

The Productivity "Slowdown": A Sectoral Analysis

By Charles S. Morris

Widespread concern has surfaced in recent years over the slowdown of labor productivity growth in the United States since 1973. Although productivity grew rapidly in 1983, official measurements of annual productivity growth over the previous nine years averaged only 0.7 percent, far below previous rates. This slowdown is believed by many to be partly responsible for the low economic growth and high inflation in the 1970s and early 1980s. Accordingly, many have advocated governmental action. For example, the President's Council of Economic Advisers stated that "a program to stimulate productivity growth must be a keystone of economic policy."¹

The advisability of policy actions to reverse the productivity growth slowdown depends on understanding its causes. If, as most economists believe, the slowdown reflects a decline in the underlying trend growth rate of productivity, it might be advisable to implement long-run policies to reverse the slowdown. If, however, there has not been a trend productivity growth slowdown, say, because of errors in official measurements of productivity, no policy action would be necessary.²

This article argues that there has been no slowdown in trend labor productivity growth since

1973. The first section presents an overview of productivity behavior in the postwar period, including traditional estimates of trend productivity growth since 1973. The second section discusses alternative explanations of measured productivity growth since 1973. The third section presents empirical evidence that trend productivity growth has not decreased since 1973 either in the economy as a whole or in major business sectors. Policy implications of these findings are discussed in the conclusion.

Overview of trend productivity growth

Labor productivity measures the amount of goods and services produced by one worker in a given time period.³ Several factors affect labor

¹ Council of Economic Advisers, *Economic Report of the President*, U.S. Government Printing Office, 1981, p. 69.

² Recent research by Michael R. Darby has shown that there has not been a trend productivity growth slowdown since 1973. See Michael R. Darby, "The U.S. Productivity Slowdown: A Case of Statistical Myopia," *American Economic Review*, forthcoming June 1984. Preliminary evidence of the lack of a decline in trend productivity growth since 1973 was also found by George L. Perry, "Potential Output and Productivity," *Brookings Papers on Economic Activity*, 1977:1, pp. 11-47.

³ Although productivity is measured in many ways, the most common measure, output per manhour worked (hourly productivity), is used here.

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productivity growth. Some, such as the influences of business cycles, have only temporary effects. Others affect the long-run trend of productivity growth. This section explains the concept of trend productivity growth. Traditional methods of measuring trend productivity growth are then used to show why most economists believe trend productivity growth has slowed since 1973.

Trend labor productivity growth — the growth that would occur if all resources in the economy were fully employed at desired levels — depends on several factors. For every hour worked, more goods and services will be produced if better technological processes are used, if workers have more machinery with which to work, or if the workers themselves have better skills. Thus, trend labor productivity growth increases with increases in the speed of technological progress, the growth of capital relative to labor, and the growth of workers' skills.⁴

Because of cyclical factors, actual productivity growth can differ from trend productivity growth over short periods. The difference is called cyclical productivity growth. Cyclical fluctuations in the economy cause actual resource employment levels to deviate from fully employed desired levels. These cyclical variations in resource employment cause the actual time path of productivity to fluctuate about the trend path. Although rarely equaling trend, actual productivity moves toward the trend as the economy moves toward full employment of resources. Because the cyclical and trend components of productivity cannot be observed separately, studies of trend productivity often lead to

⁴ Strictly speaking, trend productivity growth depends on the growth rate of the fully employed and desired ratio of capital to labor. Of course, many other factors also affect the growth of trend productivity. These other factors are not mentioned here because they are either not quantifiable or have not been found to have a statistically or economically significant influence on trend labor productivity growth in previous studies.

different conclusions.

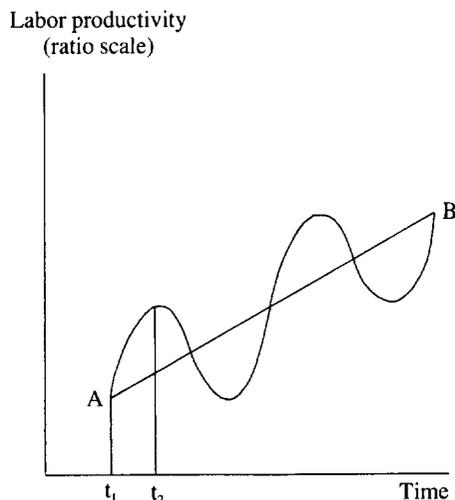
The difference between trend and actual productivity growth can be clarified by examining Figure 1. Suppose that the line AB represents the path of trend labor productivity. Because of cyclical variations in productivity, actual productivity, represented by the S-shaped curve, fluctuates about the trend path. For example, from time t_1 to time t_2 , cyclical productivity growth is positive and actual growth exceeds trend growth.

Trend productivity growth traditionally has been measured by actual growth from one year of high resource utilization to another. If trend productivity growth were estimated simply by calculating actual productivity growth over arbitrary periods of time, the estimate would partly reflect the influence of cyclical productivity growth. But if resource utilization rates are the same at the beginning and end of a period, actual productivity growth will be an accurate estimate of trend growth over that period.

Traditional estimates suggest that trend productivity growth slowed in the middle to late 1960s and slowed further after 1973. These estimates are shown in Table 1 for the U.S. private business sector and several subsectors. According to these estimates, which measure actual productivity growth between years of high resource utilization, trend productivity grew slower in every sector from 1968 to 1979 than from 1948 to 1968. The evidence also suggests that a further slowdown in trend growth started in 1974. The annual rate of trend productivity growth in the aggregate private business sector is estimated as having fallen from 3.1 percent over the 1948-68 period to 1.4 percent over the 1968-79 period. Within this later subperiod, it is estimated that trend productivity grew at an annual rate of 2.1 percent from 1968 to 1973, but only 0.8 percent from 1973 to 1979.

Although trend productivity growth first began to slow after 1968, most analysts have focused on the apparent second slowdown that began in

FIGURE 1
Hypothetical time paths
of actual and trend labor productivity



1974. One reason for focusing attention on the period after 1973 is that policy actions aimed at reversing the earlier slowdown were deemed to be unnecessary. The major reason, however, is that traditional estimates suggest that the apparent slowdown that began after 1973 was more severe than the first slowdown. According to the traditional estimates in Table 1, the decline in the annual rate of aggregate trend productivity growth from the 1948-68 period to the 1968-73 period was only 1.0 percent. Indeed, trend productivity growth in the important manufacturing sector rose in the later period. For these reasons, the productivity growth slowdown that began in the 1960s is generally considered "small, readily explained, and not particularly worrisome."⁵ In contrast, the traditional estimates show a more pronounced and more pervasive decline in trend productivity growth after 1973. According to these estimates, aggregate trend productivity growth fell to less than 1.0 percent a year, with all major sectors sharing in the overall decline.

Because the apparent severity of the productiv-

ity growth slowdown after 1973 is the basis for recommending government actions to stimulate productivity growth, the remainder of this article concentrates on explaining trend productivity growth since 1973. If it is found that the traditional estimates are misleading in suggesting a second slowdown in trend productivity growth after 1973, the case for government actions would depend on the magnitude and causes of slower productivity growth over the entire 1968-79 period.⁶

Alternative explanations of labor productivity growth since 1973

Many reasons have been given for the measured decline in labor productivity growth beginning in 1974. These explanations fall into two general categories. The conventional explanations hold that there actually has been a slowdown in trend productivity growth. Some of these studies attribute the slowdown in trend productivity growth to a slower rate of technological progress, some to a slower rate of capital accumulation, and others to the unexpected increases in energy prices in 1973-74. Michael R. Darby, on the other hand, attributes the measured decline in trend productivity growth to distortions in measured output resulting from the price controls of the early 1970s rather than to a true decline in trend growth.

⁵ Edward F. Denison, "The Interruption of Productivity Growth in the United States," *The Economic Journal*, March 1983, p. 56.

⁶ There is evidence that policy actions aimed at reversing the productivity growth slowdown over the entire period from the 1960s to the present are unnecessary. For example, Darby found that slow trend productivity growth over the 1965-79 period can be explained entirely by changes in the demographic composition of the labor force in terms of age, sex, place of birth, and education ("The U.S. Productivity Slowdown"). As new workers gain experience and learn new skills, however, trend productivity growth should increase automatically. Therefore, if demographic factors are the major cause of slow trend productivity growth over the 1965-79 period, policy actions are not only unnecessary but also inappropriate.

TABLE 1
Traditional estimates of trend productivity growth
 (percent per year)

| | U.S. Private Business Sector | | | | |
|---------|------------------------------|-------------------|------------------|---------------|---------|
| | Total | Service-Producing | Goods-Producing* | | |
| | | | Total | Manufacturing | Farming |
| 1948-79 | 2.5 | 2.0 | 3.0 | 2.6 | 4.7 |
| 1948-68 | 3.1 | 2.4 | 3.7 | 2.7 | 5.1 |
| 1968-79 | 1.4 | 1.1 | 1.7 | 2.4 | 4.0 |
| 1968-73 | 2.1 | 1.5 | 2.8 | 3.5 | 5.0 |
| 1973-79 | 0.8 | 0.8 | 0.8 | 1.5 | 3.2 |

NOTE: Based on data constructed by Elliot Grossman for the American Productivity Center.

*The goods-producing industries are manufacturing, farming, mining, and construction. Separate results are not reported for the mining and construction sectors due to data limitations.

Conventional explanations

Some studies, such as those by Edward Denison, attribute the decline in trend productivity growth since 1973 to a reduction in the pace of technological progress.⁷ These studies explain trend productivity growth by using all variables other than technological progress that are thought to affect trend productivity growth. The part of trend productivity growth that these variables do not explain is attributed to technological progress. While these studies found a slowdown in trend productivity growth, they could not explain it and, therefore, attribute the slowdown to a reduction in the pace of technological progress.

Other studies claim that slower capital accumulation caused trend productivity growth to decline after 1973.⁸ For this factor to explain a permanent decrease in trend productivity growth, it must be assumed that the slower capital accumulation rate reflects a decline in the long-run

growth rate of the desired capital stock. The slower growth of desired capital relative to labor would, according to these studies, cause the growth rate of trend labor productivity to decline.

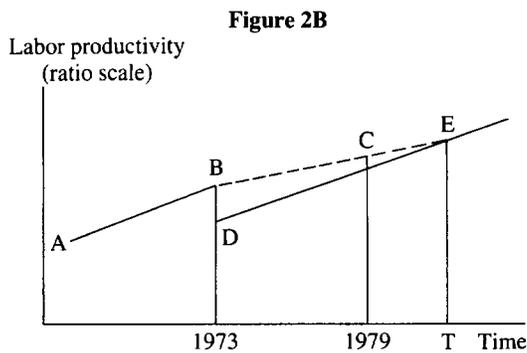
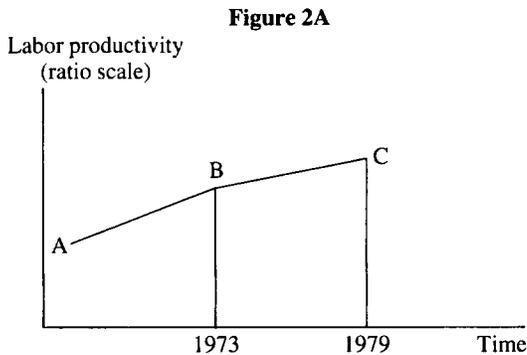
The growth path of trend productivity implied by these two explanations is shown in Figure 2A. Whether because of slower technological progress or slower capital accumulation, trend productivity grew slower after 1973 than before, as indicated by a decline in the slope of the trend productivity path after 1973.

The most popular explanation of the productivity growth slowdown is that it resulted from the energy price increases in late 1973.⁹ According to the energy price explanation advocated by Robert Rasche and John Tatom, unexpected increases in the relative price of oil in 1973-74 reduced the amount of energy used in production. For a given level of hours worked, this reduction in energy use caused real output and, therefore, trend productivity to decline. Furthermore,

⁷ For example, see Edward F. Denison, *Accounting for Slower Economic Growth: The United States in the 1970s*, Washington: The Brookings Institution, 1979, and Denison, "The Interruption of Productivity Growth," pp. 56-77.

⁸ For example, see J. R. Norsworthy, Michael J. Harper, and Kent Kunze, "The Slowdown in Productivity: Analysis of Some Contributing Factors," *Brookings Papers on Economic Activity*, 1979:2, pp. 387-421.

FIGURE 2
Growth paths of trend productivity
according to conventional explanations



because energy using capital is more expensive to operate, the desired capital growth path also declined, thereby causing a further decrease in the trend productivity growth path.

If the capital stock fell immediately, productivity would also fall immediately, so that trend productivity growth would not appear to have

⁹ The extensive development of this explanation is due to Robert H. Rasche and John A. Tatom. See John A. Tatom, "Energy Prices and Capital Formation: 1972-1977," Federal Reserve Bank of St. Louis *Review*, May 1979, pp. 2-11, and Robert H. Rasche and John A. Tatom, "Energy Price Shocks, Aggregate Supply and Monetary Policy: The Theory and International Evidence," *Carnegie-Rochester Conference Series on Public Policy*, Spring 1981, pp. 9-93. See also Council of Economic Advisers, *Economic Report of the President*, U.S. Government Printing Office, January 1977, pp. 45-57.

declined. Immediate adjustment of the capital stock does not occur, however. Instead, capital accumulation slows temporarily, with the result that the actual capital stock slowly approaches the lower desired level. Until the new desired capital stock is reached, the growth of capital relative to labor will decline, causing the growth of labor productivity to fall. Although the decline in productivity growth is only temporary, until the new growth path is reached, trend productivity growth will appear to have declined.

The growth path of labor productivity implied by the energy price shock explanation is shown in Figure 2B. According to this explanation, the trend productivity growth path shifts downward after 1973. This is shown by a parallel shift in 1973 of the trend productivity growth path from AB to DE. Actual productivity, however, does not decline immediately to the lower level. Instead, it gradually approaches DE along the path indicated by the dashed line BCE. Thus, the path of actual labor productivity is indicated by the path of ABE. Until the lower equilibrium level is reached at time T, trend productivity growth will appear to have declined.

The price control explanation

According to the price control explanation developed by Darby, trend productivity growth did not decline further after 1973 but only appears to have declined.¹⁰ The price control pro-

¹⁰ The theoretical argument is developed in Michael R. Darby, "Price and Wage Controls: The First Two Years," and "Further Evidence" in K. Brunner and A. H. Meltzer, eds., *The Effects of Price and Wage Controls*, *Carnegie-Rochester Conference Series on Public Policy*, Vol. 2, supplement to the *Journal of Monetary Economics*, April 1976, and Michael R. Darby, "The U.S. Economic Stabilization Program of 1971-1974," in M. Walker, ed., *The Illusion of Wage and Price Control*, Fraser Institution, Vancouver, 1976. The price control explanation is tested in Michael R. Darby, "The Price of Oil and World Inflation and Recession," *American Economic Review*, September 1982, pp. 738-51, and Darby, "The U.S. Productivity Slowdown."

gram of the early 1970s, it is argued, led to a measured level of productivity above the true level in 1973. Although the measurement error was eliminated by 1979, the estimate of trend productivity growth over the 1973-79 period was less than the true growth rate because the measured level of productivity was biased upward at the beginning of the period. Therefore, there appeared to be a decline in trend productivity growth even though there was none.

Under the Nixon administration's Economic Stabilization Program, price controls went through four phases lasting from the third quarter of 1971 through the third quarter of 1974. Phases I and II imposed strict controls on wages and prices from the third quarter of 1971 to the first quarter of 1973. During that time, the price of a product could be raised only if it could be shown that the quality of the product had been improved since controls went into effect and that higher costs were incurred in producing the higher quality product. Phases III and IV were periods of decontrol lasting from the second quarter of 1973 through the third quarter of 1974. Over that period it was much easier for producers to raise their prices. By the start of the fourth quarter of 1974, the price control program had been eliminated.

During phases I and II, when prices were essentially fixed, measured productivity growth overstated true growth. Phases I and II took place during a period when aggregate demand growth exceeded growth in real output. In the absence of price controls, this excessively rapid aggregate demand growth would have caused prices to rise. But because prices were fixed, measured prices increasingly understated the prices that would have prevailed. As this gap increased, the incentive for producers to evade the price controls increased. Producers could evade the price controls either by producing lower quality products without informing government officials, or by falsely claiming that they were producing a

higher quality product so that prices could be increased somewhat. Either way, measured prices were less than true prices.¹¹ Although efforts are made to take account of quality changes in computing the price level, it is doubtful that the quality changes hidden from price administrators were adequately taken into account. As a result, measured prices fell progressively further below true prices, while measured real output (the nominal value of output divided by the measured price level) rose progressively above the true level of real output. Accordingly, measured labor productivity progressively overstated the true level of productivity. Therefore, measured productivity grew faster than true productivity over the first half of the price control program.

During phases III and IV, the decontrol period, an opposite sequence of events led to official measurements of productivity growth that understated the true growth. By the fourth quarter of 1974, when price controls were eliminated completely, the measured price level accurately reflected the true price level. As a result, measures of real output and productivity were accurate. Because measured productivity was greater

¹¹ For a price index to reflect true prices faced by individuals, changes in the quality of component products must be taken into account. This can be seen in the following example. Suppose that the weight of a 20 cent candy bar is reduced from 10 to 5 ounces, but the price is not changed. The quality reduction, in this case, takes the form of a weight reduction. Because only half as much candy is received for the same amount of money, the price of the candy has actually doubled. If such changes in quality are ignored when price indexes are computed, the indexes will be a misleading indicator of the true cost of living. In this example, the measured price understates the true price by 50 percent. Furthermore, the measured real output of candy bars (the nominal value divided by price) will be twice the true quantity of candy produced. To avoid these problems, attempts are made to take account of even very subtle changes in quality when price indexes are computed. For a microeconomic analysis at the firm and industry level of the effects of price controls on the quality of output, see Sung Hee Jwa, "Price Controls: A New Look at Old Matters — Theoretical and Empirical Analysis of the Effects of Price Controls on Quality Offerings," Ph.D. Dissertation, UCLA, Department of Economics, 1982.

than true productivity at the start of phase III but equal to true productivity at the end of phase IV, measured productivity must have grown slower than true productivity over the decontrol period. Thus, measured productivity growth understated true productivity growth over the last half of the price control program.

The growth path of productivity implied by the price control explanation is shown in Figure 3. The growth rate of trend labor productivity is indicated by the slope of the trend growth path, AF. During phases I and II, measured productivity grew along BC, rising above the true growth path, BC'. During the decontrol phases, measured productivity returned to the true growth path along CE. From then on, labor productivity was measured accurately along the true growth path, EF.

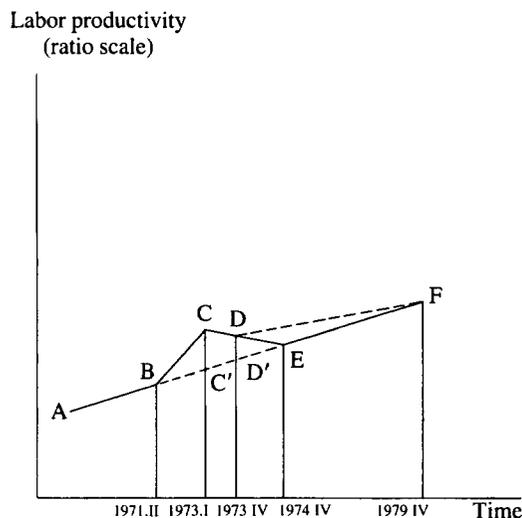
Because the true level of productivity was overstated in 1973, the estimated growth rate of trend productivity over the 1973-79 period is less than the true growth rate. That is, trend productivity growth appeared to decline when, in fact, it did not. In Figure 3, the true growth rate of trend productivity over the 1973-79 period equals the slope of D'F. Trend growth, however, is estimated by the growth of measured productivity from 1973 to 1979, the slope of DF. Because the estimated growth of trend productivity is less than the true growth, trend productivity growth appeared to have declined.

The behavior of labor productivity implied by the price control explanation differs from that implied by the explanations that claim there was actually a further slowdown in trend productivity growth after 1973. To determine which of the explanations most nearly explains the actual behavior of productivity, it is necessary to test the alternatives in a complete model of productivity.

An empirical analysis of productivity growth

This section presents a simple model of labor productivity behavior. The model is estimated by

FIGURE 3
Growth path of trend productivity according to the price control explanation



using both aggregate and disaggregated data from the private business sector. The main conclusion of the empirical analysis is that after taking proper account of cyclical factors and price controls, there is little evidence of a further slowdown in trend productivity growth after 1973.

A model of labor productivity

The model of labor productivity growth used in this study, which is similar to the one used by Darby, divides measured productivity growth into cyclical and trend components.¹² The model allows for the possibility that trend productivity growth slowed after 1968 and again after 1973. It also allows for the possibility that measured productivity growth appeared to slow after 1973

¹² See Darby, "The Price of Oil," and Darby, "The U.S. Productivity Slowdown."

because of measurement errors caused by price controls. As shown in Table 2, the model consists of five equations.

While traditional models decompose measured labor productivity growth only into cyclical and trend components, the model presented in Table 2 also accounts explicitly for the possibility that measured labor productivity growth may be systematically mismeasured. Equation 1 defines measured labor productivity growth, π , as the sum of cyclical productivity growth, π^c , trend productivity growth, π^T , and a systematic measurement error, π^E .

Cyclical productivity growth is represented by equation 2.¹³ It is assumed that cyclical productivity growth depends on the unemployment rate, the layoff rate, and employment.¹⁴

The behavior of trend productivity growth is described by equation 3. The first term, α_0 , represents the growth rate of trend productivity that would be observed if there were no slowdown in trend productivity growth in the last 20 years. A dummy variable, D69, represents the change in trend productivity growth that began in the middle to late 1960s. The first quarter of 1969 was chosen as the starting point for the first trend productivity growth slowdown.¹⁵ Another dummy variable, D74, allows for a second slowdown in trend productivity growth after 1973. If the coefficient on D74, α_2 , is *not* found to be statistically

different from zero, it would support the hypothesis that there was no further decline in trend labor productivity growth after 1973.

The systematic measurement error predicted by the price control explanation is represented by equation 4. Unlike models used in most previous studies, the model used here allows for a systematic measurement error in measured productivity growth induced by price controls. The dummy variable DPC allows for the mismeasurement of productivity growth during the price control period from the third quarter of 1971 to the fourth quarter of 1974.¹⁶ Because the price control explanation implies that the overstatement of true productivity growth during phases I and II is completely offset by the understatement during phases III and IV, the price control dummy variable, DPC, sums to zero. According to the price control explanation, the estimated value of the coefficient on DPC, ϕ , should be significantly positive.

The final equation of the model combines all of

¹³ It is possible that traditional estimates of trend productivity growth show a further decline after 1973 partly because they do not take adequate account of cyclical factors. The traditional estimates are accurate only if the rate of resource utilization is similar in each cyclical episode. Because the cyclical episodes since 1973 have been very different from previous postwar cyclical periods, it may be the case that the rates of resource utilization are different as well. For example, the recession from 1973:IV to 1975:I and the most recent recession that extended from 1981:III to 1982:IV were the worst of the postwar recessions. Furthermore, 18 of the 96 quarters between 1948:IV and 1973:IV, or 18.8 percent, were recessionary. That percentage almost doubled for the quarters between 1974:I and 1982:IV to 33.3 percent when 12 of 36 quarters were recessionary.

¹⁴ Specifically, cyclical productivity growth is assumed to depend on the change in the civilian unemployment rate, the change in the layoff rate, and the current and lagged growth rate of employment in manufacturing, mining, and construction. These variables are taken from Darby, "The Price of Oil," and Darby, "The U.S. Productivity Slowdown." Note that none of the cyclical variables is a nominal value deflated by a price index, but they are all based on counts of individuals. Darby points out that it is important that the cyclical variables are not nominal variables deflated by price indexes, such as measures of the real money stock. If the cyclical variables were deflated nominal variables, they would suffer from the same mismeasurement problem that real output and productivity suffer from and, therefore, completely explain the mismeasured productivity data.

¹⁵ Because opinions about the beginning date of the middle to late 1960s slowdown are so varied, the following procedure was used to choose the starting date of 1969:I. Using data from the entire private business sector, equation 5 was sequentially estimated with the 1960s slowdown beginning in the first quarter of each year from 1964 to 1970. The initial year of the 1960s slowdown was chosen by selecting the equation with the lowest root-mean-square error. Although 1969:I is chosen as the first quarter of the 1960s slowdown, the results presented in the text are not significantly different from the results obtained using any other year as the starting point.

TABLE 2
A model of labor productivity growth

$$\begin{aligned}
 (1) \quad \pi &= \pi^c + \pi^T + \pi^E \\
 (2) \quad \pi^c &= \beta z \\
 (3) \quad \pi^T &= \alpha_0 + \alpha_1 D69 + \alpha_2 D74 \\
 (4) \quad \pi^E &= \phi DPC \\
 (5) \quad \pi &= \alpha_0 + \alpha_1 D69 + \alpha_2 D74 + \phi DPC + \beta z
 \end{aligned}$$

Definitions:

- π = measured labor productivity growth rate
- π^c = cyclical labor productivity growth rate
- π^T = trend labor productivity growth rate
- π^E = systematic measurement error in the measured labor productivity growth rate
- z = a vector of cyclical variables that includes the change in the civilian unemployment rate, the current and lagged growth rate of employment in manufacturing, mining, and construction, and the change in the layoff rate
- D69 = a dummy variable that represents the change in trend productivity growth after 1968
- D74 = a dummy variable that represents the change in trend productivity growth after 1973
- DPC = a dummy variable that represents the overstatement of labor productivity growth from 1971:III to 1973:I and the understatement of labor productivity growth from 1973:II to 1974:IV as predicted by the price control explanation

the information contained in equations 1 through 4. Empirical estimates of equation 5 can be used to determine whether trend productivity growth declined further after 1973 or whether, instead, the measured decline was an illusion caused by the systematic distortions resulting from price controls. That is, the estimates of the model can be used to answer the following question: after accounting for the effects of variations in cyclical economic activity, the late 1960s trend produc-

tivity growth slowdown, and the mismeasurement of productivity during the price control period, is there any evidence of a further decrease in trend productivity growth after 1973?

Empirical estimates of the model

The model was estimated for the private business sector as a whole and for several sectors within the private business sector. Although Darby has used a similar model to explain aggregate productivity behavior, the price control explanation has never been tested through use of productivity data from individual sectors.¹⁷

¹⁶ See Darby, "The Price of Oil," and Darby, "The U.S. Productivity Slowdown," for a detailed description of DPC. Note that the sum of DPC represents the mismeasurement of the level of labor productivity. Because DPC sums to zero, the model implies that productivity growth was not mismeasured over the entire period from 1969:I to 1981:IV. Also, it should be clear now why the cyclical variables cannot be represented by deflated nominal variables. Because any deflated variable will also be mismeasured over the price control period, it would completely explain the productivity data during the price control period, and there would be nothing left for the price control dummy variable to explain.

¹⁷ See Darby, "The Price of Oil," where international and U.S. data are used to show that the price control explanation explains real gross national product behavior better than the oil price shock explanation. See Darby, "The U.S. Productivity Slowdown," where productivity data for the entire U.S. economy are used to show that the price control explanation explains productivity behavior better than the oil price shock explanation.

Empirical estimates explaining productivity behavior in various sectors — goods-producing, service-producing, manufacturing, and farming — are useful for two reasons. First, policymakers can formulate better policies and implement them more efficiently when provided detailed information. Second, empirical findings would be more persuasive if consistent throughout the various sectors of the economy.

Empirical estimates of equation 5 are presented in panel A of Table 3.¹⁸ (Complete results are reported in the Appendix table.) These empirical estimates show that trend productivity growth did not slow further after 1973. For every sector, the estimated coefficient on the variable D74 is not significantly different from zero. Moreover, the estimates are of the wrong sign (negative) for the farming and service-producing sectors. Finally, the estimate of the change in annual trend productivity growth after 1973 is small, never more than 1 percent.¹⁹

In addition to showing that trend productivity growth did not decline further after 1973, the results support the price control explanation of the decline in measured productivity growth. The estimated coefficient on the price control dummy variable DPC is positive for all sectors and statistically significant for all but the farming and manufacturing sectors.²⁰ Furthermore, the estimates of the price control coefficients are large enough to be significant in an economic sense. For example, for the private business sector as a whole, the

¹⁸ The data consisted of quarterly observations from 1948:III to 1981:IV. The productivity data are from a database constructed by Elliot Grossman for the American Productivity Center. All other data series are from the Citibank Economic Database. The estimation period ends in 1981:IV because the layoff rate series is not available after that date. Dropping the layoff rate variable and extending the period of estimation to 1983:II produced no significant changes from the results reported in the text.

¹⁹ Because the equations are estimated with quarterly data, all estimated coefficients are multiplied by 400 to get annual growth rates.

measured productivity growth rate overstated the true growth rate by 2.4 percentage points a year during phases I and II of the price control period.²¹ Thus, the empirical estimates confirm that the apparent slowdown in trend productivity growth beginning in 1974 results from mis-measuring true productivity growth over the period of price controls.²²

Estimates of trend productivity growth implied by the empirical estimates of equation 5 of the model are presented in panel B of Table 3.²³ The estimated growth rate of trend productivity for each sector from the third quarter of 1948 to the

²⁰ Note in the Appendix that no coefficient is significantly different from zero in the farming sector except for the constant term and the autoregressive parameter. The price control dummy variable is marginally significant in the manufacturing sector. Apparently, there is not even an illusory trend productivity growth slowdown in manufacturing after 1973 because the estimates of both α_2 and ϕ are insignificantly different from zero. Furthermore, the data indicate that there was not even a late 1960s trend productivity growth slowdown in manufacturing. That is, all productivity changes in the manufacturing sector can be explained by cyclical factors alone.

²¹ The measured overstatement is calculated by multiplying the price control coefficient estimate of 0.0422 by one-seventh and then annualizing that product by multiplying by 400.

²² Some may argue that the statistical significance of the DPC dummy variable results from the "end-of-expansion effect" (EOE) as described in Robert J. Gordon, "The 'End-of-Expansion' Phenomenon in Short-Run Productivity Behavior," *Brookings Papers on Economic Activity*, 1979:2, pp. 447-61. The EOE effect refers to the observation that productivity growth tends to decline at the end of the expansion phase of the business cycle. However, reestimating equation 5 with aggregate data after Gordon's EOE effect variable was included produced no significant changes from the results reported in the text. In particular, the estimated coefficient on DPC remained statistically significant, and the estimated coefficient on D74 remained statistically insignificant. Thus, a major result of this section — that after accounting for price controls, trend productivity growth did not decline further after 1973 — appears to be robust.

²³ Because the hypothesis of a further slowdown in trend productivity growth after 1973 was rejected, the estimates of trend productivity growth were calculated after dropping D74 from equation 5 and reestimating the model. The estimates of trend productivity growth are the only results reported because the results from these regressions were so similar to those reported in the Appendix.

TABLE 3
Results from estimates of equation 5

| | (A) | | (B) | |
|-------------------------|------------------------------------|-------------------------------|--|----------------------|
| | Coefficient Estimates ¹ | | Estimated Trend Productivity Growth ² | |
| | D74 ³ | DPC ⁴ | 1948-68 | 1968-81 ⁵ |
| Private Business Sector | 0.00048 (0.24) | 0.0422 ⁶ (3.16) | 3.3 | 1.8 |
| Service-Producing | -0.00043 (0.18) | 0.0460 ⁷ (2.77) | 3.0 | 1.5 |
| Goods-Producing | 0.0015 (0.47) | 0.0397 ⁸ (1.80) | 3.6 | 2.1 |
| Manufacturing | 0.0028 (0.85) | 0.0257 (1.23) | 2.9 | 2.8 |
| Farming | -0.0024 (0.17) | -0.0124 (0.13) | 6.0 | 6.3 |

NOTE: Initial ordinary least squares estimates of equation 5 indicated the presence of first-order autocorrelation. The Prais-Winsten two-step procedure was used in estimating equation 5 to correct for the presence of a first-order autoregressive error term.

¹t-statistics are in parentheses.

²Units are percent per year continuously compounded.

³1974 Dummy: D74 = 0 from 1948:III to 1973:IV and -1 thereafter.

⁴Price Control Dummy: DPC = 0 from 1948:III to 1971:II, +1/7 from 1971:III to 1973:I, -1/7 from 1973:II to 1974:IV, and 0 thereafter.

⁵Because the growth rate of trend labor productivity from 1968 to 1981 is constant, it equals the trend growth rate from 1968 to 1979. Therefore, the numbers in this column can be compared directly with the trend productivity growth rates for the period from 1968 to 1979 in Table 1.

⁶Significant at 0.1 percent level.

⁷Significant at 1 percent level.

⁸Significant at 5 percent level.

fourth quarter of 1968 is the estimate of the constant term, α_0 . From then on, the estimate of trend productivity growth is the difference between the constant term and the coefficient on D69, $\alpha_0 - \alpha_1$.

The evidence indicates that both the service-producing and goods-producing sectors contributed to the slowdown in aggregate trend productivity growth after 1968. However, there is no evidence of a slowdown in trend productivity growth after 1968 in either of the two goods-pro-

ducing sectors for which the model was estimated. Indeed, trend productivity growth in the farming sector seems to have increased slightly.²⁴

The combined results from both panels of Table 3 tell a very different story about postwar trend productivity growth from those in Table 1.

²⁴ Although the point estimate of trend productivity growth in the farming sector after 1968 is greater than the point estimate before 1969, the two estimates are insignificantly different in a statistical sense.

According to the traditional measures in Table 1, trend productivity growth began to slow in 1969 and slowed further after 1973 in all sectors. In contrast, the empirical estimates of the model in panel A of Table 3 show that trend productivity growth did not slow further in any sector after 1973. Moreover, the estimates in panel B indicate that aggregate trend productivity growth after 1973 is 1.8 percent a year, more than twice the traditional estimate of 0.8 percent. Although the estimates of trend productivity growth in panel B indicate that trend productivity growth declined in the goods-producing sector after 1968, neither the farming nor the manufacturing sectors contributed to the slowdown. Thus, the entire slowdown in the goods-producing sector resulted from a slowdown in mining and construction, the only other industries in the goods-producing sector. More important, though, the overall results indicate that trend productivity growth did not slow further after 1973 in any sector. Thus, traditional estimates of trend productivity growth such as those in Table 1 give a misleading impression of the source of slow productivity growth since 1973.

Summary and conclusions

This article presents evidence that the apparent second slowdown in trend productivity growth beginning in 1974 is an illusion resulting from the wage and price control program of the early 1970s. An empirical analysis of postwar labor productivity shows that after accounting for the 1969 shift in trend productivity growth and the cyclical and price control effects on measured productivity, there was no further slowdown in trend productivity growth after 1973. Because the results were consistent across major sectors, the findings strengthen the case for the price control explanation, which had previously been tested only with aggregate productivity data.

One implication of these findings is that any

policy designed to reverse the “slowdown” in trend productivity growth that appeared to begin in 1974 should be reevaluated. Although a slowdown in trend productivity growth began in the middle to late 1960s, there is no evidence of a second slowdown in the aggregate private business sector or any of its subsectors that were studied. Productivity growth was slow from 1979 to 1983, but this was due to the cyclical behavior of the economy. Viewed in this way, slow productivity growth is more the result of sluggish economic growth in recent years than the cause. As a result, macroeconomic policies designed to return the U.S. economy to balanced, noninflationary economic growth may well cause productivity growth to return to more normal rates in the years ahead.

A further implication of these findings is that for future research on trend productivity growth to be useful for policy analysis, efforts should be made to understand why productivity growth has slowed over the *entire* period from the late 1960s to the present. By failing to account for the effects of price controls, previous research—and therefore the resulting policy prescriptions—has incorrectly focused on the decline in productivity growth that appeared to begin in 1974. Instead, attention should be given to the entire period from the late 1960s to the present. To the extent that this slow productivity growth is found to result from such factors as regulations and tax laws, structural policies designed to increase productivity growth might be appropriate. On the other hand, if it is found that slow productivity growth is due to factors not amenable to policy actions, such as demographics, structural policies designed to boost productivity growth would be unnecessary.

APPENDIX
Estimates of equation 5

| Coefficient Estimate ¹ | Private Business Sector | | | | |
|---|-------------------------|--------------------|-------------------|-------------------|-------------------|
| | Service-Producing | | Goods-Producing | | |
| | Total | | Total | Manufacturing | Farming |
| Constant | 0.0083 (10.79) | 0.0074 (5.74) | 0.0090 (5.18) | -0.0072 (5.66) | 0.0149 (2.66) |
| D69 ² | 0.0035 (2.05) | 0.0041 (1.79) | 0.0026 (0.86) | -0.0016 (0.56) | 0.0007 (0.06) |
| D74 ³ | 0.00048 (0.24) | -0.00043 (0.18) | 0.0015 (0.47) | 0.0028 (0.85) | -0.0024 (0.17) |
| DPC ⁴ | 0.0422 (3.16) | 0.0460 (2.77) | 0.0397 (1.80) | 0.0257 (1.23) | 0.0124 (0.13) |
| U | -0.0096 (2.89) | -0.0088 (1.36) | -0.0080 (0.95) | -0.0112 (2.65) | -0.0112 (0.44) |
| E | -0.0055 (0.05) | -0.0848 (0.44) | 0.3874 (1.57) | 0.3177 (2.69) | -0.5316 (0.63) |
| E ₋₁ | -0.2778 (3.45) | -0.1855 (1.37) | -0.6879 (3.94) | -0.5195 (5.53) | -0.3421 (0.52) |
| LR | -0.0029 (0.90) | 0.0015 (0.27) | -0.0015 (0.21) | -0.0042 (1.18) | 0.0058 (0.22) |
| ρ ⁵ | -0.1766 (2.08) | -0.2304 (2.31) | -0.1937 (1.92) | -0.1562 (1.83) | -0.3270 (4.01) |
| Summary Statistics: | | | | | |
| R ² | 0.41 | 0.21 | 0.40 | 0.50 | 0.03 |
| Degrees of Freedom | 125 | 86 | 86 | 125 | 125 |
| Root-Mean-Square Error | 0.0076 | 0.0097 | 0.0126 | 0.0094 | 0.0620 |
| NOTE: Initial ordinary least squares estimates of equation 5 indicated the presence of first-order autocorrelation. The Prais-Winsten two-step procedure was used in estimating equation 5 to correct for the presence of a first-order autoregressive error term. U is the change in the civilian unemployment rate, E and E ₋₁ are the current and lagged growth rate of employment in manufacturing, mining, and construction, and LR is the layoff rate. | | | | | |
| ¹ t-statistics are in parentheses. | | | | | |
| ² 1969 Dummy: D69 = 0 from 1948:III to 1968:IV and -1 thereafter. | | | | | |
| ³ 1974 Dummy: D74 = 0 from 1948:III to 1973:IV and -1 thereafter. | | | | | |
| ⁴ Price Control Dummy: DPC = 0 from 1948:III to 1971:II, + 1/7 from 1971:III to 1973:I, -1/7 from 1973:II to 1974:IV, and 0 thereafter. | | | | | |
| ⁵ First-order autoregressive parameter. | | | | | |