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PRODUCTIVITY AND INFLATION

A STUDY

PREPARED FOR THE USE OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

APRIL 24, 1980

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LETTERS OF TRANSMITTAL

APRIL 23, 1980.

To the Members of the Joint Economic Committee:

I am pleased to transmit for the use of the Members of the Joint Economic Committee, other Members of Congress, and the interested public a study entitled "Productivity and Inflation."

The study analyzes the relationship between productivity and inflation, and assesses the role of productivity growth in inflation reduction. It indicates that a multiplier effect takes hold in the inflation-productivity relationship which causes a 1 percent growth in the rate of productivity to generate much more than a 1 percent inflation reduction. Up to now, it was generally thought that the inflation-productivity relationship functioned solely on a one-to-one basis. The study points out the growing awareness of the importance of productivity growth, and concludes that increased productivity can make a major contribution in unwinding our 15-year inflation, while maintaining the Nation's commitment to high levels of employment.

It should be understood that the views contained in the study are those of the authors and not necessarily those of the Joint Economic Committee or individual Members.

Sincerely,

LLOYD BENTSEN,
Chairman, Joint Economic Committee.

APRIL 22, 1980.

Hon. LLOYD BENTSEN,
Chairman, Joint Economic Committee, Congress of the United States, Washington, D.C.

DEAR MR. CHAIRMAN: I am pleased to submit a study prepared for the Joint Economic Committee entitled "Productivity and Inflation."

This study comprises an analysis of the relationship between inflation and productivity and provides new insight into the dynamics of that relationship. The study assesses the impact of productivity growth between the years 1953–79 and 1960–79, and concludes that the impact of productivity growth on inflation has been significantly understated. It indicates that a multiplier effect takes place in the productivity-inflation relationship that causes a 1 percent growth in the rate of productivity to generate much more than a 1 percent inflation reduction. This relationship has been generally viewed as operating solely on a one-to-one basis. The study, therefore, provides further evidence of the importance of increased productivity in maintaining high levels of employment while coping with the Nation's inflationary situation.

The study was prepared for the Joint Economic Committee by William C. Freund, Senior Vice President and Chief Economist, the New York Stock Exchange, in conjunction with Paul B. Manchester, Joint Economic Committee staff economist.

Sincerely,

JOHN M. ALBERTINE,
Executive Director, Joint Economic Committee.

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PRODUCTIVITY AND INFLATION

Introduction

Until recently, both economists and policymakers have paid scant attention to the impact of changing productivity rates on the pace of inflation. There is no need to seek the cause of this grievous oversight. It is probably bound up with the general lack of an adequate explanation for inflation. Unfortunately, inflation has been stereotyped as either demand-pull or cost-push in origin in the economic textbooks, with little attention to the dynamic process.

The Standard View

Even now, when national awareness of the critical importance of productivity is growing, economists generally adhere to a rather primitive explanation of the inflationary impact of changing productivity growth. The standard view today is that productivity growth is an offset to rising wage rates in a one-to-one relationship. The effect of productivity on inflation, therefore, can be put simply into this formulation:

Wage rate increase
Less: Productivity gain
Equals: Rise in unit labor cost

For example, if wages increase by 10 percent per annum, and productivity gains 3 percent per annum unit labor costs will rise 7 percent. Obviously, if productivity growth slows down by, say, 1 percent per annum, unit labor costs will rise by 9 percent. Since unit labor costs constitute some two-thirds of total costs, the assumption is that inflation will rise with unit labor costs in a one-to-one relationship.[1]

This conventional view ascribes a rather limited role to productivity growth. In the example above, a one percent improvement in productivity would bring about only a one percent reduction in the inflation rate.

Similarly, economists have placed little emphasis on diminishing productivity in heating up inflation. For example, the late Authur Okun observed that the persistence and intensification of chronic inflation in the U.S. has had some relation to the virtual disappearance of productivity growth, but not much. He wrote: "Thus, the productivity slowdown has had some inflationary effects; it may account for a point or two of our total inflation rate, but not more than that." [2]

[1] Sometimes the explanation of the role of productivity in inflation considers the process of supply and its effect on inflation. In this modified wages-productivity-price theory, an increase in productivity growth brings an increase in aggregate supply, which holds down unit labor costs. This, in turn, brings downward pressure on the average price of goods. Similarly, a decline in productivity will reduce supply and increase wage pressures. This theory flies in the face of a considerable inelasticity of wages to supply. Within wide unemployment rate parameters, wage gains appear quite unresponsive to changing conditions of supply.

[2] "Supply-Side Economics: Fact Versus Fad," American Security Bank, Washington, D.C., November-December, 1979. Similar comments were made by Arthur F. Burns in testimony before the Joint Economic Committee, March 27, 1980.

Milton Friedman recently stated that, "The supply side emphasis in Congress is fine from the point of view of promoting productivity, but it is not as an effective way to fight inflation. If you doubled productivity, you would only reduce inflation by 1.5 percentage points." [3] Given this analysis, improvements in productivity can hardly be expected to offer an exciting prospect for a substantial lowering of inflation rates. It is true that the recognition of lagging productivity growth in retarding the real growth of the economy is now spreading. Supply side economics *is* receiving more attention at universities and in Washington.[4] The point here is only that the effect of changing productivity rates on chronic inflation has been neglected. What is needed is a more dynamic explanation of the process of inflation. The customary notion of a simple offset to wage gains is too static.

This study, which draws on an earlier analysis of the New York Stock Exchange, postulates that to a degree not widely recognized, changes in productivity can have "multiplier" effects on changes in inflation rates.[5] These multiplier effects help to examine the dynamics of inflation over time. The emphasis on "over time" is to recognize that the multiplier repercussions take time to work out. Chronic inflation did not suddenly descend on the United States: it took time to emerge and develop. Similarly, gains in productivity, which themselves come relatively slowly and over a period of time, should not be expected to provide a quick fix for controlling inflation.

The Multiplier Model

The multiplier effects of productivity gains result from the interrelationship of the so-called "wage-price spiral." An increase in wage rates can push up unit costs and prices, as noted above. But that increase in prices can, in turn, operate to push up wage rates which, in turn push up prices again—as the spiral continues. In this process, whenever a decrease in productivity growth occurs, it will have a more-than-one-time effect on the spiral.[6]

Let us assume that the decrease in productivity growth occurs at a point where wages are pushing up prices. On the first round, the decrease in productivity growth will accelerate the wage-induced rise in prices. On the second round, by increasing the initial price increase, the earlier productivity slowdown will feed subsequent wage increases. Likewise, the resulting price increases will speed up through each round of the spiral.

There is a basic assumption in this multiplier model of wages-productivity-prices; namely, that labor seeks to retain at each round of the wage bargain a relatively fixed gain in real wages. This objective may not always be realized but does constitute an essential element of the wage bargain. The multiplier process, therefore, depends on an explanation of the wage setting process.

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[3] "Dr. Milton Friedman at OPCO," Oppenheimer & Co., N.Y., Report No. 80-46, January 17, 1980, p. 6.

[4] For example, see the Joint Economic Committee's Annual Report of 1979 (March 22, 1979) and 1980 (March 4, 1980), and the Midyear Report of 1979 (August 9, 1979). Serious concern about productivity is also shown in the recent amendment by Senator Bentsen to the Senate Budget Resolution, requiring that half of any budget surplus which might arise in fiscal year 1981 be targeted for a tax cut to increase productivity. (Congressional Record, March 25, 1980, pp. S2919-S2921.)

[5] "Reaching a Higher Standard of Living," January, 1979. Available on request from Office of Economic Research, The New Stock Exchange, 11 Wall Street, New York, N.Y. 10005.

[6] Monetary policy can thwart this process if it is sufficiently restrictive but only at the expense of mounting unemployment.

The Wage Bargain

It is widely acknowledged that wage increases are generally composed of two main parts: [7]

An increase to compensate labor for past inflation.—Indeed, with some two-thirds of negotiated wage contracts that cover 1,000 or more workers tied to cost-of-living clauses, the adjustment to past inflation tends to be built in. Moreover, contracts frequently also reflect anticipated inflation over the contract life.

An adjustment for labor's entitlement to perceived past productivity gains.—Workers expect their real incomes to rise and their real purchasing power to improve. Since long-run improvements in real wage rates can only come from rising productivity, this element of the wage contract generally reflects labor's and management's perceptions about average long-run productivity gains.

One current observer of the economic scene commented on these two components of current wage settlements: ". . . strong unions habitually settle for nothing less than 3 percent (productivity offset) plus the rate of inflation . . ." [8] Another observed:

> These (large) unions all have contracts similar to the one pioneered by the auto workers in 1970—3 percent annual wage increase plus essentially full adjustment for increases in the cost of living. When increases in the cost of fringe benefits are included, these contracts produce compensation cost increases in real terms of 3 percent or slightly more per year. When these contracts were first negotiated, it was believed that real wage increases of about 3 percent were in line with the economy's ability to provide higher real wages through productivity growth. In fact, however, the 3 percent figure was overly optimistic—since 1970 productivity growth has been only 1.4 percent per year.[9]

The institutionalization of the long-outdated 3 percent productivity standard was remarked upon by Barry Bosworth when he was Director of the U.S. Council on Wage and Price Stability. He noted that:

> . . . many labor contracts currently call for cost of living plus a productivity improvement. The only trouble is that this formula dates from the world of the 1950s and 1960s, when we had 3 percent annual productivity increases. This economy hasn't had a 3 percent annual productivity growth in a decade.[10]

Given this framework for wage negotiations, let us now review the process of accelerating inflation when productivity growth in one period slows down.

Accelerating Inflation

A slowdown in the productivity growth rate during one period will ignite an inflation speedup not only in that period but in succeeding periods—even after the decline in productivity growth is halted. This relationship can best be illustrated by means of an example.

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[7] Naturally, not all wage increases are set through formal collective bargaining. Nonetheless, agreements reached in union negotiations tend to have powerful spillover effects and set patterns for the entire labor market.

[8] Sam Nakagama, "Economic Perspectives," Kidder, Peabody & Co., July 28, 1978. However, few, if any, unions were able to fully offset the 13.3 percent increase in the CPI in 1979.

[9] Morgan Guaranty Survey, October 1978, pp. 5–6.

[10] "A Conversation With the Honorable Barry Bosworth," American Enterprise Institute for Public Policy Research, 1978, p. 29.

Assume that in Period 1 workers anticipate no inflation because there was no inflation in the preceding year.[11] Labor seeks a wage increase of 3 percent solely to match the perceived long-run average increase in productivity. In other words, workers expect their real incomes to rise and their purchasing power and standard of living to improve. If productivity actually rises by 3 percent in Period 1, the year will be inflation free:

Period 1:	*Percent*
Assumed inflation	0
Expected growth in real income	3
Wage increase	3
Productivity gain	3
Actual inflation (unit labor costs)	0

Next, assume that productivity gains slacken in Period 2, from 3 percent per annum to 1½ percent—an assumption which conforms to the reality of recent years. The wage-price spiral is quickly activated:

Period 2:	*Percent*
Assumed inflation	0
Expected growth in real income	3. 0
Wage increase	3. 0
Productivity gain	1. 5
Actual inflation (unit labor costs)	1. 5

Workers anticipated that purchasing power would grow at the same 3 percent rate as in Period 1. But because productivity dropped off, unit labor costs went up and so did prices. Hence, inflation enters the picture at a rate of 1½ percent. In effect, wages increase by 3 percent, half of which is consumed by inflation, leaving only a 1½-percent increase in real income. Labor is disappointed and readies new wage demands aimed at overcoming the real-income deficit.

Predictably, in Period 3, wage demands go up to 4½ percent. (The assumption is reinforced by the large number of labor contracts which have cost-of-living escalators built-in.)

Period 3:	*Percent*
Assumed inflation	1. 5
Expected growth in real income	3. 0
Wage increase	4. 5
Productivity gain	1. 5
Actual inflation (unit labor costs)	3. 0

Obviously, the windup of inflation is underway and will continue, as shown below, until something occurs to lower labor's wage demands or to raise productivity:

	Period (percent)			
	4	5	6	7
Assumed inflation	3	4½	6	7½
Expected growth in real income	3	3	3	3
Wage increase	6	7½	9	10½
Productivity gain	1½	1½	1½	1½
Actual inflation (unit labor costs)	4½	6	7½	9

In fact, inflation could spiral upward more rapidly than these calculations suggest, since labor may begin to anticipate future inflation and try to build it into wage settlements, thereby further fueling the inflation momentum.

[11] Actually, the process could start from any base level of inflation.

Winding Down Inflation

Naturally, at some point labor will have to pare down its wage demands, say to 1½ percent, in response to the lower rate of productivity gains. Then, the rate of price increase will level off and the upward spiral of price rises will be broken. If that occurs in Period 8, the arithmetic would be as follows:

Period 8:	*Percent*
Assumed inflation	9. 0
Expected growth in real income	1. 5
Wage demand	10. 5
Productivity gain	1. 5
Actual inflation (unit labor costs)	9. 0

Inflation will decline below 9 percent only if productivity gains accelerate.[12] Assume that productivity growth increases to 3 percent and that, at least for a time, labor demands only a 1½ percent gain in real wages (to match the previous plateau in productivity gains). The result is that inflation begins to unwind.

	Period (percent)		
	9	10	11
Assumed inflation	9	7½	6
Expected growth in real income	1½	1½	1½
Wage increase	10½	9	7½
Productivity gain	3	3	3
Actual inflation (unit labor costs)	7½	6	4½

Now the process has been reversed, with the rise in productivity causing inflation to decelerate from 7½ percent to 6 percent to 4½ percent. Inflation will continue to wind down so long as the rate of productivity gain continues to exceed labor's expected growth in real income. When those two factors come into balance—say, 3 percent productivity growth and 3 percent expected growth in real income, inflation will stabilize at a constant rate until one of the key variables changes again.

A key question is the length of the adjustment periods; that is, how long does it take labor to adjust its wage demands to changes in productivity? Is labor able to argue for wage increases based on historic productivity changes or will labor base its real wage demands on relatively recent productivity performance? Whatever the answer, whatever the length of the adjustment period, productivity plays a key role in this entire process.

Today, increased productivity can serve to help unwind a decade-long process of inflation. Whatever the specific causes—fiscal and monetary mismanagement, soaring commodity prices, the rise in oil prices, dollar devaluations, excess demands, rising unit labor costs—the fact of the matter is that we are in a stage of the inflation process where both costs and wages have been leaping upward. Increased productivity in these circumstances is essential to cool inflation while maintaining the nation's commitment to high levels of employment.

[12] Inflation would also decline if labor agrees to accept something less than assumed inflation plus a realistic allowance for productivity growth.

Generalized Inflation—Productivity Multiplier Model

A generalization of this productivity multiplier model is developed and estimated in the Appendix. This generalization allows for:

(1) A partial impact (measured by a parameter a) of inflation in one period on wages in the next period.

(2) An impact (measured by a parameter b) of productivity gains in one period on wages in the next period.

(3) The impact of the unemployment rate on average wage increases.

Multipliers for any period following the initial change in the productivity growth rate may be obtained. For example, M_2 and M_4, the multipliers two and four periods after the initial change, are shown to be:

$$M_2 = -1 + (b-a)(1+a)$$
$$M_4 = -1 + (b-a)(1+a+a^2+a^3)$$

The "long run multiplier" M is the limit of the short run multipliers:

$$M = -1 + \frac{(b-a)}{(1-a)}$$

As long as wages are more responsive to inflation in the previous period than to productivity growth in the previous period ($a > b$) the multipliers will exceed 1.00. Casual empiricism suggests much greater worker awareness of inflation than of productivity gains. And in the econometric analysis presented in the Appendix, this conclusion is confirmed. For the four sectors analyzed, each increase of one percentage point in the rate of inflation raises the rate of increase in hourly compensation in the subsequent year by approximately 0.80 percentage point. Changes in productivity growth rates show only a minor (statistically insignificant) impact on the subsequent year's rate of increase in hourly compensation. The results are summarized in table 1. According to these estimates a sustained increase of one percentage point in the rate of productivity growth in 1980 and subsequent years would reduce the inflation rate by 2.1 to 2.4 percentage points in 1982, and by 2.8 to 3.3 percentage points in 1984.

TABLE 1.—ESTIMATED REDUCTION IN THE RATE OF INFLATION FROM A SUSTAINED INCREASE OF 1 PERCENTAGE POINT IN THE RATE OF PRODUCTIVITY GROWTH IN 1980 AND SUBSEQUENT YEARS

Year	Estimated reduction in inflation in sector (percent)			
	Private business	Nonfarm business	Nonfinancial corporations	Manufacturing
1980	1.00	1.00	1.00	1.00
1981	1.64	1.61	1.73	1.78
1982	2.15	2.11	2.35	2.38
1983	2.57	2.51	2.87	2.85
1984	2.90	2.84	3.31	3.21
1985	3.17	3.11	3.68	3.50

Source: Appendix.

Other investigators have suggested the existence of a productivity-inflation multiplier. For example, in testimony before the Joint Economic Committee, Michael Evans, President of Evans Economics, stated:

According to our estimate, the core rate of inflation has moved up from 2 percent before 1970 to about 8 percent today at the same time that productivity growth has moved down from 3 percent to 1 percent. We also estimate that even if productivity growth were to move back to 3 percent, the equilibrium rate of inflation would go no lower than 4 percent because of higher costs of regulation, energy, and other raw materials. This suggests that each 1 percent increase in the productivity growth rate would lower inflation by about 2 percent.[13]

Evans has estimated the same 2–1 tradeoff between productivity growth and inflation in other work, but the terms of the tradeoff have worsened due to a shift in the curve. For 1953–55, he estimated 2 percent productivity growth corresponded to no inflation; for 1956–62 1.5 percent inflation; for 1963–72, 5.5 percent inflation; and for 1973–79, 7.5 percent inflation.[14]

Correlations of Productivity Growth, Inflation, Wages, and Profits

Gains from higher productivity, at the level of the individual firm or the economy as a whole, can have the following four effects:[15]

(1) They can lead to lower prices, or to a lower rate of price increases, directly benefiting consumers.

(2) They can be passed along to workers in the form of increased hourly compensation.

(3) They can be used to offset increases in nonlabor costs, thereby possibly allowing a price increase to be foregone.

(4) They can be used to increase profits.

Whatever the case, productivity gains benefit individuals as consumers, wage and salary earners, or shareholders. But because this paper focuses on productivity and inflation, we explore this relationship in more detail. It is often difficult to say what would have occurred in the absence of the gains. For example, if productivity and compensation both rise significantly, the compensation gain need not be due to the improved productivity—it might have occurred anyway, and the impact of higher productivity might be a foregone price increase. Subject to this caveat, however, we have analyzed the relations between changes in productivity and prices, hourly compensation, unit nonlabor cost, and unit profits for the nonfinancial corporate sector for 1958–79.[16]

It should be stressed that this particular correlation analysis of productivity and prices cannot allow for the multiplier effects discussed earlier due to the absence of lags in the equations estimated. The correlations nonetheless show that higher productivity growth leads to lower inflation rates. We also found that higher percentage changes in unit profits occur in years of high productivity gains; however, annual changes in hourly compensation and unit nonlabor cost were not significantly correlated with annual productivity growth.

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[13] "The 1979 Midyear Review of the Economy," Hearings before the Joint Economic Committee, July 13 1979, p. 418.

[14] Chart 2, for November 2, 1979, speech titled "The Recession Is Here—So What?"

[15] In the usual micro analysis, an increase in productivity corresponds to a downward shift in the marginal cost curve. This leads to a lower equilibrium price (unless demand is completely elastic), and a higher equilibrium quantity of output (unless demand is completely inelastic). This higher output increases the demand for labor, which corresponds to a higher equilibrium wage (unless the labor supply is completely elastic). Thus a priori we expect a combination of higher profits, lower prices, and increased wages.

[16] Obviously these variables are affected by the business cycle. There is not a consensus on the appropriate method for cyclical adjustment of these variables, but estimation of the relations between cyclically-adjusted data might be a promising area for future research.

The above results were based on time series data for the nonfinancial corporate sector as a whole. In addition, cross section analyses have been carried out for the sectors and specific industries in the private economy. Specifically, the average annual rate of increase in prices and compensation per hour were related to the rates of increase in output per hour.[17] This analysis was carried out for 1968–78 for 7 broad sectors and for 1960–77 for 35 industries.[18]

The question whether sectoral and industrial productivity gains show up in the short run in higher wages or in lower prices is of major importance. Obviously, lower prices redound to the benefit of all consumers in the economy. Higher wages, on the other hand, improve the positions of workers in the affected industries. Of course in the longer run, the benefits of higher wages would be shared more widely through labor markets, as workers are drawn to areas of rapidly rising earnings. These labor shlfts should lead to smaller wage increases in these high wage sectors and to higher wage increases for the remaining workers in the sectors from which labor is being drawn. But these labor market adjustments may take a considerable period of time, and they may be incomplete, because of many geographical, institutional, and noneconomic barriers to adjustment.

The results of these cross section analyses are clear: Sectors and industries with above average rates of productivity growth show significantly below average rates of increase in prices, with the coefficient ranging from -0.73 for the 35 industries to -1.12 for the 7 sectors (i.e., each additional percentage point of productivity growth corresponds to a lower rate of inflation of 0.73 to 1.12 percentage points.)[19] These results also clearly show that high productivity growth industries and sectors do not show higher rates of increase in hourly compensation than low productivity growth industries and sectors. They demonstrate that the gains from productivity growth in specific industries and sectors are rapidly shared with all consumers in the form of lower rates of inflation.

Impact of Inflation on Productivity Growth

In our dynamic model, we have described a one-way causation; that is, the impact of changing productivity growth rates on inflation. But the causation also runs in the opposite direction: Rising inflation rates tend to depress productivity growth. The economic literature increasingly recognizes the effect of rising inflation on raising the effective corporate tax rate; on creating business uncertainty and increasing the risk premium incorporated in capital budgeting decisions; and on increasing the effective tax imposed on corporations and investors. All of these factors, in turn, influence capital investment and the rate of productivity growth.

A society caught in a chronic inflation therefore has a difficult task to extricate itself not only from the dynamics of the wage-price process but to restore the incentives to investment.

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[17] Data was not available on rates of increase in nonlabor cost and profits.

[18] Data is updated from tables 20, 21, 22 of the Bureau of Labor Statistics Publication, "Productivity and the Economy," Bulletin 1926, 1977.

[19] It should be reiterated that the multiplier impact is not picked up here because this is a cross section analysis, unlike the previous time series model with a lag in the wage equation.

Inflation and Corporate Tax Rates

Part of the reason for the downtrend in the capital-labor ratio has been the adverse effect of inflation on corporate taxes.[20] A recent study by the National Bureau of Economic Research shows that taxes now take two-thirds of the total real income on corporate capital.[21]

The distorting effects of inflation have returned corporate taxes to the level of the mid-1950s before accelerated depreciation and the investment tax credit began to reduce the tax burden. Professor Martin Feldstein recently stated that "The implication of a 66 percent effective rate of tax on corporate income is clear. Since the real rate of return on corporate capital before Federal taxes is approximately 12 percent, the net rate of return after taxes is only one-third of this or 4 percent. A net return of 4 percent is just not enough of an incentive to sustain the desirable level of saving and risk taking."[22]

The effect of inflation on effective corporate tax rates therefore discourages capital investment and the productivity growth it generates. Similarly, the effect of inflation in producing "phantom" corporate profits—that is accounting inventory gains, resulting from the first-in first-out valuation method, and insufficient depreciation allowances to replace capital equipment—inhibits capital formation. In the New York Stock Exchange study on productivity, Professor John W. Kendrick, a leading authority on the subject, concluded that about one-quarter of the slowdown in total factor productivity in the U.S. between 1973 and 1977 was due to inadequate capital investment.[23] The contribution of capital investment in lifting labor productivity alone is even higher.

One could go on and list other effects of inflation which inhibit capital investment. For example, it is widely believed that inflation has increased the element of uncertainty in investment decisions and thereby increased the risk premium incorporated in capital budget decisions. Alan Greenspan has placed considerable emphasis on this effect of inflation in discouraging capital investment. Writing in the Economist (August 6, 1977). Greenspan concluded "An inflationary environment makes calculation of the rate of return on new investment more uncertain. Even if overall profits advance in line with the rate of inflation, the dispersion of profits among business tends to increase as the rate of inflation climbs. The risk of loss rises, or at best, the attainment of profits becomes more elusive" (p. 32).

A similar discouragement occurs to research and development as inflation raises the uncertainty of returns and lifts the risk premium incorporated in risk-yield estimations.

Professor Burton Malkiel of Princeton concluded in an article (Fortune, November, 1977) that the low valuation of equity prices has been due to the escalation of the "risk premium" incorporated by investors in their equity portfolio yield requirements:

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[20] For discussion, cf. "Building a Better Future, Economic Choices for the 1980s," The New York Stock Exchange, December, 1979, Chapter 3. Available on request from Office of Economic Research, The New York Stock Exchange, 11 Wall Street, New York, N.Y. 10005.

[21] Martin Feldstein and Lawrence Summers, "Inflation and the Taxation of Capital Income in the Corporate Sector," NBER Working Paper No. 312, January, 1979.

[22] "Inflation and Saving: The Role of Taxes," Address by Martin Feldstein before the NAM, March 29, 1979, p. 5.

[23] "Reaching a Higher Standard of Living," *op. cit.*, pp. 14–20.

The stickiness of the stock market, then, appears to result not from a persistent inflation-induced profit squeeze but rather from a very sharp increase in the risk perceptions of investors. This change in perception has caused a sharp markdown in the price investors are willing to pay for a dollar of earnings (p. 161).

In any catalog of the impact of inflation in discouraging investment and productivity growth, mention should be made of the effects of inflation on capital gains taxes. High taxes prompt investors to favor conservative portfolios and to lock themselves into long-term investments. A study of the National Bureau of Economic Research concludes that the selling of corporate stock is, in fact, very sensitive to capital gains tax rates and that capital gains taxes are imposed on both nominal as well as real returns.[24] Other research indicates that savings and investment are responsive to taxation so that the imposition of capital gains taxes on monetary but not real gains reduces the funds available for real private investment.[25]

Earlier, we concluded that a slowing in productivity growth will produce multiplier effects on the rate of inflation over time. We can now modify that model still further. The effect of accelerating inflation will itself discourage capital investment. As this happens, productivity growth is slowed still further and the multiplier effect on investment is further aggravated. The result is a textbook example of a vicious circle of cause and effect. Inflation is not a benign force which can easily be contained. It feeds on itself through a multiplier and accelerator process all its own.

Fortunately, the process can also be made to work in reverse. A rising rate of productivity growth can reduce inflation over time and with it generate greater incentives to capital formation and productivity growth.

Implications for Economic Policy

The most important implication of this study for economic policy is simply that the productivity slowdown is an important cause of our inflation—that it accounts for more than "a point or two of our total inflation rate." This is due to the multiplier principle—each sustained change of one percentage point in productivity growth will have an effect on inflation of several percentage points in the opposite direction. Our estimates of the size of this multiplier range from 2.1 to 2.4 two years after the initial change in the productivity growth rate, and from 2.8 to 3.3 four years later.

Another implication arises from our study of the impacts of productivity growth in specific sectors and industries. The basic question is whether such changes are primarily reflected in higher wages and profits in the industry, or whether they are largely passed on to consumers in the form of lower prices (or, in a time of general inflation, lower rates of inflation). In both cases there obviously are benefits. But in the case of higher wages and profits, they are primarily retained by those most directly involved, at least in the short run. In the case of lower prices, benefits rapidly accrue to all consumers.

Our results indicate that, on either a sector or an industry basis, the gains from above average rates of productivity growth are passed

[24] Martin Feldstein, Joel Slemrod and Shlomo Yitzhaki, "The Effects of Taxation on the Selling of Corporate Stock and the Realization of Capital Gains," National Bureau of Economic Research, Working Paper No. 250, June, 1978.

[25] Michael J. Boskin, "Taxation, Saving and the Rate of Interest," Journal of Political Economy, April 1978, pp. 3-27.

on to consumers in the form of below average rates of inflation. Also, perhaps surprisingly, there was no significant correlation between sectoral or industry productivity growth and increases in hourly compensation.

Productivity growth should be considered in designing any wage and price standards. Wage settlements which otherwise might be inflationary may not be if accompanied by large productivity gains. For example, if wage standards allow 8.5 percent gains, and the norm is 1.0 percent productivity growth, this yields a 7.5 percent rate of increase in unit labor cost. But if one firm or industry can achieve 4.0 percent productivity growth, then it could settle up to 11.5 percent, without exceeding the 7.5 percent increase in unit labor cost.

Two qualifications must be made in applying this principle. First, in many cases it is difficult to measure a firm's or industry's productivity. Second, this hypothetical firm or industry might have no need or desire to settle at rates up to 11.5 percent. But in any program of wage and price standards, the role of productivity gains must be dealt with.

Productivity growth and inflation are linked in a complex interactive relationship. As shown, a change in the rate of productivity growth produces a multiplied effect on the rate of inflation. But this is not the end of the interaction. A rise in the rate of inflation, in itself, causes feedback effects on the pace of inflation. These effects are produced via interest rates and the incentive to invest. As interest rates rise in response to higher inflation, the hurdle rates to be met by new investment projects also rise. Unless the projected profit rates of new investments rise with inflation, and unless the risk factor incorporated in new capital projects remains unchanged, capital investment will respond negatively to rising inflation. In general, inflation does tend to depress capital formation and, in time, productivity growth.

Economics has a long way to go to fully comprehend the complex relationships between productivity growth and inflation. The analysis and modeling presented in this paper represents a bare beginning. The evidence, however, points to a multiplier effect of changing productivity growth on inflation. The time has come to end the long neglect of lagging productivity growth in the analysis of economic events—not only in the analysis of real growth over the longer run, but the dynamic process of accelerating inflation.

Appendix. Algebraic Formulation and Empirical Estimation of the Productivity Multiplier Model

Let W_t = % change in average hourly compensation, period t
P_t = rate of inflation, period t
O_t = % change in productivity, period t
X_n = gain in productivity, maintained for $(n+1)$ periods
ΔP_{tn} = change in rate of inflation, period t, resulting from X_n
$M_n = \Delta P_{tn}/X_n$ = multiplier relating changes in productivity growth for $(n+1)$ periods to changes in inflation rate
M = long run productivity multiplier
a, b, c = parameters

Then, because the rate of inflation tracks closely the rate of change in unit labor cost:

(1) $$P_t = \%\text{ change in unit labor cost} = W_t - O_t$$

and an equation linking wages to an exogenous trend c and a lagged response to inflation and productivity gains is postulated:

(2) $$W_t = aP_{t-1} + bO_{t-1} + c$$

(For the sake of simplicity, other determinants of compensation gains such as measures of the tightness of labor markets are omitted here, but included in the empirical estimates below.)

Substituting (2) into (1):

$$P_t = -O_t + aP_{t-1} + bO_{t-1} + c$$

Substituting (1) for P_{t-1}:

$$P_t = -O_t + (b-a)O_{t-1} + aW_{t-1} + c$$

Substituting for W_{t-1}, P_{t-2}, W_{t-2}, P_{t-3}, etc.

(3) $$P_t = -O_t + (b-a)\sum_{j=1}^{n} a^{j-1}O_{t-j} + c$$

Now if $X_n = \Delta O_t = \Delta O_{t-1} = \ldots \Delta O_{t-n}$, from (3):

(4) $$\Delta P_{tn} = [-1 + (b-a)\sum_{j=1}^{n} a^{j-1}]X_n \qquad \text{or}$$

(5) $$M_n = \frac{\Delta P_{tn}}{X_n} = -1 + (b-a)\sum_{j=1}^{n} a^{j-1} \qquad \text{and as } n \to \infty$$

(6) $$M = -1 + \frac{(b-a)}{(1-a)} \qquad \text{(as long as a} < 1)$$

Examples:

A. In the text it was assumed for periods 2–7 that

$a=1$, $b=0$, $c=3$, thus:

$P_t=-O_t+P_{t-1}+3$

$P_2=-1.5+0+3=1.5$

$P_3=-1.5+1.5+3=3$

$\vdots$

$P_7=-1.5+7.5+3=9$

In period 8, c falls to 1.5

$P_8=-1.5+9+1.5=9$

And for periods 9–11 productivity growth is increased to 3 percent:

$P_9=-3+9+1.5=7.5$

$P_{10}=-3+7.5+1.5=6$

$P_{11}=-3+6+1.5=4.5$

B. In the Joint Economic Committee's "1979 Midyear Report" (p. 38) it was assumed that $a=0.6$, $b=0$, $X_n=1$, thus:

$\Delta P_{1980}=-1(1)=-1$

$\Delta P_{1981}=(-1-0.6)(1)=-1.6$

$\Delta P_{1982}=(-1-0.6(1+0.6))(1)=-1.96$

$\Delta P_{1985}=(-1-0.6(1+0.6+0.6^2+0.6^3+0.6^4))(1)=-2.38$

Long run $\Delta P=-1-\frac{0.6}{1-0.6}=-2.50$

As long as wages are more responsive to the previous year's inflation than to the previous year's productivity change ($a>b$) there will be a multiplier effect ($|M_n|>1$). Empirical support for this hypothesis is now discussed.

The key equation underlying the productivity multiplier model is (2) above. This has been estimated for the private business sector, nonfarm business sector, and manufacturing for 1953–79, and for the nonfinancial corporate sector for 1960–79. The results are given in table 2.[1]

The coefficient relating average hourly compensation changes to inflation in the previous period (a) is highly significant, and approximately equal to 0.8 in all cases. The coefficients of productivity growth in the previous period (b) range from −0.01 to 0.20, but none are significant. The coefficients of the unemployment rate (d) are significantly less than zero (at significance levels from 10% to 1%), implying that each increase of one percentage point in the unemployment rate reduces the rate of increase in average hourly compensation by 0.4 to 0.6 percentage point. Coefficients of determination (R^2) range from 0.73 to 0.84. None of the Durbin-Watson statistics (D.W.) indicate significant autocorrelation. The derived estimates of the two year and four year productivity multipliers M_2 and M_4 are shown; multipliers for other periods may be found from (5) above.

Areas of future research would include: testing of other possible independent variables in the wage determination equation; a distributed lag formulation; development of a quarterly model; and integration into a complete econometric model.

TABLE 2.—*Various estimates of the productivity multipliers*

Equation estimated is:

$$W_t=c+aP_{t-1}+bO_{t-1}+dU_t$$

Where

W_t = % change in average hourly compensation, period t

P_{t-1} = rate of inflation (CPI), period $(t-1)$

O_{t-1} = % change in productivity, period $(t-1)$

U_t = rate of unemployment, period t

M_2 = two-year productivity multiplier $=-1+(b-a)(1+a)$

M_4 = four-year productivity multiplier $=-1+(b-a)(1+a+a^2+a^3)$

[1] Data for the nonfinancial corporate sector is not available for years prior to 1959. For the other three sectors data is available back to 1947, but initial estimates for these entire series yielded large residuals for the early 1950s, perhaps due to the wage and price controls in effect through 1952.

All equations estimated by Ordinary Least Squares for 1953–1979, except 1960–1979 for nonfinancial corporate sector.

t statistics shown in parentheses below coefficients.

Sector	c	a	b	d	M_2	M_4	R^2	D.W
Private business	6.30	0.81	0.17	−0.62	−2.2	−2.9	0.74	2.23
	(5.15)	(6.84)	(.88)	(−2.97)				
Nonfarm business	5.69	.81	.20	−.56	−2.1	−2.8	.78	1.94
	(5.58)	(8.16)	(1.31)	(−2.99)				
Nonfinancial corporate	5.27	.84	.11	−.50	−2.4	−3.3	.84	1.83
	(4.61)	(6.84)	(.69)	(−2.41)				
Manufacturing	5.24	.78	−.01	−.37	−2.4	−3.2	.73	1.71
	(4.52)	(6.60)	(−.13)	(−1.55)				

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