IS INCREASED PRICE
FLEXIBILITY STABILIZING?

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ABSTRACT

This paper uses Taylor's model of overlapping contracts to show that

increased wage and price flexibility can easily be destabilizing. This

result arises because of the Mundell effect. While lower prices increase

output, the expectation of falling prices decreases output. Simulations

based on realistic parameter values suggest that increases in price

flexibility might well increase the cyclical variability of output in the

United States.

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Most economists would answer the question posed in our title affirmatively. It is certainly true that if prices were completely inflexible, markets could never equilibrate to changing conditions. And given a disturbance in nominal aggregate demand, "more flexible" prices imply that more of the disturbance is absorbed as a change in the price level, leaving less to appear as a cyclical movement in production. Considerations along these lines have led to a widespread belief that there is an intimate causal connection between wage and price inflexibility and cyclical fluctuations in employment and output.

This paradigmatic belief--that the magnitude of the business cycle depends largely on the degree of institutional wage rigidity--is institutionalized by the pedogical style of many macroeconomics courses. At some point a "Classical" aggregate supply curve generated by complete price flexibility and atomistic markets, is counterposed to a "Keynesian" aggregate demand-aggregate supply model, where the short-run aggregate supply curve is infinitely price-elastic because nominal wages are assumed fixed. The teacher then demonstrates that in the "Classical" model a monetary (or any other nominal) shock has no real effects on output because the aggregate price level adjusts to clear all markets, and in the "Keynesian" model a monetary shock has real effects because quantities adjust. The message carried away is that the crucial market failure generating business cycles is the existence of sticky nominal wages: if only the labor market were fully competitive and flexible, then business cycles would be much smaller. This view suggests the desirability of any possible policy measures which increase wage and price flexibility.

This message is too simple. We believe, as we argued in DeLong and Summers (1984), that the sign of the macroeconomic consequences of increased aggregate price flexibility is not a settled issue. We think that the question, "is increased price flexibility stabilizing?" is—or should be— kept open, and there is a real chance that aggregate price flexibility would be destabilizing at the margin given the present structure of the American economy.

The view that price level flexibility can be destabilizing has been expressed many times. Irving Fisher (1923,1925) saw the business cycle as "largely a 'dance of the dollar'": expected deflation led to high anticipated real interest rates, little investment, and low output. If the money supply were manipulated to stabilize the price level—said Fisher— much of the business cycle would disappear, for "what concerns business is not whether prices are high or low but whether they are rising or falling. Thus rising prices stimulate business because the prices a producer can get outrun his expenses for interest rent, salaries, and wages, while falling prices depress trade...[W]e find that this one element, rapidity of price movement, during the period 1914-1922 seems to account, almost completely, for the ups and downs of business."

Keynes (1936) argued in his chapter 19 that it was preferable in a gathering recession to increase real balances by printing money rather than by helping along the decline in prices, because

> it would be much better that wages should be rigidly fixed
> and deemed incapable of material changes, than that depression
> should be accompanied by a gradual downward tendency of money-
> wages, a further moderate wage reduction being expected to
> signalize each increase of, say, one percent in the amount of
> unemployment. For example, the effect of an expectation that
> wages are going to sag by, say, two percent in the coming year
> will be roughly equivalent to the effect of a rise of two

percent in the amount of interest payable for the same period.
and according to L. Jonung (1981), the Swedish Central Bank's attempt to
adopt a price-stability rule for the conduct of monetary policy greatly
insulated Sweden from the Great Depression.

More recently, James Tobin (1975) has stressed the potential role of
destabilizing deflation in creating a situation in which there is
"protracted unemployment which the natural adjustments of a market economy
remedy very slowly if at all." He argues that "even with stable monetary
and fiscal policy, combined with price and wage flexibility, the adjustment
mechanisms of the economy may be too weak to eliminate persistent
unemployment" because the destabilizing price change effect on aggregate
demand may well swamp the stabilizing price level effect.

In DeLong and Summers (1984), we noted that the increasing degree of
nominal rigidity in the U.S. economy over the past century had coincided
with a dramatic decrease in the cyclical volatility of economic activity.
This observation tends to bely explanations of cyclical fluctuations based
on nominal rigidities. We presented models with backward-looking
expectations, in which marginal increases in aggregate price flexibility
were destabilizing, in the sense that they increased the steady-state
variance of output in response to independent stochastic shocks. We
conjectured that the same property--destabilizing price flexibility--would
hold true in at least some models with fully rational expectations.[1]

This paper presents such a model. We take Taylor's (1979 and 1980)
macroeconomic model with staggered labor contracts and modify it so that (a)
it produces persistent fluctuations of output in response to macroeconomic
demand shocks, and (b) it allows anticipated changes in the price level to
affects on the level of aggregate demand through effects on real interest

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rates or the distribution of wealth. Solving the model numerically, we find that for a wide range of parameter values, an increase in the responsiveness of wages to excess demand or supply in the labor market leads to an increase in cyclical variability as measured by the steady state variance of output.

The paper is organized as follows: Section I describes our modifications of the Taylor model and shows that increasing the flexibility of prices may well be destabilizing in our modified model. Section II verifies the robustness of this result by examining modifications of the time structure of contracts. We are able to verify that the volatility of output ultimately declines as the wage-price process approaches perfect Walras-like flexibility. But this limiting result is very misleading as a guide to marginal changes in price flexibility that start from current levels. Section III generalizes the analysis by allowing aggregate demand to depend on both Tobin's q and the rate of deflation as well as the real interest rate. The former generalization tends to increase the stabilizing character of price flexibility while the latter reduces it. Section IV concludes the paper by discussing some empirical observations supporting our analysis.


I.    WAGE RIGIDITY AND OUTPUT VOLATILITY

John Taylor ((1979) for the intuitive, simplified version; (1980) for the full model and extensions) set forth the following simple macroeconomic model to illustrate how the asynchronization of nominal price setting decisions can have important aggregate effects:

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1.  $y_t = m_t - p_t + v_t$     aggregate demand

2.  $m_t = hp_t$               money-supply rule

3.  $p_t = .5(w_t + w_{t-1})$     definition of price level

4.  $w_t = .5w_{t-1} + .5E_{t-1}w_{t+1} + g(.5E_{t-1}y_t + .5E_{t-1}y_{t+1}) + e_t$

                              --wage setting equation

where $e_t$ and $v_t$ are stochastic shocks.

Equations (1) through (3) are completely standard. Equation (1) says
that with variables in logarithms, output $y_t$ equal to real money balances
$m_t - p_t$ plus a white-noise velocity shock $v_t$. Equation (2) asserts that the
monetary authority partially accommodates increases in the price level by
increasing the nominal money supply in the proportion h. Equation (3)
defines the aggregate price level. Taylor supposes that workers negotiate
two-period fixed nominal wage contracts. The aggregate price level in
period t is simply the average of the two different contracts in force at
that moment--the contract which begins in period t-1 and the contract which
begins in period t. Each contract covers half of the labor force, and $w_t$ is
defined as the (log of the) wage paid in periods t and t+1 to those workers
whose contract is negotiated at the end of t-1.

Equation (4) contains the heart of the model. The contract wage $w_t$ is
set as the average of the contract wages $w_{t-1}$ and the expected contract wage
$w_{t+1}$--the average of the wages of those contracts which overlap the periods
covered by the contract which pays $w_t$--adjusted for excess demand or supply
in the labor market through the terms containing $E_{t-1}y_t$ and $E_{t-1}y_{t+1}$.
"$E_{t-1}$" appears because the contract is negotiated before the realization of

period t's shocks. The parameter g represents the degree of wage
flexibility: the higher is g, the greater is the response of wages to demand
conditions.

Recent research, Akerlof and Yellen (1985), Mankiw (1985), and
Blanchard (1985), suggests that contracts of the type envisioned by Taylor
can be justified on micro-economic grounds. The private loss from such
arrangements is second-order relative to the social consequence which is
first-order. In the presence of small transactions costs, firms and
workers may therefore enter into such contracts. Alternatively, following
the arguments advanced in Fischer (1984), the analytical use of a
contracting model of this type may be justified on empirical grounds:
contracts similar to those envisioned by Taylor do predominate in American
labor markets, even if economists cannot fully rationalize their existence.

Taylor's model provides a clean and forceful implementation of the
fundamental insight that the asynchronization of price changing decisions
can have significant consequences for the business cycle. But for the
purpose of examining the effects of varying degrees of price flexibility,
Taylor's particular implementation of this idea is deficient in two major
respects: first, the specific models advanced by Taylor (in 1979 and 1980)
produce the wrong kind of output persistence; second, the specific model
possesses no channel through which price flexibility could be stabilizing.
We consider these points in turn.

As Taylor demonstrates, equations (1) through (4) can be solved to
produce a moving average representation for output as a function of the
shocks $e_t$ and $v_t$:

$$(5) \quad y_t = .5\beta e_t - .5\beta \{ \sum_1^{\infty} ((D)^{i-1} + (D)^i) e_{t-i} \} + v_t$$

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where D is some complex function of structural parameters and $\beta=1-h$. An aggregate demand shock--the velocity shock $v_t$--generates no persistent fluctuations. The only source of persistent fluctuations is the $e_t$ shock in equation (4).

What economic interpretation can be given to a positive $e_t$ shock? It is an exogenous increase in the wage rate attached to the contract beginning in period t. It may be thought of as representing an exogenous outburst of union militancy. These episodes of successful bargaining lead to inflation, to a higher price level. Because the monetary authority does not fully accommodate this cost-push shock, this price-level increase is gradually rolled back by a prolonged period of subnormal output. The business cycle described by Taylor is, therefore, a cost-push business cycle. Equation (5) describes persistent cyclical output fluctuations that come about because of exogenous supply-side wage shocks. It has, therefore, relatively little to tell us about the persistent output fluctuations in response to demand-side shocks that Keynesian economists at least, think lie at the heart of the business cycle.[2]

If a version of Taylor's (1979) model is to give much insight into the workings of the business cycle, the model must generate persistent output fluctuations as a result of demand shocks. Note that if the model's timing convention is modified so that wages depend on contemporaneous demand, white noise nominal shocks will generate negatively serially correlated movements in output. We found it impossible to generate persistent output flucutations as the result of transitory nominal shocks in this framework. To examine the issue of price flexibility within a model which gives a plausible account of business cycles, the assumption that

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aggregate demand shocks are serially uncorrelated must be droped. Instead, the model must incorporate a persistent nominal demand shock.

Even with a persistent nominal demand shock, however, the Taylor model is still unsatisfactory for the purposes of this paper. There is no channel through which price flexibility could possibly be destabilizing; the model's treatment of the determinants of aggregate demand is too simple. Given $v_t$ and the monetary policy reaction function, output simply moves inversely with the price level. In order to treat the effects of deflation which might exert downward pressure on output, we must complicate the determinants of aggregate demand. We do this by relaxing Taylor's assumption that the demand for money is interest inelastic.

The modified model exhibits the Mundell effect. The interest rate that determines demand for goods is a real interest rate; the interest rate that clears the money market is a nominal interest rate. Inflation or deflation drive a wedge between the two and shift the short-run solution of the IS-LM system, which determines output. While a lower price level is expansionary, the expectation of falling prices is contractionary, creating the possibility of instability. This seems the easiest but not the only way to model the host of possible channels--redistributions, bankruptcies, liquidity failures, real interest rate changes, and so forth--through which deflation might depress output.

We assume output as determined by the IS curve depends on the short-run real interest rate and a serially-correlated demand shift term $s_t$:

(6) $\quad y_t = -A\{i_t - [E_t p_{t+1} - p_t]\} + s_t$

(7) $\quad s_t = \mu s_{t-1} + z_t$

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where $z_t$ is independent and identically distributed. The money-demand function is standard, with velocity depending on the nominal interest rate:

(8)  $m_t = p_t + y_t - v_t$

(9)  $v_t = \gamma i_t$

Parallelling Driskill and Sheffrin (1985), the money authority follows an interest-rate rule which is designed to remove $m_t$ as an independent variable from (8) and (9):

(10)  $m_t = \beta(i_t)$

Deleting the "cost-push" wage shock from the wage equation, but otherwise using the price level definition and the wage setting equation from the original two-period contract version of the Taylor model described above yields:

(11)  $p_t = .5(w_t + w_{t-1})$

(12)  $w_t = .5(w_{t-1} + E_{t-1}(w_{t+1})) + .5g(E_{t-1}y_t + E_{t-1}y_{t+1})$

This model (6)-(12) resists analytic solution. Therefore the model is numerically solved for a range of parameter values. Although there are five free parameters—$g, \beta, \gamma, A$ and $\mu$—the behavior of output and prices has only four independent dimensions of variation. $\gamma$ and $\beta$ affect the movement of $Y_t$ and $p_t$ only through their sum since substituting (10) and (9) into (8) leads to:

(13)  $y_t + p_t = (\beta + \gamma)i_t$

and substituting (13) into (6) leads to:

$$(14) \quad y_t = [A\{[E_t p_{t+1} - p_t] - B(p_t)\} + s_t]/(1+AB)$$

Where $B = (\beta+\gamma)^{-1}$. Equation (14) reveals that the price level affects,
directly and indirectly, output through two channels: there is a
"destabilizing" expected price change effect and a "stabilizing" price level
effect.

With this model, we pose the following question: given that the model
falls short of some ideal contingent-claims Walrasian economy in many ways,
does additional aggregate price flexibility--an increase in the
responsiveness of wages to excess supply and demand, an increase in the
coefficient g--stabilizing the economy? We calculate the steady-state
variance of output in response to a unit variance white-noise process for
$z_t$, and determine whether additional price flexibility increases or
decreases the steady-state variance of output for the economically relevant
part of the range of parameter values.

The model is solved numerically for the steady-state variance of output
by the following procedure: first, we calculate the impulse response
functions for output and prices in response to a single $z_t$ shock. To
determine a unique solution, the transversality condition that the effects
of the shock eventually go away is imposed. The model thus becomes
mathematically a two-point boundary value problem which can be solved
numerically along the lines of the Fair-Taylor (1983) algorithm. That is, we
assume a path of expectations for prices and output after the shock, solve
the model forward conditional on this path of expectations, check for the

convergence of the "actual" with the "anticipated" path, update the path of expectations, and iterate. Second, once the impulse response function has been found, the steady-state variance of output in response to a univariate white-noise process for $z_t$ is easy to determine. If $R_i$ is the impulse response in the i'th period after the shock, then the effects of the shock $z_{t-j}$ will contribute $(R_j)^2(z_{t-j})^2$ to the variance of $y_t$. Since independent variances add, the steady-state variance of $y_t$ generated by a unit-variance independent and identically distributed $z_t$ process is simply

$$\sigma^2 \sum_0^\infty R_j^2$$

In our initial set of numerical solutions, we let A--the semi-elasticity of output with respect to the real interest rate--vary between 1 and 3. Assuming an average nominal interest rate of 8 percent, the .17 interest elasticity of real spending estimated by Friedman (1978) is equivalent to an A of two. B, the inverse of the sum of the interest semi-elasticities of money demand and money supply, takes on two values: .2, representing accommodating monetary policy (or a banking sector which elastically supplies real balances) and a sizable responsiveness of money demand to interest rates, and .4, representing relatively unaccommodating money supply and money demand behavior. To place these values in perspective, note that with a nominal interest rate assumed to average eight percent and Goldfeld's (1976) estimate of -.20 for the interest elasticity of money demand, completely interest inelastic money supply implies B equals .42; if the money supply has an interest elasticity of +.20, then B equals .21.

Perhaps the best way to evaluate the plausibility of our parameter estimates for A and B is to calculate their implications for the simple

Keynesian multiplier. Holding all present and future expected prices constant, the simple comparative-statics calculation of $dy/_{dg}$ from equations (6)-(10), assuming a marginal propensity to spend of .67 is given by:

|      |       | B=.2 | B=.6 |
|------|-------|------|------|
|      | A=1   | 2.5  | 2.2  |
| M=   | A=2   | 2.1  | 1.5  |
|      | A=3   | 1.9  | 1.5  |

an increase in autonomous spending of 1 percent GNP leads in the comparative-statics to an increase in nominal demand of K percent. These values span most estimates of this spending multiplier.

We allow g, the responsiveness of wages to excess demand or supply in the labor market, to vary between 0 and 1. Thinking of a period as 1 year, a value of .1 for g implies that a one percent reduction in output reduces the wages by .05 percent in the first year and by .1 percent after two years. In the language of Okun (1978), it implies a sacrifice ratio of 20 slightly greater than his upper bound estimate. A value of 1 for g implies a sacrifice ratio of 2, which is somewhat below Sachs' (1985) optimistic reading of recent experience.

The basic numerical solutions are presented in Table 1. The degree of price flexibility increases within each row reading across. And it can be clearly seen that increasing price flexibility typically increases—not decreases—the steady-state variance of output.

Price flexibility is destabilizing at the margin in almost all cases. Only as the disturbance to the IS equation approaches a random walk is price flexibility ever helpful in reducing the variance of output, and then only over a relatively narrow range as the parameters move from a situation with

no price flexibility to one with some price flexibility. Starting from the position of no price response to output fluctuations at all, a small amount of price flexibility can effectively damp the far-future effects of a current shock, thus reducing steady-state output variance. But very soon the margin of diminishing returns is reached because the far-future output fluctuations have already been damped, there are only small marginal returns as price flexibility is increased, and increased price flexibility disturbs the real interest rate in the present.

The pattern of responses shown in Table 1 is typical of the many calculations which we performed. In general, increases in B, A, and μ all tend to slightly increase the region over which price flexibility is stabilizing. The steeper the LM curve or the flatter the IS curve, the smaller is the scope for destabilizing price flexibility. And the more persistent are shocks, the more likely are the advantages of moving the price level quickly towards its equilibrium level to counteract the disadvantages of having a volatile rate of change of the price level.

It is interesting to note that price flexibility increases the variance of output not by increasing the persistence of shocks but by front-loading their effects. As Figure 1 shows, the combination of price flexibility and the real interest rate effect together concentrate the output effects of a persistent nominal demand shocks in the present and near future, close in time to the moment when the shock occurs. If in response to a monetary contraction the price level is expected to decline substantially, then (a) real balances will be back to normal in the following period, so the effects of the contraction will not persist, and (b) the contractionary effects of high nominal interest rates will be reinforced by the extra increase in the real interest rate created by the anticipated price decline.

# Table 1

## Steady-State Variances of Output

### B=.2

| | | g=0 | .1 | .2 | .4 | .6 | .8 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| μ=.5 | A=1 | 92* | 97* | 103* | 113* | 120* | 126* | 129* |
| | 2.0 | 23* | 23* | 25* | 27* | 29* | 31* | 32* |
| | 3.0 | 10* | 10* | 11* | 11* | 12* | 13* | 14* |
| μ=1.0 | A=1 | ∞ | 710* | 776* | 914* | 1019* | 1104* | 1176* |
| | 2.0 | ∞ | 176* | 192* | 226* | 253* | 275* | 293* |
| | 3.0 | ∞ | 78* | 84* | 99* | 112* | 122* | 130* |

### B=.4

| | | g=0 | .1 | .2 | .4 | .6 | .8 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| μ=.5 | A=1 | 68 | 69* | 72* | 76* | 80* | 83* | 85* |
| | 2.0 | 17 | 17* | 18* | 19* | 20* | 21* | 22* |
| | 3.0 | 7.5 | 7.3* | 7.7* | 8.2* | 8.6* | 9.1* | 9.3* |
| μ=1.0 | A=1 | ∞ | 328 | 314 | 326* | 344* | 360* | 374* |
| | 2.0 | ∞ | 85 | 79 | 81* | 85* | 90* | 93* |
| | 3.0 | ∞ | 36 | 35 | 36* | 38* | 40* | 41* |

Note: Price flexibility destabilizing at the margin is denoted by *. The choice of parameters is described in the text.

## Figure 1

Impulse Response Functions to a $Z_t$ Shock:

Low (g=0) and Moderate (g=.4) Price Flexibility Cases

$A=2.0, B-.25, \mu=.7$



Period
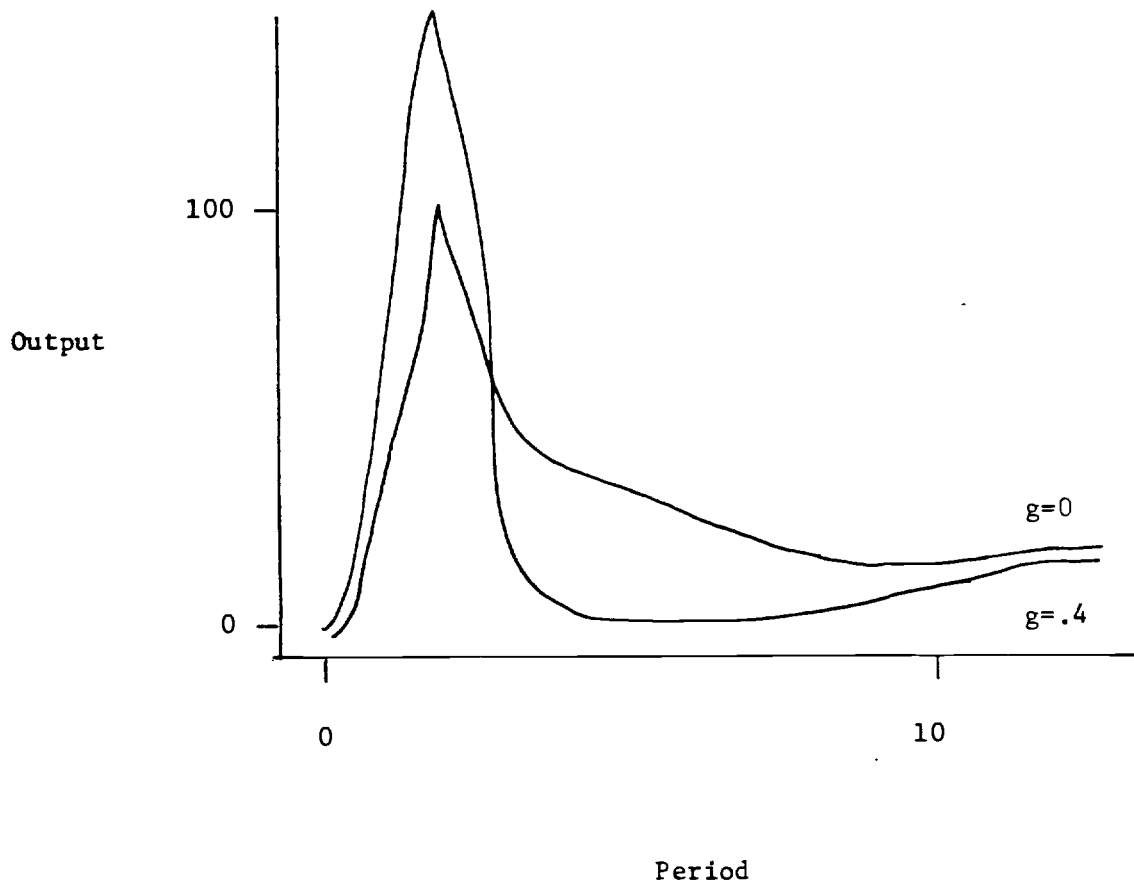
Output is subject to shorter--and sharper--swings with more flexible

prices. In DeLong and Summers (1984) we show that serial correlation in

output has in fact increased over time as prices have become more and output

less volatile. The serial correlation in quarterly changes in output has

risen from approximately .4 before World War I to approximately .8 today.

A common pattern--increased serial correlation and decreased volatility with

more rigid prices--is present both in history and in the model. Perhaps this

mechanism has something to do with the changing character of American

business cycles.

Although this model is too simple and stylized for the conclusions

reached from analysis of it to be easily applied, the conclusions do seem

striking. Taking Taylor's (1979) model, and modifying it so that it (1)

allows for the influence of real interest rates on aggregate demand, and (2)

generates persistent output fluctuations in response to demand-side shocks,

we found that this model exhibits destabilizing price flexibility as

stressed by Fisher, Keynes, and Tobin for a wide range of plausible

parameter values.


## II. ALTERNATIVE CONTRACT STRUCTURES

### Changing Contract Length:

In addition to changing g as a way of modelling increases or decreases

in wage and price flexibility, there is another possible type of change in

price flexibility that can be analyzed with this model. It is possible to

change the number and the length of the overlapping contracts. Taylor (1980)

describes how to generalize his wage-setting equation from the case of two-

to the case of many-period contracts.

## Table 2

### Increasing the Length of Nominal Contracts

#### A=2,B=.4

| Contract Length: | | 2 periods | 3 periods | 4 periods |
|---|---|---|---|---|
| μ=.5 | g=0 | 17.0 | 17.0 | 18.0 |
| | .1 | 17.2 | 17.1 | 17.1* |
| | .2 | 17.6* | 17.4* | 17.2* |
| | .4 | 18.7* | 17.9* | 17.5* |
| | 1.0 | 21.3* | 19.2* | 18.2* |
| μ=1.0 | g=0 | ∞ | ∞ | ∞ |
| | .1 | 84.6 | 97.4 | 109.4 |
| | .2 | 79.6 | 84.2* | 93.3* |
| | .4 | 80.8* | 79.6* | 83.6* |
| | 1.0 | 93.4* | 83.1* | 81.0* |

Note: Price flexibility destabilizing at the margin is denoted by *. The choice of parameters is described in the text.

The previous section has shown that price flexibility is almost always destabilizing for the case of two period contracts, but how does the variance of output change as the number of periods a given contract lasts increases from two to three to four?

Table 2 shows that, at least for the parameters chosen, increasing the of nominal contracts in the model frequently decreases the steady-state variance of output. We present only results for B=.4. With B=.2, increasing contract length reduces the variance of output for all our chosen values of μ and A. As the contract length increases, the aggregate price level does not adjust as quickly to nominal shocks. And this sluggish response of the price level slightly reduces the magnitude of real interest rate fluctuations enough to reduce the variance of output in many cases.

This result casts some doubt upon the validity of arguments by those who, like Thurow (1979), argue that the United States should attempt to explicitly encourage the development of "corporatist" institutions to explicitly conduct centralized wage bargaining. More generally, it calls into question standard Keynesian arguments suggesting that long term contracts help to explain the cyclical variability of output. In the model we are working with, shortened contracts, frequent reopeners, and so forth do not necessarily stabilize output in many cases.

Approaching the Limit of "Perfect Markets

There is yet another dimension of changing flexibility available which we can use to further explore the properties of this simple model: it is possible to change the "length" of the period itself, to reduce the amount of "time" taken up by each count of the index t. Instead of thinking of the model as comprising one year-long periods and two year-long labor contracts,

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we can examine the performance of the model with six month-long periods and one year-long contracts, or with three month-long periods, and so forth. How do the effects of price flexibility change as we change the length of the period in the model?

In order to effectively halve the length of the amount of time covered by a single period in the model, the following steps are necessary: first, we set the parameter $\mu_{new}$ equal to $\sqrt{\mu_{old}}$. For the demand shock to decay in the same amount of "time" in the transformed model, it must decay in twice the number of periods. Second, we adjust the variance of the initial shock $z_t$ so that the steady state variance of the shift term $s_t$ in the IS curve is the same as it was before.

Keeping the parameter g the same in the transformed and the untransformed model implies that the transformation to a period that covers half as much time involves a doubling of the responsiveness of the price level to output deviations.

This way of increasing price flexibility has a strong advantage over the other two possible ways--decreasing the contract length and increasing the value of the parameter g. It is not possible by varying the contract length or increasing g to create a sequence of economies which smoothly converges to the Walrasian limit. There is a tremendous difference between one- and two-period contracts, and continuously increasing g eventually leads to economically-meaningless behavior on the part of the model as small expected price changes lead to enormous output jumps in the present. Shortening the amount of "time" covered by a single period allows for continuous movement to the Walrasian ideal, where nominal demand shocks have no real effects at all.

As Table 3 illustrates, convergence toward the Walrasian limit does

Table 3

Approaching the Walrasian Limit

Period Length Relative to Initial Value

| | | 1 | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 | 1/64... | 1/∞ |
|---|---|---|---|---|---|---|---|---|---|
| A=1.0 | g=0 | 54.4 | 54.4 | 54.4 | 54.4 | 54.4 | 54.4 | 54.4 | 54.4 |
| | .1 | 54.5 | 54.6 | 54.1 | 49.0 | 39.3 | 31.5 | 29.5 | 0 |
| | .2 | 54.6 | 56.0 | 56.3 | 50.0 | 40.2 | 32.2 | 30.1 | 0 |
| | .4 | 56.0 | 59.6 | 60.6 | 53.5 | 42.3 | 33.4 | 31.0 | 0 |
| | .6 | 57.2 | 62.7 | 64.3 | 56.9 | 44.7 | 35.1 | 32.6 | 0 |
| | .8 | 58.6 | 65.6 | 67.4 | 62.1 | 45.9 | 36.6 | 34.1 | 0 |
| | 1.0 | 59.6 | 68.1 | 69.8 | 62.6 | 47.8 | 38.0 | 35.3 | 0 |
| A=2.0 | 0 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 |
| | .1 | 13.6 | 13.6 | 13.6 | 12.5 | 10.7 | 9.0 | 8.9 | 0 |
| | .2 | 13.6 | 13.7 | 13.8 | 12.5 | 10.4 | 8.6 | 8.5 | 0 |
| | .4 | 13.8 | 14.2 | 14.8 | 13.1 | 10.4 | 8.4 | 8.3 | 0 |
| | .6 | 14.1 | 14.9 | 15.8 | 13.9 | 11.0 | 8.8 | 8.6 | 0 |
| | .8 | 14.5 | 15.6 | 16.8 | 14.7 | 11.8 | 9.3 | 9.2 | 0 |
| | 1.0 | 14.8 | 16.2 | 17.6 | 15.5 | 12.3 | 9.7 | 9.5 | 0 |

Note: The value of B=.4 is assumed. When the period length is 1, μ=.25 is assumed.

happen eventually: for periods of 1/8 the original or shorter, the steady state variance of output drops relatively quickly (although by only 10-20 percent, by much less than 50 percent, with each iteration) as the period is shortened further.[3] But before the value of 1/8, convergence toward the limit is not or is at most only slightly visible. The effect of a shortened period in causing more rapid price changes--and thus more of an incentive to postpone or accelerate spending by one period--approximately balances the stabilizing effects of more rapid price flexibility. In the limit, increased price flexibility is indeed stabilizing. But one must already be very close to that Walrasian limit before its properties become a good guide to the behavior of the model.

## III. ALTERNATIVE DETERMINANTS OF AGGREGATE DEMAND

The previous sections have all assumed that what matters for the determination of aggregate demand is the short-term real interest rate, the one-period interest rate $r_t$. But there is an important and convincing line of thought which argues that the relevant interest rate for the purpose of determining investment is a long-term interest rate. Suppose that the level of aggregate demand is determined by the level of investment, which is in turn determined by Tobin's q. How does this shift in the mechanism that determines aggregate demand change the results of the previous sections?

Blanchard and Sachs (1983) consider a model with quantity-constrained demands, fully optimizing agents, and durable capital that is costly to adjust. They conclude that the Mundell effect is not strong enough to be destabilizing. In their model, price flexibility amplifies fluctuations in

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the short-term real interest rate. But because price flexibility leads to the faster damping of disturbances, long-term rates are less erratic and output is less variable.

A critical issue here is the length of time which constitutes the "long run," is the horizon with which Tobin's q is calculated. In the spirit of the previous models in this paper, we replace $r_t$ in (8) with its closest analogue in a q-theoretic framework--$q_t-1$.

$$(15) \quad (1+AB)y_t = A(q_t-1) + s_t$$

Arbitrage implies that $q_t$ evolves according to:

$$(16) \quad q_t = \sum_{j=0}^{\infty} \prod_1^j (1+\partial_{t+i} + r_{t+i})(F_k)_{t+j}$$

where $(F_k)_t$ is the paid on a unit of capital in place in period t, $\delta$ is the sum of the risk premium on equity, and rate of depreciation, and $r_t$ is the real short term interest rate. Clearly the larger is $\delta$, the closer is $q_t$ to $1-r_t$. If $\delta$ is "high enough" in some sense, price flexibility will be destabilizing even in this q-theoretic framework. The process determining $q_t$ will place very high weight on the more volatile real return fluctuations in the present and less weight on the more stable real returns in the far future. The interesting question is whether $\delta$ is likely to be "high enough" to render price flexibility destabilizing in actual economies.

Since World War II, the real return on equities in the U.S. has averaged some nine or so percentage points higher per year than the return on treasury bills. One component of $\delta$ is therefore this risk premium. It is reasonable to assume that capital depreciates at 10 percent per year. We

therefore postulate that $\delta=.20$ in the calculations reported below.

The model used in the simulations reported below in Table 4 is, therefore, our basic model with two period contracts with the IS aggregate demand equation (8) replaced by (15) and with the arbitrage condition (16) for $q_t$ included with a value of .20 for $\delta$ and with profits taken to be a constant fraction of output. Results are presented for $\mu=.75$. With lower values of $\mu$ price flexibility is more destabilizing. With greater values of $\mu$ it is less destabilizing.

For high interest elasticities of money demand and money supply--and thus low B's--price flexibility is still destabilizing over a large range. Moving to a theory of aggregate demand based on the long rather than on the short-term interest rate weakens but does not eliminate the plausibility of destabilizing price flexibility. With higher values of B, the traditional conclusion that price flexibility is stabilizing is restored.

As Hall (1977) emphasizes, there are strong reasons to expect investment to depend on short as well as long real rates. Timing is a critical aspect of many investment decisions. For many types of capital goods, adjustment costs are not important. And so the financial variable that should enter into the determinant of aggregate demand should be neither $r_t$ nor $q_{t-1}$ but instead some weighted average.

There are several other reasons to think that the weight placed on $r_t$ should be relatively high. Much cyclically-sensitive capital formation is non-durable, or not very durable. Moreover, there may be effects which are well-correlated with the short-term interest rate which are not in representative decision-maker models. Agents may be limited in their spending by liquidity constraints. And sharp declines in the price level that were unanticipated at the moment many contracts specifying financial

liability were written can have large effects on aggregate demand through the distribution of wealth. Putting a high weight on $r_1$ would leads us back towards the results in earlier sections.

Destabilizing price flexibility is not removed as a possibility by the move from using short-term housing long-term interest rates in the determination of aggregate demand. Our initial conclusion that models derived from Taylor (1979 and 1980) can exhibit destabilizing price flexibility for a wide range of plausible parameter values has turned out to be quite robust. If Taylor's models can serve as a reasonable base from which to reason about the behavior of the economy, the results of this paper show that there is every reason to take Keynes (1936) seriously when he challenges the view that increased price flexibility would reduce the seriousness of business cycles.

IV. CONCLUSIONS

. Our results suggest that standard Keynesian models wage and price rigidity have the implication that increases in price flexibility may well increase the cyclical variability of output. This conclusion holds even allowing for forward looking behavior in wage setting and in financial markets. This observation makes it unlikely that nominal rigidities of the type associated with union contracts for example, can plausibly be blamed for cyclical fluctuations in output. Even if increased nominal rigidity is not stabilizing, it is unlikely to be significantly destabilizing. As we have emphasized elsewhere (Delong and Summers, 1984), these observations are consistent with the broad sweep of American macro-economic history. The

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## Table 4

### A Q-Theory of Aggregate Demand

$\mu=.75$

|       |      | g=0  | .1    | .2    | .4    | .6    | .8    | 1.0   |
|-------|------|------|-------|-------|-------|-------|-------|-------|
| B=.2  | A=1  | 157  | 148*  | 149*  | 153*  | 157*  | 158*  | 159*  |
|       | 2    | 39.2 | 37.0* | 56.3* | 37.0* | 37.6* | 37.7* | 37.4* |
|       | 3    | 17.4 | 16.7* | 16.0* | 16.2* | 16.5* | 16.7* | 16.6* |
| B=.4  | A=1  | 115  | 96    | 88    | 83    | 81    | 79    | 74    |
|       | 2    | 28.8 | 25.1  | 21.8  | 20.2  | 19.6  | 19.2  | 18.9  |
|       | 3    | 12.8 | 11.7  | 9.7   | 8.9   | 8.7   | 8.5   | 8.4   |

Note: Price flexibility destabilizing at the margin is denoted by *.

increasingly non-Walrasian character of the economy and the associated reductions in wage and price flexibility have coincided with improvements in macro-economic performance.

The mainline American Keynesian view that the major difference between economies that are well-approximated by "classical" and economies that are well-approximated by "Keynesian" models lies in the fact that the first set of economies have more aggregate price flexibility is particularly odd in view of the origins of Keynesian economics in the experience of the Great Depression. Between 1929 and 1932, the U.S. price level declined by nine percent a year. In 1932, U.S. real GNP was two-thirds of what it had been three years earlier. Is it difficult to believe that the problems of the U.S. economy during the Great Contraction were due to the fact that prices did not adjust quickly enough to absorb the nominal shock which came either from inappropriate monetary policy or from pessimistic animal spirits? It seems implausible to assert that if only the price level had declined by twenty percent per year instead of nine that the U.S. economy would have had a high level of output in 1932. Rather more plausible is the belief that if the price level had fallen at twenty percent per year the contraction would have been even more serious as very high real interest rates would have drastically reduced the level of economic activity. These inferences are supported by the coincidence of the beginnings of recovery and the end of rapid deflation in 1933.

International evidence corroborates our skepticism about the empirical importance of nominal rigidities as an explanation for business cycles. In much of Latin America, high rates of inflation are endemic. Nominal rigidity is one of the few problems that these economies do not have. With the increased wage and price flexibility that accompanies rapid inflation,

real interest rates are much more variable than in the United States and so too is real output. The experience of a number of countries suggests that the variability of output in Latin America is not a purely real phenomenon. Despite a high degree of price flexibility, monetary and fiscal policies have potent effects on the level of economic activity.

As Fisher (1984) emphasizes, economics does not possess a fully satisfactory theory of price adjustment. There does not yet exist a convincing demonstration that a decentralized economy wuill rapidly converge to its Walrasian equilibrium after being shocked. The stability of an economy without institutional impediments to price flexibility, in the face of demand shocks is an assumption not a conclusion of economic analysis. The performance of actual economies suggests that it may not be a particularly good one.

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FOOTNOTES

1. This conjecture was challenged by Driskill and Sheffrin (1985). For reasons
discussed below, we believe that their model does not provide a satisfactory
framework for examining the issue of destabilizing price flexibility.

2. Driskill and Sheffrin (1985) rely on a version of Taylor's model in which
there are no aggregate demand shocks in their study of the impact of
flexible prices. This formulation does not seem very satisfactory for
capturing Keynes' vision of cyclical fluctuations.

3. Results are presented for B=.4. Results with B=.2 suggest that the
Walrasian limit is even less relevant.