CHAPTER 18

Externalities associated with nominal price and wage rigidities

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Arguments in favor of economic policy intervention are usually based on the existence of *externalities*. This mode of argument, long a tradition in microeconomics, is relatively new to macroeconomics. In the 1960s, for example, when Milton Friedman outlined in *Capitalism and Freedom* the pros and cons of government policy in many areas of economics, he centered his discussion around the existence of externalities in every area *except* macroeconomics.

Ever since the start of research on the microfoundations of macroeconomics in the early 1970s, many studies have attempted to correct this omission by casting proposals for macroeconomic policy in an externality framework. The vast majority of these studies has been concerned with externalities that relate to whether the natural or average rate of employment is inefficient. Few have been concerned with whether the observed fluctuations in employment around the natural rate are inefficient. In his 1972 book *Inflation Policy and Unemployment Theory,* Edmund Phelps summarized over a dozen externalities, all suggesting that the natural rate of employment is inefficient and higher than the optimum level of unemployment. Phelps mentioned externalities due to imperfect competition, information spillovers about conditions in the labor market from employed to unemployed workers, overpricing of labor due to lemon problems, failure to incorporate the value of self-respect from a good job, external effects of on-the-job training and experience, and income taxes that discriminate in favor of leisure. More recently, efficiency wage theories

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as divisibility, durability, and recognizability are particularly important for frequently traded objects still seems to be a good one. And now our modeling capabilities are such that we can actually study the role of such properties.

3 Concluding remarks

The two policy problems I have discussed – payment of interest on money and government currency provision – seem very different. I chose to discuss the first because it is often taken to be a solved problem. I chose to discuss the second because it seems so fundamental: An answer to it will not only determine whether some governmental role is desirable – the alternative being some sort of competitive money system – but will identify what that role ought to be. Certainly, the second problem subsumes the first, in that any model allowing us to analyze the government's role in the financial system will also have implications for whether there should be an interest subsidy on some or all of the assets in the model.

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based on shirking with costly monitoring of employee behavior or on turnover costs have also shown that the natural rate is inefficient. [See, for example, Calvo (1979), Shapiro and Stiglitz (1984), and Yellen (1984).] Trading externalities as developed by Diamond (1982) also show that the natural rate is inefficient. These types of inefficiencies are now being examined and applied by many researchers [See Katz (1986) for a review.]

Although recent progress on formally incorporating externalities into macroeconomics has clearly been significant, this emphasis on the inefficiency of the natural rate seems misplaced from the point of view both of empirical experience with macroeconomic policy and much macroeconomic theory. In modern macroeconomic theories that incorporate both price–wage rigidities and rational expectations, the natural rate is viewed as approximately invariant to monetary and fiscal policy, and the assumed goal is to reduce the size and duration of the fluctuations in the economy around the given natural rate. [See, for example, Fischer (1977) or Phelps and Taylor (1977).] One of the central reasons that the economy departs from the natural rate for prolonged periods is the existence of nominal wage and price rigidities that prevent the economy from adjusting quickly to disturbances. But these wage and price rigidities are temporary; they lead to temporary fluctuations in employment, not to permanent underemployment. Eventually the economy tends to return to the natural rate of unemployment, and (on average) unemployment is equal to the natural rate.

Although there are many models of macroeconomic fluctuations based on temporary nominal wage and price rigidities, there has been little discussion of how policy proposals to stabilize fluctuations in these models should be related to externalities. Are these fluctuations inefficient from a social point of view? If not, where are the externalities? This is in contrast to the relatively large amount of research on the efficiency of the natural rate.

The aim of this paper is to describe how a significant part of economic fluctuations can be interpreted as due to an externality directly associated with nominal wage and price rigidities. It argues that the externality is actually an implicit property of many existing macro models with wage and price rigidities, and explores ways – meant mainly to be suggestive for future research – to make the externality more explicit in these models. The paper concludes by arguing that many policy proposals – such as indexing wages to inflation, legislating profit sharing, or even instituting incomes policies (including tax-based incomes policies) – can be viewed as attempts to deal with this externality; but all are either ineffective or cause other problems.

1 The empirical nature of price and output fluctuations

Empirical evidence on the relationship between output fluctuations and price and wage fluctuations underlies my view that price and wage rigidities are an important aspect of the theory of economic fluctuations. I begin therefore with a brief review of the empirical evidence. I focus on the experience of the major industrialized countries during the last thirty years. The variables that I focus on are (1) the output gap y defined as the percentage deviation of real output from the natural rate of output, the latter measured as a piecewise linear trend, and (2) the inflation rate p measured as the rate of change in the output deflator. The output-inflation data are based on annual observations for seven countries – Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States – for the period from 1954 through 1984. I summarize the observations on these two series using simple bivariate vector autoregressions and their moving-average representations.

Table 1 reports the autoregressions for the seven countries, and Figure 1 plots the moving-average representations as calculated directly from the coefficients of these autoregressions. For annual data, two lagged values are sufficient to eliminate serial correlation of the residuals. I compute the moving-average process without orthogonalizing the error process in the estimated autoregressions. As described in Taylor (1980b, 1986), I find this approach leads to transformations of the vector autoregressions that are easier to interpret. However, the same general patterns in the moving-average coefficients are observed if one orthogonalizes the error process.

There is a striking similarity among the moving-average representations in the seven countries, as a glance at the general shapes in Figure 1 makes clear. The first row of plots gives the effect of an output shock on output (yy), the second row of plots gives the effect of an output shock on inflation (py), the third row gives the effect of an inflation shock on output (yp), and the last row gives the effect of an inflation shock on the inflation rate (pp).

Of course, both output and inflation are persistently moved by their own shocks in all the countries, as can be seen in the first and fourth rows. The pattern is much like the pattern for the United States noted in my previous work [Taylor (1986)]. However, what is more interesting and relevant for the role of price and wage rigidities in these fluctuations are the second and third rows, which show the dynamic cross-interaction between inflation and output in the different countries. In the United States the effect of output shocks is to increase inflation, while the effect of inflation shocks is to decrease output. In other words, the intertemporal cross-correlation between inflation and output shocks reverses sign when

Table 1. *Autoregressions for inflation and output, 1954–84*

Dependent variable	Lagged dependent variables				
	$p(-1)$	$p(-2)$	$y(-1)$	$y(-2)$	σ
Canada					
p	.798	−.062	.261	−.073	1.92
	(4.5)	(−.4)	(2.4)	(−.6)	
y	−.225	.165	.809	−.011	3.46
	(−.7)	(.6)	(4.1)	(−.05)	
France					
p	.591	−.101	.311	−.101	2.60
	(3.6)	(.7)	(1.8)	(−.9)	
y	−.137	−.189	.890	.142	2.98
	(−.7)	(−1.1)	(4.6)	(.6)	
Germany					
p	.852	−.235	.071	−.079	1.13
	(5.6)	(−1.6)	(1.6)	(−1.7)	
y	−1.020	1.085	.967	−.226	4.90
	(−1.5)	(1.7)	(5.0)	(−1.1)	
Italy					
p	.829	.088	.165	−.042	2.28
	(3.8)	(.37)	(1.3)	(−.28)	
y	−.437	.030	.872	.153	3.26
	(−1.4)	(.1)	(4.1)	(.7)	
Japan					
p	.740	−.193	−.166	.188	3.37
	(2.4)	(−.7)	(−.7)	(1.0)	
y	1.000	−.174	.432	.270	4.70
	(2.3)	(−.5)	(1.4)	(1.0)	
United Kingdom					
p	.790	.084	.746	.249	2.60
	(2.4)	(.5)	(3.4)	(.8)	
y	−.127	.083	.782	.006	2.46
	(−.6)	(.6)	(3.8)	(.0)	
United States					
p	.751	.096	.283	−.054	1.16
	(3.6)	(.5)	(2.9)	(−.5)	
y	−1.063	.772	.862	.024	2.26
	(−2.6)	(2.0)	(4.5)	(.1)	

Note: p = inflation rate, y = output gap, σ = std. error (percent).

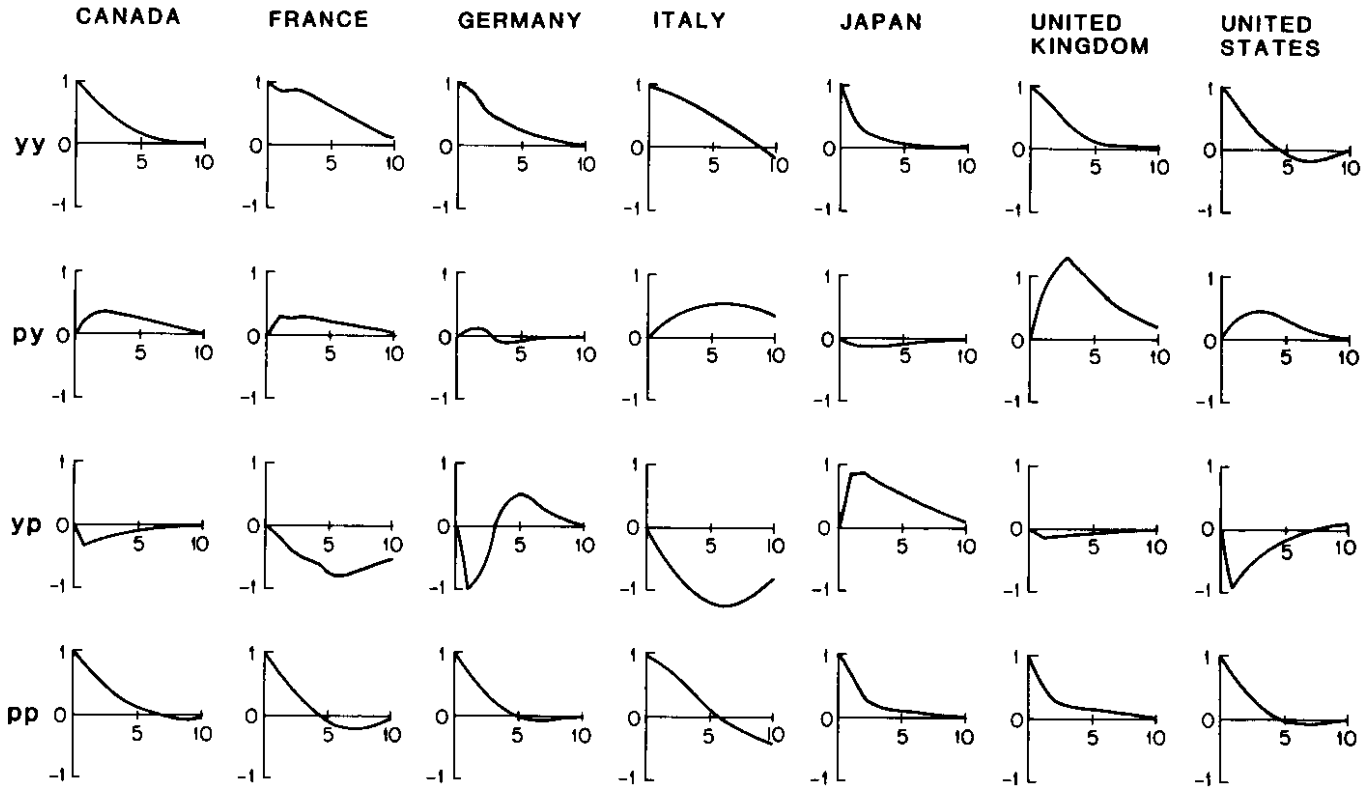

Figure 1. Moving-average representations computed from autoregressions reported in Table 1.

we switch variables. Figure 1 indicates that the same pattern seems to exist in most of the other countries; the only exception is Japan. Save this one exception, the reverse cross-correlation is apparently a central part of economic fluctuations.

A simple two-part theoretical explanation for these reverse cross-correlations is based on the existence of wage and price rigidities. The explanation goes as follows: (1) positive deviations of output from the trend level represent periods of excess demand during which prices and wages tend to be bid up gradually, and then raise the inflation rate with a lag; and (2) increases in inflation are not completely tolerated by policy makers, so that such increases result in less than fully accommodative policies that cause the economy to go into a recession after a lag. Less than fully accommodative policies could occur with monetary tightening in the face of inflation shocks, but fiscal policy could also be used. The story is similar in the case of shocks of the opposite sign: Decreases in output eventually cause declines in inflation, and decreases in inflation eventually cause increases in output.

Particular realizations of these cross relationships are well known in these industrialized countries. For example, the increase in inflation in the late 1960s and during the two oil shocks in the 1970s all led to recessions. More recently, in early 1986 a surprise decline in inflation – due largely to reductions in the price of oil – was expected to lead to continued high growth rates or real output despite the disruptions which the price change had in certain areas. In fact, most economic forecasters raised their forecast of world economic growth. These are all examples of the negative effect of inflation on output when inflation is dated prior to output.

On the other hand, inflation fell soon after the recessions in the 1970s and early 1980s. These are examples of the positive effect of output on inflation when output is dated prior to inflation.

It is not much of an exaggeration to say that all the significant fluctuations in the macroeconomy during the last thirty years have been due to these relationships between output and inflation. If so, then the intertemporal cross-correlations between inflation and output documented in Figure 1 are a crucial part of macroeconomic behavior that cannot be ignored. In Section 2 I argue that an important externality associated with wage and price rigidities is manifested in these correlations.

It may appear surprising that the same general explanation based on wage and price rigidities can apply in so many countries when we know that there are differences between the countries in their wage-setting institutions and macroeconomic policies. In fact, the differences – contract length, indexing, degree of accommodation by the monetary authorities – would affect the length of the lags rather than the signs of the coefficients

Of the seven countries, the one that is most different from the others is Japan, where wages are apparently set in a synchronized fashion rather than being staggered as in the other countries. Of course, this may be one reason why the empirical observations are so different in Japan.

Are these correlations consistent with other business cycle theories – such as the real business cycle theories described by King and Plosser (1984)? There are many structural explanations of any reduced-form correlation, but in my view the above explanation is still more complete than alternative business cycle theories. It is clearly beyond the scope of this paper to discuss all alternative theories. To my knowledge, however, descriptions of real business cycle theory do not attempt to deal with the timing relations between inflation and output that I documented and emphasized above. In principle, the negative relation between inflation and output could be due to shifts in the production function, rather than to the tightening of monetary policy. However, focusing on one example, it is hard to think of a productivity shock that could have led to the large recessions in 1981–82. Moreover, shifts in productivity per se do not generate the Granger prior relationship between inflation and output. For the Granger causality one needs to rely on other explanations – based perhaps on expectations.

2 The nature of the externality: an illustrative example

The nature of the externality associated with nominal wage and price rigidities is fairly easy to explain informally; indeed, except for a change in terminology and emphasis, the basic idea has been around since the beginning of macroeconomics as a field. I start with an early statement of the idea from Milton Friedman, since I referred to his research as an example of the tendency not to mention externalities explicitly in macroeconomics. Consider Friedman's (1948) analysis of the implications of wage rigidities for his famous proposals for monetary and fiscal policy. When there are wage rigidities, he writes,

> let there be a substantial rise in the wage of a particular group of workers as a consequence either of a trade-union action or of a sharp but temporary increase in the demand for that type of labor or a decrease in its supply, and let this higher wage rate be rigid against downward pressure. Employment of resources as full as previously would imply a higher money income, since, under the assumed conditions of rigidity, other resources would receive the same amount as previously, whereas the workers whose wage rate rose would receive a larger amount if fully employed . . . . The only escape from this situation [of unemployed resources] is to permit inflation.

If the increase in inflation is prevented then there must be a decline in output and employment.

When the wage rate of a group of workers increases, there will tend to be an increase in the overall level of wages. Firms, whether competitive or imperfectly competitive, will raise their prices accordingly. If the money supply is unchanged then this increase in wages and prices will reduce the real supply of money in the economy; real output necessarily falls. The fall in output associated with a fall in real money balances is consistent with any reasonable model of aggregate demand, whether based on a simple quantity equation, a full ISLM apparatus, or a model in which a reduction in real money affects real output by reducing the amount of intermediated credit. Note that if the money supply is increased in response to the exogenous wage shock, then there will be an increase in inflation. Only if real money balances are held constant will a decline in employment below full employment be avoided.

In fact, the mechanism bringing about the decline in overall employment in Friedman's 1948 model is fiscal policy rather than monetary policy. In Friedman's 1948 framework, the tightening of aggregate demand occurs because the higher level of nominal income increases taxes - the tax system is progressive - but government spending does not change. The increase in the government budget surplus is a drag on the economy. This story contrasts with the case where the money supply is fixed and the increase in prices reduces real balances, raising interest rates and thereby causing investment demand and output to fall. The end result is the same.

This is an externality because the workers who increase their wage do not take account of the influence of their actions on the overall price and wage level. Changes in the overall price level in turn affect the economy unless they are nullified by the policy makers. The workers therefore ignore the fact that they cause a drop in the overall level of employment that occurs as the central bank does not accommodate the increase. The wage rigidities create an interdependency in the economy. If workers could coordinate their wage setting, with some cutting their wages so that the overall wage level does not increase, then the adverse effects could be avoided. Competition rules out such coordinated wage setting, however.

It is important to emphasize that this externality is an economywide phenomenon, involving the interaction among markets. If one looks only at one market (say, the labor market), it is indeed difficult to see why the externality would exist. The implicit-contract work of Azariadis (1975), for example, suggests that even with wage rigidities the labor market will be operating efficiently. Looking at only one market ignores the fact that the externality occurs because of interdependencies throughout the econ-

omy. Short of collectively instituting an economywide auction market for all goods, there is no way to avoid this interdependency. The group of workers whose wage rate rose substantially suffers only part of the reduction in employment. Because the drop in employment is economywide, even though it is temporary much of it falls on other workers, and the market provides no way to make compensation.

3 Externalities in a model with nominal wage setting

Consider a model where there are no externalities and where prices and wages are perfectly flexible – set by a central auctioneer. For concreteness suppose that the economy consists of two types of workers whose employment (n_1 and n_2) is used in producing goods according to the production function

$$y = f(n_1, n_2). \tag{3.1}$$

Suppose that each type of worker has a utility function

$$U_1(y_1, n_1), \qquad U_2(y_2, n_2), \tag{3.2}$$

where y_1 and y_2 are consumption of the single good by each type of worker. Note that I have not included consumption of type-1 workers in the utility function of type-2 workers. This would be an obvious externality unrelated to wage and price rigidities. Let the nominal wage rate for each type of worker be x_1 and x_2, and let the price of output be p.

If the workers and the representative firm take wages and prices as given and maximize profits and utility, and if prices and wages are such that demand equals supply, then the equilibrium values of n_1, n_2, x_1/p, and x_2/p are given by the solution to

$$\begin{aligned} &f_1 = x_1/p, \qquad f_2 = x_2/p; \\ &U_{1n}/U_{1y} = -x_1/p, \qquad U_{2n}/U_{1y} = -x_2/p, \end{aligned} \tag{3.3}$$

with y given either by the production function (3.1) or by total income. Let the solution values be y^* for total output and n^* for total employment.

In this model, with no externalities, the competitive equilibrium clearly is efficient. From a macroeconomic perspective this competitive equilibrium corresponds to the "natural" rate of employment and output. In other words, the natural rate of employment n^* and the natural rate of output y^* are efficient. Note that the absolute level of nominal wages and prices is undetermined.

Now consider the possibility of economic fluctuations. I assume that these fluctuations arise as the economy moves from one long-run equilibrium in the above model to another long-run equilibrium. Suppose there

are shocks to production or to utility in this simple competitive economy. If the shocks are permanent then the economy will eventually settle down to a new equilibrium. This new equilibrium will also be efficient. But we are interested in the fluctuation in the economy as it moves away from the old equilibrium and toward the new one. The fluctuation will depend on the mechanism through which prices and wages are adjusted.

Suppose that nominal wages (x_1 and x_2) and the price are set by different decentralized decision makers. Assume also that there is a desire to keep the average price and/or wage from drifting too far away from some target. That is, x_1, x_2, and p are each under the control of a different agent, but there is a common goal of maintaining price stability; that is, keeping $(p+x_1+x_2)/3$ near some target. Alternatively the goal could be to maintain p near some target; we choose the average of wages and prices to emphasize that all nominal price and wage decisions generally enter into the aggregate target. In order to have a determinate aggregate target, it is necessary to have at least one of the wages or the price (or an average of the three) enter the model. There are many ways this could be done. For example, real money balances could be entered into the production function or the utility functions. A more direct approach, which incorporates the policy reactions described in Section 1, is to assume that policy makers keep demand for goods away from the natural rate according to the rule $y=y^*-a(m-M/(p+x_1+x_2))$, where M is the money supply and where a and m are positive constants. In other words, total demand for output is directly controlled by the monetary authorities in such a way that the economy is at the natural rate only if $p+x_1+x_2=M/m$, where M and m are set by the monetary authorities. There is no need to be specific at this point about the mechanism through which the monetary authorities do this. Note that when total production is greater or less than y^*, employment could be determined by some employment rule through which (for example) employment is reduced or increased proportionally for each type of worker according to the ratio y/y^*. We also leave open the explicit nature of this employment rule.

In this situation, employment and therefore utility will be affected by the overall price level. There is of course an overall average price-wage level (M/m) that will make output equal to the natural rate. But the decentralized price and wage setters have aims other than targeting the overall price level – namely, adjusting relative wages and real wages to values appropriate to the new optimal allocation. And if they do not coordinate their wage and price setting then they will not be able to keep the average price–wage level equal to M/m at all times, nor the level of output and employment equal to the natural rates. The lack of coordination in price and wage adjustment clearly generates an externality. This externality is

quite general and exists for a whole range of possible price and wage decision rules (for example, staggered wage setting and marginal-cost pricing), except for those in which prices and wages are determined by a central auctioneer and are perfectly flexible.

The existence of this externality seems consistent with the empirical observations mentioned in Section 1. The increase in inflation that leads to recessions corresponds to the increase in $p+x_1+x_2$ that leads to a decline in y relative to y^* in the model. More specifically, the increases in oil prices in the 1970s represented part of a relative price shift that – under the existing wage–price setting system – led to an increase in the overall price level that was not fully accommodated by the monetary authorities and that therefore led to a recession. Similarly, the decline in oil prices in 1986 should lead to a worldwide boom.

The wage and price setting system that currently exists in the United States and in many other countries can be viewed as a practical substitute for a world in which prices are perfectly flexible and determined by a central auctioneer. This substitute involves seemingly infrequent changes in wages and prices, made by decentralized decision makers. It is not clear whether these infrequent changes are the result of adjustment costs, or whether they have evolved because the overall system would work less well with more frequent changes. The actual wage–price system (as distinct from the imaginary auctioneer) now appears to be fairly effective in allocating resources. But it also leads to the externality that we have mentioned. An unresolved question is whether the externality is a necessary part of the allocative mechanism. For example, does the degree of monetary accommodation – the extent to which the relative wage increase leads to an increase in overall inflation or a drop in output – influence the size of the relative wage increase? In Taylor (1981) it was shown, in a particular staggered-contract model, that more accommodation leads to smaller relative price variability. This reduced variability could hinder the allocative effects of the initial wage increase.

4 Is it a pecuniary or technological externality?

An important distinction is sometimes made between pecuniary and technological externalities [see Scitovsky (1954)]. Pecuniary externalities per se are not a cause of inefficiency. They occur as a result of a change in tastes or production, and a consequent change in prices, that move the economy from one equilibrium to another. Greenwald and Stiglitz (1986) make the distinction this way: Technological externalities occur when "the action of one individual or firm directly affects the utility or profit of another," while pecuniary externalities occur "when one individual's or firm's actions

affect another only through effects on prices." For example, if there is a permanent change in people's tastes away from butter to margarine, workers employed in making butter will be paid less in the new equilibrium than they were in the old equilibrium. There appears to be an externality, in that the people who change their tastes have an effect on the well-being of butter manufacturers and their employees that they ignore when they make their taste change. Yet both equilibria – the one before the taste change and the one after – can be Pareto efficient, in which case there is no externality in the usual (or technological) sense of the word. Except for distributional considerations there is no reason for policy intervention in the case of pecuniary externalities, as is clear from this example.

Is the externality that we discussed in Sections 2 and 3 a pecuniary externality? I have argued that it is not. But there is a superficial similarity in that individuals affect each other through prices. The shock that called for a change in wages in Friedman's example of downward wage rigidities was a change in a utility or production function, but the actions of individuals or firms did not directly affect the utility or production function of others. The natural state of the economy could be Pareto efficient in this example. If so, after wages and prices have fully adjusted the economy would be back in a Pareto efficient situation. In the case of wage and price rigidities, however, the externality occurs during the transition from one possibly Pareto efficient equilibrium to another. The externality is in the price adjustment process itself, not directly in the conventional utility or production functions. People do not take account of the fact that their actions have adverse effects on the behavior of the economy as it passes between equilibria. The externality is quite different from the traditional types of externalities that have nothing to do with slow wage and price adjustment, but it is nevertheless more than a purely distributional pecuniary externality.

Recently, Akerlof and Yellen (1985), Blanchard and Kiyotaki (1985), and Mankiw (1985) have shown that price and wage rigidities, which occur simply because workers or firms have a *small* cost of adjusting prices and wages, can lead to *large* welfare losses in the economy as a whole. These "near rational" price decisions have impacts on other agents in the economy because there are other sources of inefficiency in the economy – for example, monopolistic competition. Hence, there is a similarity with the pecuniary externality mechanism mentioned above: Pecuniary externalities can have welfare effects if there are other sources of inefficiency in the economy. The externality that I describe in this paper is conceptually distinct from the mechanism described by Akerlof and Yellen (1985), Blanchard and Kiyotaki (1985), and Mankiw (1985). The externality in

this paper would exist even if there were no other distortions or nonconvexities in the economy. Here it is the lack of coordination in achieving an aggregate price–wage target in any economy where nominal wage and price decisions are decentralized, combined with a social desire for stable aggregate price–wage, that generates the externality.

5 Reform proposals

Many macroeconomic policy changes and reforms that have been proposed can be interpreted as ways to eliminate the externality associated with nominal wage and price rigidities. In this section we briefly review three proposals: indexing, incomes policies, and the profit-sharing proposal made by Weitzman (1985).

Indexing

Indexing can be thought of as a way to facilitate movements in the overall level of wages and prices while not interfering with the relative wages or real wages. If wages were more responsive to changes in prices, then the overall level of wages and prices could adjust more quickly without real effects on output. With wages fully indexed to prices, a reduction in the money supply could reduce the average level of wages and prices toward a target level, with little or no change in output. The externality associated with wage rigidities would effectively be reduced.

As Fischer (1977) and Gray (1976) have shown, however, indexation can hinder the adjustment of the economy to changes in productivity or tastes that require changes in the real wage or in relative wages. In terms of the model discussed above, indexing wages x_1 or x_2 to prices p prevents real wage adjustments. Indexing wages x_1 to other wages x_2 prevents relative wage adjustments. Thus, the imposition of indexing to alleviate the externality associated with wage rigidities can have harmful side effects. Indexing does not appear to be a satisfactory solution to the externality problem, because it interferes with relative- and real-wage adjustments that must occur if resources are to be allocated efficiently when tastes or technologies change.

Incomes policies

Wage and price controls – as well as tax-based incomes policies – have frequently been proposed and sometimes used in the United States and other countries. These policies can also be interpreted as a way to eliminate the externalities associated with wage and price rigidities discussed

above. In terms of our discussion in Section 3, the theoretical idea behind wage and price controls is to prevent the average level of wages and prices from rising without using restrictive monetary and fiscal policies. Relative price changes of the type mentioned earlier could take place, but by controlling the overall inflation rate the controls effectively force other wages to be reduced, or not increase as much.

In practice, however, wage and price controls do not seem to have worked very well. It is difficult to control the overall level of prices without having an impact on relative prices. As our discussion above makes clear, coordinating wage and price decisions of individual decision makers would necessarily interfere with the price-adjustment mechanism and thereby probably interfere with the allocative role of the price system.

Profit sharing

A recent proposal by Weitzman (1985) is to replace the current price-wage adjustment system with a profit-sharing system. One of the stated aims of Weitzman's proposal is to reduce the size of economic fluctuations. Is the proposal effective in eliminating the externality discussed in this paper? Two aspects of profit sharing need to be considered. First, profit sharing has characteristics similar to indexing: When there is a drop in demand that causes prices and profits to fall, wage payments are automatically reduced. Thus, as with indexing, the overall level of wages and prices falls more quickly in response to a monetary contraction and with a smaller effect on output. A disadvantage of profit sharing is also similar to indexing: Changes in labor productivity may require a change in the profit share going to workers. Just as indexing keeps the real wage from changing, profit sharing keeps the labor share from changing. Of course it would be possible to change the parameters of a profit-sharing plan, but the same could be said for an indexing formula.

A second aspect of profit sharing is that it would change the demand for labor. As Weitzman emphasizes, firms paying less at the margin to hire workers will want to hire more workers. How does this increased demand for labor fit into the general discussion of externalities discussed in this paper? In order to answer that question, a less general framework than the one introduced above is clearly necessary. For this purpose I look at the staggered wage-setting model that I have used in earlier work [Taylor (1980a)]. Consider the following variables and notation: The money supply is m, the price level is p, the average wage rate is w, the contract wage is x (set in any period by a subset of the workers), and real output is y; all these variables are measured in logs. Note that the notation in this section is different from the previous sections.

Aggregate demand is given by

$$y = b(m-p). \tag{5.1}$$

We assume that there is a natural or potential level of output, normalized to be $y=0$.

We will consider two economies - one based on wage payments and the other based on profit sharing. In the wage-payment case, prices are assumed to be a markup over the wage. The price equation, in log form and omitting constants, is simply

$$p = w. \tag{5.2}$$

Note that, in the long run, output $y=0$; so the price level and therefore the wage w must equal m in the long run. In the short run, the wage is given by a staggered wage-setting equation

$$x = .5(w^e + w^e_{+1}) + c(y^e + y^e_{+1}), \tag{5.3}$$

where x is the contract wage set by workers in a given period. The superscript e represents the expectation of the variable. I look only at the case where wage decisions last two periods. (Note that the subscripts on x now represent the period rather than the type of worker.) The average wage is given by $w = .5(x + x_{-1})$. The behavior of the model is much like that described in Section 2 or 3. When there is an increase in the wage of one group of workers [equation (5.3) is shocked], a fixed money supply leads to a contraction of output. Alternatively, an accommodative monetary policy leads to a larger increase in the overall wage and price level, and a smaller drop in output. The externality associated with the nominal rigidities are just as in the earlier example.

Now consider the case of Weitzman's share economy. Rather than being paid a fixed wage rate x, workers are paid a lower fixed wage x^f plus a share x^s of the profits of firms. The parameters x^f and x^s are taken as parameters of the profit-sharing contract. The vector $x' = (x^f, x^s)$ replaces the single parameter x (the contract wage) in the standard wage model.

How will prices be determined in the profit-sharing case? Weitzman assumes that prices - at least in the short run - are set as a markup over the fixed-payment part of the profit-sharing contract. In terms of the notation introduced so far, this implies the following analogy with equation (5.2):

$$p = v, \tag{5.4}$$

where $v = (x^f + x^f_{-1})/2$ is the average of the wage portion of the profit-sharing contract in this period and the previous period. [As we discuss below, prices will adjust to a value that is not given by equation (5.4) in the long run.]

We now need to explain the determination of the pair x'. The most straightforward assumption is that pair x' is determined in the same way that the single wage x is determined in the wage model; that is, through equation (5.3). Workers would prefer a profit-sharing contract with a high x' much as they would prefer a wage contract with a high x. The market would then determine the overall level as represented by the pair x'. In attempts to bid workers away from other firms in good times, firms would bid up the contract x' relative to the other firms' contracts. Conversely, in bad times (with high unemployment) workers would be less willing to bargain for a contract with an x' much higher than the prevailing x'. In normal times, it is reasonable to expect that workers and firms would set profit-sharing contracts that were about equivalent to the prevailing level of contracts. These considerations that go into the determination of the profit-sharing contract are identical to those that go into the simple wage contract. Consequently, a reasonable profit-sharing determination equation for x' is again equation (5.3).

Weitzman is not specific about how the wage parameters would adjust, except that they will converge to values for which the economy will operate at the same long-run equilibrium as under the pure wage system. This long run will also imply a different value for p than given in equation (5.4); as the pay parameters adjust, the price level will adjust to give the same level of real balances as in the pure wage economy.

In the profit-sharing economy, the equations are (5.1), (5.3), and (5.4), with x' replacing x in equation (5.3) and with p adjusting upward (slowly perhaps) to cover total wage payments. The behavior of the profit-sharing economy and the wage economy is therefore very similar, *as long as part of the profit-sharing system entails a fixed wage component,* however small. The reasons could be the same as those listed by Friedman (see Section 2). Suppose, for example, that it is the result of a strong trade union action: The trade union of one group of workers receives a big increase in its profit-sharing contract. Unless there is an offsetting decline in the terms of the other group of workers this will increase the demand for money – more will be needed to pay workers in the form of wages. The increase in the demand for money will result in a loss of output unless it is accommodated by the central bank. In sum, the externalities of the wage system continue to exist in a profit-sharing system.

6 Concluding remarks

The aim of this paper has been to describe the externality existing in macroeconomic models of economic fluctuations that are based on nominal price and wage rigidities. The general description does not rely on any one specific model of wage and price determination. Three elements of

any model are crucial for the externality, however: (1) wages and prices are set in nominal terms by decentralized decision makers, (2) there is a common desire for stability of the aggregate price–wage level, and (3) the monetary system is able to make total demand for production and employment differ from the efficient levels whenever the aggregate price–wage level is off target.

The paper also briefly examined three policy proposals that can be interpreted as attempts to deal with this externality. All three – indexing, incomes policies, and profit sharing – do not seem to alleviate the welfare loss associated with the externality without creating other problems. Apparently, more detailed and explicit models of nominal wage and price adjustment are necessary before we can say how other types of proposals [such as "more-or-less accommodation" of monetary policy as in Taylor (1980a)] are likely to deal more effectively with the externality.

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