workers and impede efficiency.

Perhaps the return to a low-inflation environment in recent years in itself explains the intensification of competitive pressures, which has been a spur to the growth of productivity. Indeed, the data do suggest a relationship between inflation and productivity growth over the long run. But that statistical relationship is modest at best and inferring causality is complicated by a circularity that arises because increased growth in output per hour depresses unit labor costs and, hence, prices.

Taken at face value, historical relationships suggest low inflation would explain very little of the most recent surge in output per hour. To be sure, while lack of pricing power and associated competitive pressures may have initiated much of the cost cutting and organizational changes that have occurred, it will ultimately be the quantity of fat in the system and the opportunities for productive reorganization that will determine the potential gains in productivity.

Only in retrospect, if then, will we be able to ascertain how much of the past year's elevated growth in output per hour was transitory--that is, growth that resulted from cutting of fat, reorganizing operations, and more fully exploiting technologies already embedded in the existing capital stock. Such improvements, even though they are long-lasting, are, of course, a level adjustment with no necessary implications for productivity growth going forward. Moreover, there is an upper limit to the amount of output that can be produced from an existing facility, even in the short run, no matter how intensively it is employed and how much fat is taken out of the system. Corporate management can not unendingly reduce cost without at some point curtailing output or embodying new technologies through investment to sustain it.

The recent upsurge in the growth of output per hour has understandably renewed interest in the relationship between investment and so-called adjustment costs. Firms do not necessarily reap the full benefits of their capital investments immediately because of the disruptions to activity that can be initially created when new equipment is installed; these disruptions may include learning to use the new equipment and software or getting the new machines to mesh with existing systems. Thus, although capital investment ultimately boosts output per hour, these adjustment costs temper the initial benefits to increased production obtained from new investment.

It is likely that as capital spending fell over the past couple of years, so did the disruptions that accompanied its installation. Moreover, the dislocations associated with the substantial investment of the late 1990s and 2000 also likely were waning. This lower level of disruption provides a boost to growth in output per hour for a time. How much remains an open question. The quantitative evidence on the magnitude of this effect spans the range from significant to small.²

The ability of businesses to boost productivity with what seems to be minimal new capital investment over the past two years suggests that output per hour growth in the later years of the 1990s likely trailed the growth in underlying productivity in those years. If this inference is

²Susanto Basu, John Fernald, and Matthew Shapiro, in their paper "Productivity Growth in the 1990s: Technology, Utilization, or Adjustment?," *Carnegie-Rochester Conference Series on Public Policy*, (April 2001) pp. 117-165, find significant effects. Frank Lichtenberg, in his paper "Estimation of the Internal Adjustment Costs Model Using Longitudinal Establishment Data," *Review of Economics and Statistics*, vol. 70 (1988), pp. 421-430, finds much smaller effects.

accurate, part of that earlier growth in underlying productivity is being reflected in today's gains in output per hour.

The difficulty in explaining the recent past is most evident when we decompose gains in output per hour into the contribution from changes in worker quality, the amount of capital used by workers--that is, capital deepening--and the contribution from all other factors, a notion that economists label "multifactor productivity." By definition, multifactor productivity includes technical change, organizational improvements, cyclical factors, and myriad other influences on output per hour, apart from capital investment. With capital spending sluggish over the past year, and no evident acceleration of worker quality, it is likely that growth of multifactor productivity accounts for an appreciable portion of the rise in output per hour.

Based on historical experience, it seems improbable that all of the large rise in multifactor productivity could be attributed to cyclical or transitory factors. Conversely, it seems very unlikely that all of the increase in the growth of productivity could be attributed to structural influences. The truth, presumably, lies between these two extremes, but where has yet to be determined. At minimum, however, it seems reasonable to conclude that the step-up in the pace of structural productivity growth that occurred in the latter part of the 1990s has not, as yet, faltered.

Indeed, high growth of productivity over the past year merely extends recent experience. Over the past seven years, output per hour has been growing at an annual rate of more than 2-1/2 percent, on average, compared with a rate of roughly 1-1/2 percent during the preceding two decades. Although we cannot know with certainty until the books are closed, the growth of productivity since 1995 appears to be among the largest in decades.

Our nation has had previous concentrated bursts of technological innovation. In those instances, business practices slowly adapted to take advantage of the new technologies. The result was an outsized increase in the level of productivity spread over a decade or two, with unusually rapid growth rates observed during the transition to the higher level.

For example, as the benefits that attended the development of the electric dynamo and the internal combustion engine more than a century ago became manifest in both the capital stock and the organization of production, the growth of labor productivity surged. From an average annual rate of 1-3/4 percent in the late nineteenth and early twentieth century, it jumped to a 3-3/4 percent rate in the decade following World War I. Subsequently, productivity growth returned to a 1-3/4 percent pace. Then, for the quarter-century following World War II, productivity growth rose to an average rate of 2-3/4 percent before subsiding to a pace of 1-1/2 percent annually from the mid-1970s to the mid-1990s.³

Arguably, the pickup in productivity growth since 1995 largely reflects the ongoing incorporation of innovations in computing and communications technologies into the capital stock and business practices. Indeed, the transition to the higher permanent level of productivity associated with these innovations is likely not yet completed.

Surveys of purchasing managers in recent quarters consistently indicate that an appreciable share reports that their firms still have a considerable way to go in achieving the

³In contrast to the boom in productivity after World War I, which many economists associate with a few key innovations, analysts usually ascribe the post-World War II boom to innovations in many sectors reflecting the diffusion through the private economy of (a) new technologies that appeared in the 1930s but were not fully implemented during the Depression, and (b) a gradual application to civilian activities of military-related innovations. Sectors with major innovations included electronics, chemicals, pharmaceuticals, and transportation (jet travel).

desired efficiency from the application of technology to supply management. If the backlog of unexploited long-term profitable technologies remains high, it should be assumed that once currently elevated risk premiums and the heightened cost of equity capital (and some debt) recedes, or cash flows expand, new productivity-enhancing capital investment will pick up.

Further evidence that firms still have not fully adapted their operations to the latest state of technology also is provided in a recent study⁴ that attempts to measure the “technological gap”—that is, the difference between the productivity of leading-edge capital and the average productivity embodied in the current capital stock. This gap is estimated to be quite wide currently, which suggests that there are still significant opportunities for firms to upgrade the quality of their technology and with it the level of productivity.

The paper presented by Stephen Oliner and Dan Sichel this morning also provides a basis for arguing that a significant portion—and possibly all—of the productivity revival of the mid-1990s is sustainable. Based on an analysis of a multisector growth model, their work suggests that a range for sustainable growth in labor productivity over the next decade is 2 percent to 2-3/4 percent per year. Jorgenson, Ho, and Stiroh use a similar methodology and find a range from a little less than 1-1/2 percent to about 3 percent with a central tendency of around 2-1/4 percent.⁵

⁴Jason G. Cummins and Giovanni L. Violante, “Investment-Specific Technical Change in the United States (1947-2000): Measurement and Macroeconomic Consequences,” *Review of Economic Dynamics*, vol. 5 (April 2002), pp. 243-284.

⁵Dale W. Jorgenson, Mun S. Ho, and Kevin J. Stiroh, “Projecting Productivity Growth: Lessons from the U.S. Growth Resurgence,” Federal Reserve Bank of Atlanta *Economic Review*, Third Quarter 2002, p. 1-13.

These estimates are clearly plausible, but history does raise some warning flags concerning the length of time that productivity growth continues elevated. Gains in productivity remained quite rapid for years after the innovations that followed the surge of inventions a century ago. But in other episodes, the period of elevated growth of productivity was shorter. Regrettably, examples are too few to generalize. Hence, policymakers have no substitute for continued close surveillance of the evolution of this current period of significant innovation.

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In summary then: given the difficult adjustments that our economy has been undergoing, long-term productivity optimism may currently seem a bit out of place. It may appear even more so in the months ahead should output per hour soften following this period of outsized gains. Nevertheless, it is both remarkable and encouraging that, despite all that has transpired over the past couple of years, a significant step-up in the growth of productivity appears to have persisted.