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Commentary

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Although I am obviously biased, I regard working out of models where nominal frictions coexist with optimizing behavior to be both important and far from being finished. One important advantage of these models is that they make it relatively easy to calculate the welfare effects of different policies because the objective functions used to compute optimal behavior can also be used to compute the effect of policy interventions. By doing this, one is able to analyze policy in models that have Keynesian features without having to assume an ad hoc objective function for the government. This is a big step forward relative to the tradition where the objective function of the government was something that was simply tacked on at the end of the model.

Robert G. King and Alexander L. Wolman's article contains two substantive results that take the form of two "mom and apple pie" policy recommendations. In particular, King and Wolman recommend that inflation be low and stable. They suggest that low and stable inflation rates lead to high levels of welfare in their model. Although I do not take issue with these recommendations, I argue that further work is needed before one can be sure these recommendations flow from the kind of model King and Wolman consider. I argue that small and plausible changes in the model are likely to imply that higher levels of inflation are more desirable than low levels of inflation. Second, although I agree that the kind of model considered here creates a presumption that a stable inflation rate is good, the authors have not really demonstrated the optimality of such a policy within their framework.

THE OPTIMALITY OF STABLE PRICES

I take up the second point first. To see the advantages of stable inflation in this type of setting, I provide an intuitive rationale for price-level stability. It seems to me that price-level stability is likely to have good welfare properties in any model where agents find it either difficult or costly to change their prices. One simple explanation for such a result is that it avoids any costs of changing prices. To see this, suppose firms set prices to maximize a profit function like

$$\sum_{\tau=0}^{\infty} \beta^{\tau} h(P_{t+\tau} - \overline{P}_{t+\tau}) - c(P_{t+\tau}/P_{t+\tau-1}),$$

where β is a discount factor, P_t represents the price charged at time t, $\overline{P}_t$ is the price the firm would charge in the absence of costs of changing prices at t, h is a function that has a maximum at 0, and c is a function that has a minimum at zero. Then, getting firms to stabilize their prices avoids the costs represented by c.[1]

Another closely related rationale for a policy with a constant price level is that, if firms are symmetric, they never change their price. But this action is optimal only if the prices already being charged would be optimal in the absence of impediments to price changes. Otherwise firms would change their prices either when they are given an opportunity to do it for free (as in this model) or more generally, when they can do so at a modest cost. Even with fixed costs of changing prices, firms would likely change their prices if they are not optimal: The stability of the price level means that a firm need only change its price level once to reach and remain at the optimal price. Since a stable price level must thus be equivalent to having firms charge the price they would charge in the absence of costs or impediments to price changes, it is an optimal policy as long as one likes the outcome with flexible prices.

[1] The King and Wolman setup is one where the function c is always equal to zero when its argument is zero. In addition, c depends on a stochastic component. For certain realizations, this component, c is zero also when a price change occurs (so that price changes are free), For the other realizations, the cost c of any price change is so prohibitive that firms avoid price changes altogether.

This last condition is crucial. If you do not like the outcome with flexible prices because, for example, it involves high average markups, the presumption for a stable price level loses its force. It then becomes conceivable that some complicated reaction of the price level to underlying shocks may be able to reduce the total importance of the distortions due to high markups. I do not take such a result as being particularly likely but it is important to note that it cannot be ruled out from King and Wolman's analysis. They only show that keeping a stable inflation rate leads to an outcome that resembles the one with flexible prices. This is not the same as showing that this outcome is desirable within this setting.

HIGHER INFLATION MAY BE PREFERABLE

I now turn to King and Wolman's recommendations concerning the average inflation rate. They conclude that the Friedman rule remains nearly optimal even though there are impediments to changing prices. Such a result obtains even though an increase in the steady-state inflation rate can lower the average markup of price over marginal cost and this reduction is socially desirable. The reason inflation can lower markups is that firms who change their prices set them so they equal a present discounted value of the prices they would charge without impediments to price changes. Thus, the price P_t^* of a firm that can change its price at t equals

$$P_t^* = E_t \sum_{j=0}^{\infty} \delta_j \overline{P}_{t+j},$$

where $\overline{P}_t$ is the price the firm would charge at t if it could change its prices every period. The "discount factors" δ_j depend on the probability that the firm will change its price within j periods, as well as on the amount it would sell in the various periods over which the firm keeps its price constant. In addition, there is a tendency for δ_j to fall when j increases because the firm discounts future profits so that more immediate future $\overline{P}$s are weighted more heavily. In an inflationary environment, this can lead P^* to fall short of the average of the $\overline{P}$s that are expected to prevail over the period in which prices are fixed. Such a shortfall of P^* can lead average output to rise as a result of inflation. On the other hand, Benabou and Konieczny (1994) consider a very related problem and show that inflation can actually reduce aggregate output in this setting because, in some circumstances, the value of δ_j for relatively high values of j is high. This occurs if the derivative of profits with respect to price is particularly large when the price is far below the single-period optimum price. In this case an increase in inflation, which makes it more likely that the price will end up far below the single-period optimum, leads to a large increase in P_t^*.

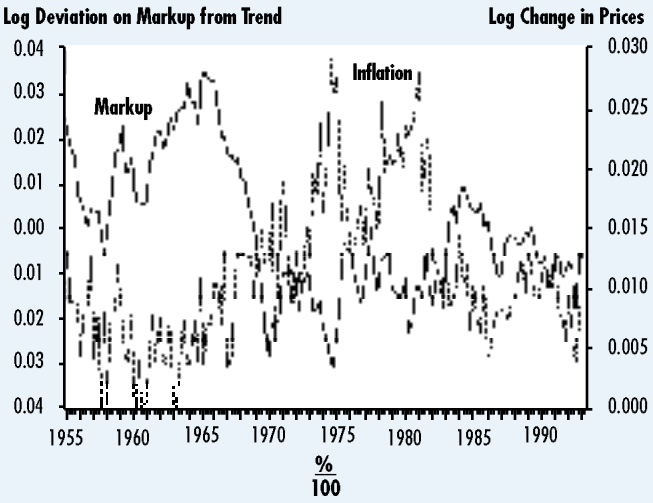
In King and Wolman's calculations, these effects are extremely small for low inflation rates. According to their equations 18 and 19, a 1 percent increase in the quarterly inflation rate from 0.25 percent per quarter to 1.25 percent per quarter would lower the average markup from 1.2986 to 1.2944, for a total reduction of .0042. On the other hand, an increase in inflation from .0125 to .0225 actually *raises* the markup from 1.2944 to 1.2962 and further increases in inflation further increase the average markup. In fact, the inflation rate that minimizes the average markup is .0155. Although the connection between the average markup and welfare is not tight in this model (because inflation also raises the variability of relative prices), this suggests it is unlikely that the optimal inflation rate could ever exceed .0155. Because the effects of low inflation rates on the markup are small and because the markup ceases falling with inflation at a small inflation rate, the only important welfare effect of inflation in this model is the traditional one that relates to the demand for money.

THE INFLATION-MARKUP LINK

As I see it, the biggest problem with this analysis is that there is no compelling

Figure 1

Inflation and the Average Markup



reason to focus on the parameters that lead to this very weak relationship be-tween inflation and markups. In particular, these parameters imply a link between inflation and markups that is much weaker than the link that appears to be present in U.S. data. In a trailblazing article, Benabou (1992) reported that a 1 percent increase in the quarterly inflation rate led to about a 1/3 percent reduction in retail markups. Benabou used several techniques to separate the effects of expected and unanticipated inflation and showed that the quantitative effects of expected inflation were about the same as those of the raw infla-tion series. Part of the reason for this can be seen in Figure 1, which is inspired by ongoing work of my colleague Olivier Blanchard. Figure 1 plots inflation and the deviation of the markup from its average value for the United States. The markup deviation is constructed using the formula in Rotemberg and Woodford (1991) under the assumption the average markup is 1.1, that the elasticity of substitution is 1, and that the capital share in income is 0.25.[2]

Figure 1 shows an even stronger link between markups and inflation. Moreover, this association is present at relatively low frequencies so that it is unlikely to be due exclusively to the effect of unexpected inflation.[3] Markups were low throughout the 1970s when inflation was high; whereas markups were higher in the 1960s and 1980s when inflation was lower. Overall, a simple regression of this markup series on inflation delivers coefficients smaller than −1 so that a 1 percent increase in the quarterly inflation rate appears to be associated with a more than 1 percent reduction in markups.

If you are to believe that Figure 1 represents the effects of inflation on markups, you obviously need to modify the King and Wolman model. But, the modifications needed to enlarge the importance of the inflation-markup link do not seem particularly implausible. Benabou (1992) and Benabou and Konieczny (1994) show the sort of modifications sufficient to imply that increases in inflation raise aggregate output (and lower the average markup). They show that the case considered here (where marginal cost is constant and demand is isoelastic) always implies that aggregate output falls when inflation rises. On the other hand, output rises with inflation if marginal cost falls sufficiently as output expands or if the isoelastic demand assumption is replaced by the assumption that demand is linear in price. Another, more radical departure is to model search explicitly. In search models, an increase in inflation can lead to big reductions in markups because the changes in relative prices induced by inflation lead people to search and this can dramatically reduce the market power of individual firms.

Thus, the results concerning the size in the reduction of markups brought about by increasing inflation are both special and not particularly compelling. In addition, King and Wolman's setup is one where reductions in markups have relatively small welfare consequences. In other words, perfectly plausible modifications would imply much larger welfare improvements from modest reductions in markups. One way of doing this is to recognize that the economy is already subject

[2] With an elasticity of substitution equal to one, this formula depends only on the labor share and hours worked. For the labor share, I used the ratio of labor compensation to the sum of labor compensation and corporate profits. I measured hours worked using the BLS estimate of hours worked in nonagricultural establishments.

[3] One reason why this measured markup falls so much is that the measure of the average markup weighs more heavily those goods on which more money is being spent and this leads it to weigh more heavily those goods for which markups are currently low because their prices have been fixed for a long time. With an increase in inflation, the lowest relative price charged falls and this leads people to make relatively more purchases at low markups. This is not the whole story, however, because Benabou (1992) reports a strong connection between markups and inflation also in the case of fixed weight price indexes.

to other preexisting distortions. A 1 percent reduction in markups is likely to have a much bigger effect on welfare if one starts with an economy that already has a 25 percent average tax rate on labor and capital income than if one starts with an undistorted economy.

A potentially more important reason why markup reductions may lead to large welfare improvements is that they may be able to reduce productive inefficiencies. In King and Wolman's model only final consumers are subject to the distortions brought on by market power. Thus, goods are produced with the efficient combinations of capital and labor. In practice, of course, many produced goods are intermediate inputs that other firms buy. When firms with market power sell these intermediate goods at high prices, they encourage their customers to buy fewer of them. In particular, purchasers might be led to substitute other inputs for these intermediate goods. Alternatively, firms might be led to produce these intermediate inputs themselves even if they are not as good at this as firms that sell the intermediate inputs in the marketplace. Thus, a reduction in markups can reduce the productive inefficiency that stems from the inappropriate input choice by firms that use intermediate products. Such a result is in agreement with the fact that booms in economic activity are associated with an increase in the ratio of materials purchased in the marketplace relative to materials produced in-house by partially vertically integrated firms. This would make sense if, as Michael Woodford and I have repeatedly stressed, markups are countercyclical (perhaps for the reasons presented here). Then, booms (where markups are low) are periods where outside purchasing should be more important.

All this is simply to suggest that, if one takes seriously the idea that changes in inflation affect markups, the optimal rate of inflation may be quite different from the Friedman rule. Many more experiments with alternative specifications will have to be carried out before I am persuaded that this optimal inflation rate is low.

MODEL INCLUDES IMPORTANT FEATURES

Before closing, I will comment on the article's title, "Inflation Targeting in a St. Louis Model of the 21st Century." I ask myself whether this really is a St. Louis model for the 21st century. I must admit to hoping that it is. It is a model that is small but nonetheless includes many features of the economy I consider important. Moreover, it is a model where welfare analysis is conceptually easy to carry out. However, there are computational difficulties with the welfare analysis that may well be responsible for the authors' lack of proof that price stability is optimal. In addition to these computational problems, the model is too stripped down to allow one to form a judgment about the optimal level of inflation. A final question in my mind is whether it is as good as the original St. Louis model at obtaining accurate dynamic multipliers for the effect of shocks.

REFERENCES

Benabou, Roland. "Inflation and Markups: Theories and Evidence from the Retail Trade Sector," *European Economic Review* (April 1992), pp. 566–74.

_____ and Jerzy Konieczny. "On Inflation and Output with Costly Price Changes: A Simple Unifying Result," *The American Economic Review* (March 1994), pp. 290–7.

Rotemberg, Julio, and Michael Woodford. "Markups and the Business Cycle," NBER *Macroeconomics Annual*, 1991, pp. 63–129.