Why a Rule for Stable Prices May Dominate a Rule for Zero Inflation

by William T. Gavin
and Alan C. Stockman

William T. Gavin is an assistant vice president and economist at the Federal Reserve Bank of Cleveland. Alan C. Stockman is a professor of economics at the University of Rochester and a consultant to the Federal Reserve Bank of Cleveland. The authors thank Shaghil Ahmed and Joseph Haubrich for useful comments.

Introduction

Economists have long debated the wisdom of various constitutional constraints on monetary policy. Milton Friedman argued that economists do not know enough about the complexities of the economy to make discretionary policies that would be better than rules, and that the attempt to improve economic performance through discretionary policies has led to consequences worse than those that would have resulted from rules.[1] Another, entirely different, argument in favor of rules comes from the time-consistency literature: Rules affect expectations, and committing in advance to a policy rule (typically of a state-contingent nature) leads to better outcomes than can be obtained with optimal discretionary actions.[2]

Opponents of rules typically focus on the complexity of optimal state-contingent rules, arguing that these complex rules might be better approximated by discretionary policy actions than by simple rules that could be written and enforced at reasonable cost.[3]

One implication of the time-consistency literature is that institutions and rules might be used to improve an economy's inflation performance without sacrificing output. Some of our current monetary institutions have been rationalized as attempts to achieve a lower inflation outcome than occurs in a world in which the optimal short-run policy is not time-consistent. One institution that has lowered inflation is the independent central bank.[4] Another is the practice of appointing conservative central bankers.[5]

In this paper, we show that a rule for the price level may dominate a rule for the inflation rate, even in the case where, for purely economic reasons, an inflation rule is preferred. In our model, policymakers do not have perfect control over inflation, some policymakers have a preference for more inflation than is socially desirable, and the penalty for breaking the rules

---

■ **1** See Friedman (1959).

■ **2** See Kydland and Prescott (1977) for an original statement of the time-consistency problem.

■ **3** See Summers (1988) for three arguments against rules.

■ **4** See Bade and Parkin (1987) and results summarized in Alesina (1988), table 9 on page 41.

■ **5** See Rogoff (1985).

is not overly severe. Under these conditions, an inflation rule will lead some policymakers to attribute policy-induced inflation to nonpolicy causes. Because nonpolicy shocks to the inflation rate can occur in any time period, a severe penalty is not optimal.

Under a price-level rule, the source of the inflation in any time period does not matter. The penalty associated with this rule provides an incentive for policymakers to offset inflation, regardless of the source. A price-level target constrains the current behavior of policymakers because today's choices directly affect tomorrow's options.

I. Stable Prices vs. Zero Inflation

We present a simple example of inflation and monetary policy in which two types of policymakers might be in charge of monetary policy. These two types want different levels of inflation. They differ because inflation has two effects: 1) a negative effect on overall social welfare and 2) uninsurable redistributive effects that benefit some people at the expense of others. We assume one type of potential policymaker receives private gains from inflation that may dominate his share of the overall social loss. The other type loses more than the aggregate social loss from inflation. We do not model the reasons for the lack of insurability of these redistributive consequences of inflation; our model simply assumes there are limits on insurance or financial markets that prevent such insurance from operating perfectly.

We assume that while inflation is observable, the behavior of policymakers is not—people observe and understand inflation, but not the monetary policy that affected it. Monetary policy cannot be perfectly inferred from either inflation or monetary growth because random factors, such as shifts in output supply and the demand for money, also affect these variables.

We interpret rules as penalties (or rewards) for policymakers based on observed outcomes of inflation: They are features of the overall compensation package of policymakers. This package could include implicit as well as explicit payments, and deferred as well as current payments (in such forms as fame, praise by the news media, and opportunities to give speeches and write books, or to take various desirable positions after the policymaker's term of office expires).

If there were no limits on the penalties that could be imposed on policymakers, a rule could specify an extreme penalty for policymakers whenever inflation deviates from zero by some threshold amount. Then any policymaker would try to achieve zero inflation. But the random forces affecting inflation would sometimes make it exceed that threshold, so the penalty would sometimes apply. To induce anyone to be a policymaker, the salary would have to compensate for the *risk* of high inflation due to random events and the subsequent penalty. With risk-averse individuals, the required salary would have to be very high to compensate for the risk of a severe penalty.

Thus, an optimal reward structure for policymakers involves a limited penalty for deviating from target inflation and a correspondingly smaller expected reward. We do *not* model the incentives to enforce the rule; we simply assume that constitutional rules are enforceable and are actually enforced.

For simplicity, we assume the socially optimal inflation rate is zero (though the optimal inflation rate is immaterial to our argument).[6] We compare two policy rules (compensation packages for policymakers)—one that penalizes policymakers whenever inflation deviates from the socially optimal rate (zero), and another that penalizes them whenever prices deviate from a stable level.

We believe that a stable price level is a better goal for monetary policy than a zero-inflation goal that allows drift in the price level. A stable price policy eliminates inflation and the associated uncertainty that interferes with efficient long-term nominal contracting and borrowing.

To avoid biasing our results in favor of the price-level rule, however, we ignore these arguments for a stable price level. Instead, we assume that society gains from a zero rate of inflation (even if this means price-level drift). The stable-price-level rule requires inflation or deflation to correct for past changes in the price level. Although this inflation or deflation causes a social loss when it occurs, the stable-price rule can generate a socially better outcome because it alters the incentives of policymakers.

II. A Simple Model

We examine a simple two-period model in which inflation, π, results from a monetary policy variable, m, and an exogenous random disturbance, e:

(1) $\pi = m + e$.

We assume $E(e) = 0$ and is observed only after m is chosen. This random disturbance may be thought of as a combination of shocks to output supply, shifts in money demand, and errors in monetary control. This random component prevents people from observing policy actions directly.

Inflation is socially costly. We assume there is a social loss from inflation $z(\pi)$, where

(2) $Z(\pi) = z\pi^2, z > 0$.

The population of the economy is fixed and normalized at two. The social cost of inflation is divided equally among all households, so each bears one-half of this social cost.

There are two types of households in the economy—type-i households, who privately benefit from inflation at the level $\pi^* > 0$, and type-0 households, who privately lose from nonzero inflation. The population of each type is normalized at one.

The purely private component of the loss to each type-0 household from nonzero inflation is $H(\pi)$, where

(3) $H(\pi) = (b/2)\pi^2, b > 0$.

The total loss each period to each type-0 household is the sum of the two losses, $Z(\pi)/2 + H(\pi)$.

The purely private component of the loss to each type-i household is $G(\pi)$, where

(4) $G(\pi) = (g/2)(\pi - \pi^*)^2, g > 0$.

The total loss each period to each type-i household is $Z(\pi)/2 + G(\pi)$.

In our example, as inflation rises from zero to π^*, some households gain at the expense of others. In addition to this redistribution, inflation has a social cost of $Z(\pi)$.

The monetary policy variable, m, is controlled by a central bank that may be captured by either group. We do not model this capture here, as it is largely immaterial for our argument. The outcome of this process is a random variable. We assume that the same policymaker is in charge for both periods.

We consider two alternative rules for monetary policy. Each rule is a set of penalties to the group in charge of policy, for deviating from some target inflation outcome. We assume these rules can be perfectly enforced. Section III considers a rule for zero inflation—one that does *not* penalize the policymaker for failing to correct past changes in the price level. Section IV then considers a rule for a stable price level—a zero-inflation rule that penalizes policymakers for failing to correct *past* changes in the price level.

III. A Zero-Inflation Rule that Allows Price Drift

Consider a rule for zero inflation that does *not* penalize a policymaker for failing to correct past changes in prices. The rule consists of a penalty (smaller total compensation) for inflation. We assume it takes the form

(5) $K(\pi) = (k/2)\pi^2, k > 0$.

We do not derive the optimal penalty in this paper. To do so would require the explicit specification of the relationship between the cost of compensating policymakers and the level of the penalty. The optimal penalty would be chosen so that the marginal benefit from a lower inflation trend associated with a higher penalty would just offset the increased compensation required by the policymaker at the higher penalty rate.

Type-0 Policymakers

If a type-0 individual controls policy, his problem in the second period ($t = 2$) is to choose m to minimize

$$E[H(\pi) + \frac{Z(\pi)}{2} + K(\pi)]$$

subject to (1). Let $q = z + k$. The type-0 policymaker minimizes

$$E[\frac{b+q}{2}(m+e)^2],$$

which implies that he chooses $m = 0$. His minimized expected loss is then

$$\frac{b+q}{2}E(e^2).$$

The optimization problem of a type-0 policymaker in the first period is to choose m to minimize

(6) $\quad E[\dfrac{b+q}{2}(m+e)^2 + \beta\dfrac{b+q}{2}e_2^2]$,

where β is a discount factor and e_2 denotes the second-period realization of the random disturbance e. This obviously has the same solution as at $t=2$, namely $m=0$. A type-0 policymaker subject to this rule would choose monetary policy that results in zero expected inflation each period.

Type-i Policymakers

We now turn to the optimization problem of a type-i policymaker. At $t=2$, he chooses m to minimize

$$E[\dfrac{g}{2}(m+e-\pi^*)^2 + \dfrac{q}{2}(m+e)^2].$$

This implies

(7) $\quad m = \dfrac{g}{g+q}\pi^* \equiv \mu\,\pi^*$.

The minimized expected loss of the type-i policymaker at $t=2$ is

(8) $\quad E\{\dfrac{g}{2}[(\mu-1)\pi^* + e]^2$

$\qquad + \dfrac{q}{2}(\mu\,\pi^* + e)^2\}$.

In the first period, this policymaker chooses m to minimize

$$E[\dfrac{g}{2}(m+e-\pi^*)^2 + \dfrac{q}{2}(m+e)^2]$$

$$+ \beta\,E\{\dfrac{g}{2}[(\mu-1)\pi^* + e_2]^2$$

$$+ \dfrac{q}{2}(\mu\,\pi^* + e_2)^2\},$$

which implies

(9) $\quad m = \dfrac{g}{g+q}\pi^* \equiv \mu\,\pi^*$.

This is the same monetary growth rate as in the second period. So, a type-i policymaker chooses a time-invariant money growth rate that yields *positive expected inflation*.

The policy rule for zero expected inflation results in *positive* expected inflation if a type-i policymaker is in charge because he balances the penalty for higher inflation against his private gains from inflation. The limitations on penalties discussed earlier prevent the penalty from being so large that this policymaker would set $m=0$.

IV. A Stable-Price Zero-Inflation Rule

We now turn to a *stable-price rule*, which invokes a penalty in the second period if inflation deviates from a level that would return the price level to its original position in the first period. We assume the penalty at $t=2$ raises the per-household cost of inflation, to the households in charge of policy, from $K(\pi)$ to $K(\pi - \pi^T)$, where π^T is the *target inflation* specified by the rule. This target inflation is, in our setup, simply the negative of *actual* inflation at $t=1$: $\pi^T = -\pi_1 = -(m_1 + e_1)$, where m_1 is the first-period money growth rate and e_1 is the first-period exogenous disturbance. This implies $K(\pi - \pi^T) = k(m + e + m_1 + e_1)^2$.

Type-0 Policymakers

A type-0 policymaker at $t=2$ chooses m to minimize

$$E[\dfrac{b+z}{2}(m+e)^2 + \dfrac{k}{2}(m+e+m_1+e_1)^2],$$

which implies

(10) $\quad m = \dfrac{-k}{b+z+k}(m_1 + e_1) \equiv -r(m_1 + e_1)$.

The policymaker weighs the costs of non-zero inflation against the costs of deviating from the rule. He then chooses money growth to attempt to reverse a fraction r of the previous period's inflation. His minimized expected loss at $t=2$ under the stable-price rule is

(11) $\quad E\{\dfrac{b+z}{2}[-r(m_1 + e_1) + e]^2$

$\qquad + \dfrac{k}{2}[(1-r)(m_1 + e_1) + e]^2\}$.

Now consider the incentives of this policymaker in the first period. He chooses m_1 to minimize

$$E[\frac{b+z+k}{2}(m_1+e_1)^2]$$

$$+\beta E\{\frac{b+z}{2}[-r(m_1+e_1)+e]^2$$

$$+\frac{k}{2}[(1-r)(m_1+e_1)+e]^2\}.$$

This implies that $m_1 = 0$ in the first period and that the second-period policy simplifies to $m = -re_1$. So a type-0 policymaker would choose the policy $m = 0$ in the first period. In the second period, he would choose policy to try to reverse a fraction r of any accidental inflation in the first period resulting from the random shock e.

Type-i Policymakers

Finally, we turn to the behavior of a type-i policymaker subject to the stable-price rule. In the second period, he chooses m to minimize

$$E[\frac{z}{2}(m+e)^2+\frac{g}{2}(m+e-\pi^*)^2$$

$$+\frac{k}{2}(m+e+m_1+e_1)^2].$$

This implies

$$E[z(m+e)+g(m+e-\pi^*)$$

$$+k(m+e+m_1+e_1)]=0,$$

or

$$(12)\quad m=\frac{g\pi^*-k(m_1+e_1)}{z+g+k}$$

$$=\mu\pi^*-r(m_1+e_1).$$

In period 2, the type-i policymaker chooses an inflation rate that balances the private gain from positive inflation against the cost of the penalty for deviating from zero. Under the stable-price regime, however, the cost of deviating from zero inflation also depends on the inflation rate in the first period. The period 2 money growth will be modified to offset some of the period 1 inflation. The minimized expected loss of the policymakers is, conditional on $t = 1$ variables,

$$E\{\frac{z}{2}[\mu\pi^*-r(m_1+e_1)+e]^2$$

$$+\frac{g}{2}[\mu\pi^*-r(m_1+e_1)+e-\pi^*]^2$$

$$+\frac{k}{2}[\mu\pi^*(1-r)(m_1+e_1)+e]^2\}.$$

In the first period, a type-i policymaker knows that positive inflation will be costly in the second period and chooses m to minimize

$$E[\frac{z+k}{2}(m+e)^2+\frac{g}{2}(m+e-\pi^*)^2]$$

$$+\beta E\{\frac{z}{2}[\mu\pi^*-r(m+e)+e_2]^2$$

$$+\frac{g}{2}[\mu\pi^*-r(m+e)+e_2-\pi^*]^2$$

$$+\frac{k}{2}[\mu\pi^*(1-r)(m+e)+e_2]^2\}.$$

So,

$$(z+k)m+G(m-\pi^*)$$

$$+\beta\{z(\mu\pi^*-rm)(-r)$$

$$+G[(\mu-1)\pi^*-rm](-r)$$

$$+k[\mu\pi^*+(1-r)m](1-r)\}=0,$$

which implies

$$(13)\quad m=\frac{g\pi^*[z+g+(1-\beta)k]}{(z+g+k)^2+(z+g)\beta k}$$

$$=\mu\pi^*\frac{z+g+k-\beta k}{z+g+k+(1-\mu)\beta k}$$

$$\equiv\varphi\pi^*$$

$$\leq\mu\pi^*.$$

An important feature of this solution for money growth is that it is positive but smaller than $\mu\pi^*$, the money growth rate that the policymaker would choose in the absence of the stable-price rule.

The solution in (13) for first-period policy implies that the second-period policy choice is

$$(14)\quad m=\mu\pi^*-r(\varphi\pi^*+e_1).$$

We summarize these results in table 1. The stable-price rule has costs and benefits relative to the rule permitting price-level drift. If type-0 households control monetary policy, they choose zero-money-growth rates under the latter rule, but they choose money growth that attempts to reverse a portion of previous inflation

TABLE 1

Money-Growth Rates Under Alternative Policy Rules

	Zero-Inflation Rule Permitting Price-Level Drift	
	Type-0 households	**Type-i households**
$t = 1$	0	$\mu\pi^*$
$t = 2$	0	$\mu\pi^*$
	Stable-Price Rule	
	Type-0 households	**Type-i households**
$t = 1$	0	$\varphi\pi^*$
$t = 2$	$-re_1$	$\mu\pi^* - r(\varphi\pi^* + e_1)$

NOTE: μ, r, and φ are as defined in equations (9), (10), and (13). Recall that φ is smaller than μ, so the stable-price rule results in less inflation in *each* period if the policymaker is type-i. This is the social benefit of a stable-price rule. The cost of that rule is the nonzero expected inflation in the second period that occurs if the policymaker is type-i.

SOURCE: Authors.

under the stable-price rule. This is a cost of a stable-price rule, because it would be socially optimal, ignoring incentives, for money growth to be zero each period.

But the stable price level also has important benefits. Under this rule, if a type-i person controls monetary policy, he chooses lower money growth each period. In the second period, the stable-price rule operates directly by penalizing him for failing to return the price level to its target level. In the first period, expectations of this penalty lead him to choose less money growth.

Suppose the probability that the policymaker is type-0 is p and the probability that the policymaker is type-i is $1 - p$. Then expected inflation under a zero-inflation rule that permits price drift is $(1 - p) \mu \pi^*$ each period; expected inflation under a stable-price rule is $(1 - p) \varphi\pi^* < (1 - p) \mu \pi^*$ in the first period and $(1 - p) (\mu - r\varphi) \pi^* - re_1 < (1 - p) \mu \pi^*$ in the second period.

The variance of inflation under the zero-inflation rule allowing drift is $p(1 - p) \mu^2 \pi^{*2} + \sigma^2$ each period. The variance under the stable-price rule is $p(1 - p) \varphi^2 \pi^{*2} + \sigma^2$ in the first period and $p(1 - p) (\mu - r\varphi)^2 \pi^{*2} + \sigma^2$ in the second period. Since $\mu > \varphi > r\varphi > 0$, the stable-price rule also reduces the variance of inflation.

V. Conclusion

We have presented an example in which a rule for monetary policy specifying a stable price level dominates a rule for zero inflation with price-level drift. This result occurs despite our assumptions that zero inflation—rather than a stable price level—is socially optimal and that policymakers cannot perfectly control inflation. Our example thereby ignores the arguments we have made elsewhere for a stable price level.

Nevertheless, a stable-price rule can be better than a rule for zero inflation that permits price drift, particularly because policy is unobservable. The stable-price rule raises the penalty on a policymaker who purposely engineers positive inflation but falsely claims that it was the unintended result of random forces. The cost of this rule is a change in incentives of policymakers who would act in the social interest without the rule. But, as in our example, this cost can be second-order, while the benefit is first-order.

In this two-period model, the policymaker always prefers the zero-inflation rule over the price-level rule. Well-intentioned policymakers know that they would deliberately aim for the social optimum without the rule. Those who would privately gain from inflation would find that the zero-inflation rule is less costly than the price-level rule.

There are several artificial features of our example. For simplicity, we assume a two-period model. There is likely to be some inflation on average over the two periods even under a constant-price-level rule. This average inflation converges to zero as the number of periods increases.

We have not explained the social costs of inflation, though we have attempted to summarize them elsewhere. We have interpreted a rule as a penalty function for failing to achieve some goal, and we have ignored the problem of incentives for enforcement. Nevertheless, there may be enforceable rules that the government can impose on the behavior of one of its agencies, such as a central bank. If so, our conclusion may be fairly general.

This paper has not addressed the question of an *optimal* rule. But it shows why a simple stable-price rule can dominate a simple zero-inflation rule by reducing the policymaker's incentive to create inflation for special interests and blame it on random events.

References

Alesina, Alberto. "Macroeconomics and Politics," in *NBER Macroeconomics Annual 1988.* Cambridge, Mass.: MIT Press, 1988.

Bade, Robin, and Michael Parkin. "Central Bank Laws and Monetary Policy," manuscript, University of Western Ontario, June 1987.

Friedman, Milton. *A Program for Monetary Stability.* New York: Fordham University Press, 1959.

Gavin, William T., and Alan C. Stockman. "The Case for Zero Inflation," Federal Reserve Bank of Cleveland, *Economic Commentary,* September 15, 1988.

Kydland, Finn E., and Edward C. Prescott. "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy,* vol. 85, no. 3 (June 1977), pp. 473–91.

Rogoff, Kenneth. "The Optimal Degree of Commitment to an Intermediate Monetary Target," *Quarterly Journal of Economics,* vol. 100, no. 4 (November 1985), pp. 1169–89.

Summers, Lawrence. Comment on "Postwar Developments in Business Cycle Theory: A Moderately Classical Perspective," *Journal of Money, Credit, and Banking,* vol. 20, no. 3, part 2 (August 1988), pp. 472–76.