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2 Nominal Income Targeting

Robert E. Hall and N. Gregory Mankiw

There is increasing agreement among economists on two broad principles of monetary policy. The first principle is that monetary policy should aim to stabilize some nominal quantity. Monetarists have sought to make monetary policy stabilize the growth of the nominal money stock. In some periods of history, policy has been committed to pegging the nominal price of gold. Some economists have proposed stabilizing a bundle of commodity prices or even the consumer price index (CPI).

The second principle, which was taken for granted up until the past fifty years, is the desirability of a credible commitment to a fixed rule for monetary policy. It is now apparent that there are substantial gains if the central bank commits in advance to a set policy, rather than leaving itself free to exercise unconstrained discretion. Traditionally, policy rules took the form of a committed value for the monetary unit in terms of gold or silver. Today, the focus is on rules that promise to deliver better performance as measured by stability in output and prices. One frequently advocated rule is targeting nominal income. Some advocates of such rules advocate the complete suppression of discretion in monetary policy-making; others view the rules as more general guides and would give policymakers discretion to depart occasionally from targets.

This paper explores some of the issues raised by rules for monetary policy. We proceed as follows. Section 2.1 discusses the desirable properties of commitment and the characteristics of a good policy rule. We emphasize, in particular, rules aimed at stabilizing nominal income. Section 2.2 considers how a government could implement a nominal income rule. We discuss the role that

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the consensus forecast of nominal income could play in ensuring that the central bank not deviate from an announced target. Section 2.3 examines the time-series properties of nominal income and its consensus forecast in order to evaluate how actual policy has differed from nominal income targeting. Section 2.4 presents simulations using a simple model of the economy in order to consider how economic performance might have differed historically if the Fed had been committed to some type of a nominal income target.

2.1 Rules for Monetary Policy

We begin by discussing some general issues regarding rules for monetary policy.

2.1.1 The Benefits of Rules

The principal economic argument for policy rules comes from the analysis of strategic behavior. It is a general proposition that a player in a game has much to gain from the ability to commit in advance (Fudenberg and Tirole, 1991, 74–77). Absent that ability, a player cannot make a credible threat to take a later action that will not be in the player's interest when the time comes to take the action. The most cosmic example is the doomsday bomb, wired in advance to destroy the world upon nuclear attack. Similarly, it can be advantageous to commit *not* to take an action that would be rational on the spot. For example, as Fischer (1980) pointed out, it is desirable that the government be able to commit not to impose one-time capital levies. Commitment in advance is essential, because an unexpected one-time capital levy is the ideal nondistorting tax once capital is in place.

Kydland and Prescott (1977), Barro and Gordon (1983), and others applied this principle to monetary policy, pursuing Lucas's (1972) hypothesis that surprising monetary expansions raise output. If other distortions in the economy make it desirable to raise output, then the government will, rationally, try to create a new surprise each year. But the public will be able to see what the government is doing. The result of these attempted monetary surprises, therefore, will be higher expected inflation and higher actual inflation, but not higher output. By committing in advance not to try to create monetary surprises, the government can lower expected inflation and achieve better performance.

The monetary history of the United States and many other countries seems to support this view. After the gradual departure from the commitments implicit in the Bretton Woods system, there was a worldwide episode of inflation in the 1970s. It appears that most major governments are now committed to reasonably stable prices. Yet the form of the commitment is vague. One of our purposes in this paper is to discuss ways that the commitment could be made more precise and therefore more credible. Because any reasonable government will abandon a policy rule that is unworkable, there must be a strong practical case in favor of any particular form of commitment.

There is also a political argument for policy rules. If the central bank is under the control of elected politicians, or is closely allied with their interests, it may be tempted to make opportunistic policy changes before elections. A rule for monetary policy would largely suppress these political influences. Moreover, to the extent that a monetary rule induces the central bank to offset the macroeconomic effects of fiscal policy, as a nominal income target would, a monetary rule can suppress the political business cycle resulting from fiscal policy as well.

2.1.2 Characteristics of a Good Rule for Monetary Policy

The generic monetary policy rule requires the central bank to keep a designated indicator within a prescribed band. A rule is defined by the choice of indicator and the location and width of the band. In evaluating the desirability of a particular rule, there are four principal characteristics to consider.

The first characteristic is *efficiency.* A good policy should deliver the minimum amount of price variability for a given level of employment variability. To put it differently, one should restrict attention to those policies that are on the frontier in the price variability-employment variability space. In the past, economists have derived optimal policy rules within fully developed macro models. By contrast, we would recommend a different approach. A policy rule should deliver satisfactory performance across a wide spectrum of macro models. On the one hand, the policy should give reasonable price stability in a model of full monetary neutrality, where monetary policy has no important influence over real activity. On the other hand, the policy should yield a reasonable compromise between price and employment stability in a model where money is not neutral.

A second characteristic of a good rule is *simplicity.* A rule that is simple has a better chance of adoption in the first place and a better chance of continuing to be enforced. Closely related is *precision.* Under a precise rule, such as "Keep the price of gold at $300 per ounce," there can be no doubt whether the central bank is adhering to the rule. A rule such as "Keep employment stable in the short run but prevent inflation in the long run" has proven to be hopelessly vague; a central bank can rationalize almost any policy position within that rule.

A fourth characteristic, closely related to simplicity and precision, is *accountability.* A monetary policy is more credible if the citizens of a country can make the agency responsible for monetary policy—typically the central bank—accountable for achieving the policy. Therefore, a policy rule should have the property that there is no doubt whether the central bank is performing its role properly. Under the relatively vague definition of the Federal Reserve's responsibilities currently in force, the Fed can justify a range of actions as being consistent with achieving price and output stability. When policy turns too expansionary, as it probably did in the early 1970s, or too contractionary, as it probably did in the early 1980s, there is no immediate breach of the rule for which the Fed can be disciplined. By contrast, these policy deviations would have been unambiguous under the type of policy we consider below.

Policy rules—even those with these four desirable characteristics—have side effects. Keeping one variable under tight control may bring high volatility to other variables. Rules that make an intelligent choice between price and employment stability may require tolerance of large swings in interest rates and exchange rates, for example, especially if policy in other major countries is volatile. Yet if a policy rule is on the frontier of price and employment stability, such side effects should probably be ignored.

2.1.3 Rules Based on Nominal Income

Recent advocates of rules for monetary policy have called for the close pegging of a variety of nominal indicators—monetary aggregates, commodity price indexes, the consumer price index, exchange rates, and the price of gold. But it seems fair to say that the consensus today favors nominal income as the most suitable object of monetary policy.

Keeping nominal income on a smooth path is a monetary policy that receives support from all branches of modern macroeconomics. In equilibrium macroeconomics, with full monetary neutrality, smooth growth of nominal income implies a path for the price level which is simply the ratio of the nominal income target to the equilibrium level of real income. Absent erratic behavior of equilibrium output, price stability will be the result of the policy. In views of macroeconomics admitting monetary nonneutrality, the nominal income standard amounts to an intermediate position on the hard question of how monetary policy should respond to a shock to the price level. Under a nominal income target, real output falls 1 percent for each percentage point by which the price level is too high. By contrast, under a price standard, monetary policy would be called upon to deliver unlimited contraction until it eliminated all of a price shock. Later, we will illustrate the operation of a nominal income target in a simple aggregate model with a Phillips curve. But the desirability of this policy comes from its robustness with respect to the characteristics of the economy in general and to the sources of monetary nonneutrality in particular.

Nominal income targeting is one policy in a broader class which Hall (1985) dubbed "elastic price targets." Policies in this class set a fundamental price target, but permit deviations from the target to the extent that the unemployment rate deviates from its equilibrium level. A more elastic policy permits a larger price deviation per point of unemployment deviation. Within a Phillips curve economy, an elastic price policy is efficient in the sense we defined earlier: it puts the economy on the frontier of best achievable combinations of price and employment variability.

The policy of targeting nominal income has long been discussed among economists. Early contributions to the contemporary literature are Meade (1978), von Weizsäcker (1978), and Tobin (1980). Bean (1983) developed a formal analysis of the implications of nominal income stabilization in a general equilibrium macro model. In his model, there is an "aggregate demand" shock whose effects are the same as those of a random component of the money stock. All reasonable policies offset the part of this shock that is known when monetary policy is determined. In addition, the model considers a random shift of the production function. With inelastic labor supply, nominal income targeting minimizes the variance of the deviation of real output from its equilibrium value; otherwise, the minimum variance policy targets a combination of real income and the price level with different weights on the two variables.

West (1986) pointed out that Bean's conclusions were specific to his particular model of monetary nonneutrality. Moreover, Bean used a criterion to evaluate the performance of policy that gives no weight to stability of the price level. Finally, Bean did not consider the source of disturbances that seem to have generated the most acute problems of monetary policy in the last few decades—random disturbances in the price level itself. Asako and Wagner (1992) further investigated issues raised by the Bean and West papers.

Taylor (1985) concentrated on dynamic aspects of nominal income targeting. He considered three policy rules. The first calls upon the central bank to keep the *growth* of nominal income as close to a constant as possible. Past deviations from the policy are not considered in setting the policy for a new year. The second policy is an empirical summary of actual postwar policy. The third sets the nominal income growth target equal to a prescribed constant plus the deviation of real income from equilibrium at the beginning of the year; this rule has the central bank raise nominal income growth when the economy is in recession.

According to Taylor's calculations, the effects of stabilizing the growth rate of nominal income are quite unfavorable: because the rule does not concern itself with the level of real activity, it lets random shocks build into large movements of output, with overshooting relative to equilibrium. The postwar actual policy rule does better on this account. The third rule seems to deliver the best performance, when the volatilities of output and inflation are the criteria.

Taylor called attention to the importance of stabilizing the *level* of real output and not its rate of change, if the level is what really matters. The same point applies to the price level, though Taylor does not explore this area. If the ultimate goal is to stabilize the price level, then the logic developed in Taylor's paper with respect to the level of output applies equally to the price level. Policy should make up for deviations of the level of output from equilibrium and the price level from target. The best policy rule will be one that keeps the *level* of nominal income on a target path.

McCallum (1988) made two important contributions to the recent literature on stabilization. First, he stressed the need for robustness in policy rules: given our ignorance of the true structural model of the economy, a good policy will be one that performs reasonably well across a wide variety of models, rather than one that is optimal for one model. Second, McCallum focused on a policy rule to which the central bank could be held precisely accountable. Rather than prescribe a nominal income target, McCallum would prescribe changes in the bank's own portfolio based on the most recent observation of nominal income and on various lagged variables. In McCallum's view, the central bank could be held to a much tighter standard for the monetary base than for nominal income.

Interestingly, none of the theoretical papers on stabilization has tackled the questions of the fundamental motivation for stabilizing either output or the price level. Two questions seem central: Should policy try to stabilize the growth rate or the level of real activity? Should policy try to stabilize the inflation rate or the price level? These questions have remained largely outside the professional commentary on stabilization. For real activity, if there is an increasing marginal cost of departures of real output from equilibrium, then a simple convexity argument establishes that volatility is socially undesirable. In this case, Taylor is right that stabilization efforts should be directed at the level, not the rate of growth. Alternatively, if fluctuations are costly in part because there are costs associated with adjusting to different levels of economic activity, then the volatility of the growth rate may be of independent interest.

For prices, the issue is even less clear. As Hall (1985) observed, an important source of the social cost of unstable prices is in personal financial planning. It would appear to be desirable to run the economy so that the probability distribution of the price level thirty years in the future has a mean close to the current level (no chronic inflation) and with only a moderate amount of dispersion. In this respect, it would be better to stabilize the price level rather than the rate of inflation. By contrast, under inflation stabilization, there will be a random-walk element to the price level, representing the accumulation of random influences not deliberately canceled by stabilization policy. The variance of the conditional distribution of the future price level will grow in proportion to the time horizon. By thirty years out, the dispersion will inevitably be large, even though the incremental randomness from each year may be small.

Other costs of price instability point toward the desirability of inflation stabilization. For example, a traditional argument holds that inflation is socially costly because it enlarges the wedge between the private cost of holding currency and the social cost of producing it. By this argument, it would only add to the social cost of a burst of inflation for it to be followed by a compensatory period of deflation, as a policy to stabilize the price level would mandate.

A related question is the measure of the price level that is most suited for stabilization. Again, the answer should flow from a theory of the social benefits of price stability. If the benefits are mainly in the area of personal financial planning, the object of stabilization should be prices relevant for consumers. Monetary policy could promise to remove almost all macroeconomic uncertainty from the CPI, so families could plan without having to consider variations in the purchasing power of their earnings. Alternatively, the promise could apply to a wage index, so plans could be made without macro uncertainty about earnings. A compromise between the two would be the gross domestic product implicit deflator. In the past few decades, the primary source of differences between the CPI and the implicit deflator has been the world oil price. Because the United States consumes more oil than it produces, the CPI gives more weight to oil than does the implicit deflator. Stabilizing the implicit deflator or the nominal wage means that monetary policy does not have to erase all of the effect of changing oil prices on the cost of living. By contrast, under CPI stabilization, changes in oil prices would necessitate changes (in the opposite direction) in the implicit deflator and nominal wages.

2.1.4 Conclusions on the Form of the Monetary Policy Rule

We find a reasonable professional consensus on the proposition that a good, if not precisely optimal, rule for monetary policy is to target nominal income. The exact form of a nominal income target depends on one's view of the relative importance of stabilizing the level or growth of output, and of stabilizing the price level or inflation rate. The literature suggests a consideration of three types of nominal income policies:

- *Growth-rate targeting.* Keep the growth of nominal income as close to a constant as possible.
- *Level targeting.* Keep the level of nominal income as close as possible to a path that is prescribed, once and for all, at the time the policy is first put into effect.
- *Hybrid targeting.* Keep the growth of nominal income over the coming year as close as possible to a constant plus the current percentage gap between real income and its equilibrium level.

Below we perform some simulations to estimate the economic performance that might result from each of these policies. Our next topic, however, is how the central bank should implement a nominal income policy rule.

2.2 Implementation of the Policy Rule

The feedback from monetary change—purchases or sales of securities in exchange for reserves—to nominal income is notoriously slow. Proposals to stabilize nominal income through optimal control rules based on estimated causal relations between money growth and nominal income growth may lack robustness. Control rules must be biased strongly toward inaction in order to avoid the possibility of unstable feedback.

Control is most effective and least likely to result in instability when the variable under control responds quickly to the inputs. Steering a car comes naturally to most people because the effects of moving the steering wheel are almost instantaneous. Steering a large ship is a highly specialized task because there are long lags between changing the rudder and the actual movement of the ship. And once the ship starts to turn, it continues long after the rudder is returned to normal. A novice is likely to oversteer in the first place and then make larger and larger unstable corrections. A central bank faces a similar problem if it uses its portfolio to keep nominal income on target.

As Gordon (1985) and Hall (1985) observed, forecasts can help deal with the problem of long lags and unstable feedback. The spirit of such a rule is that policy is too expansionary when today's forecast of nominal income a year or two hence is above the target for that time. It is reasonable to expect the central bank to make the forecast of a serious independent forecaster exactly on target, even though it could never be expected to put actual income on target. The feedback loop from current monetary policy to current forecasts of nominal income a year or two in the future is quick and powerful. It takes many months for monetary policy to affect actual income, but the consensus forecast that far in the future is quite responsive to current monetary policy. Within a few days of a change in monetary policy, the consensus forecast changes to reflect expert opinions about the effects on all macro variables, including nominal income.

In the United States, the Federal Reserve Board already is a close follower of outside forecasts. Moreover, the Fed has a large and respected forecasting group of its own. Forecasts are already an important part of the process of executing policy. Just as the experienced pilot of a large ship can predict the movements of the ship well into the future, based on observations of tide, wind, engine speed, and rudder settings, the Fed already takes advantage of the contribution that forecasts make to the control process. Were the Fed to be fully committed to the nominal income target, it would probably be unnecessary to tell it to use forecasts to improve the feedback control process.

The most important role of forecasts is to enforce the monetary policy rule upon the central bank. Because there are random unpredictable determinants of nominal income, the central bank cannot be expected to keep nominal income itself exactly on target. A band of a few percentage points in either direction would have to be part of a statement of a policy rule formulated in terms of nominal income itself. In this case, the public could not know whether any given deviation from the policy rule was the result of recent random events or the result of the central bank having decided to depart from the rule.

By contrast, there is no need for any band if the policy is stated in terms of a forecast for one to two years in the future. If the consensus of outside forecasters says that nominal income will come in below target, the public and the legislature will know that the central bank has failed to adhere to the policy. A policy to peg the consensus forecast is on much the same footing as a policy to peg the exchange rate; it is subject to immediate and almost indisputable verification.

We say "almost indisputable" because there is an issue of defining the consensus. In the United States, there is a published consensus of respected private forecasters (*Blue Chip Economic Indicators*), but the definition of the consensus is potentially open to argument. Compared to the current debates about the conduct of monetary policy, however, this issue seems minor.

The argument for tying the Fed to outside forecasts rests in part on a principal-agent argument. A principal (in this case, the citizens) needs to set up incentives for the agent (the Fed) to deliver the result that the principal wants. The agent's own incentives can lead to behavior quite undesirable for the principal. Certainly the chronic inflation experienced in much of the postwar era supports this style of analysis. Even if there is some reduction in policy effectiveness associated with tying monetary policy to outside forecasts, this may be a reasonable price to pay to solve the principal-agent problem.

Once the Fed is committed to pegging the consensus forecast of nominal income, we see no need to tell it how to go about achieving the peg. The Fed's bond traders should simply buy or sell securities as needed to keep the forecast at the peg. In practice, this would be similar to the way in which many central banks today achieve exchange-rate pegs. There is a difference in response time, of course. The exchange rate reacts to portfolio changes in a few seconds, whereas the consensus forecast reacts to portfolio changes in a few days or a week. Just as a supertanker needs a more qualified pilot than a small ship, a central bank pegging a nominal income forecast needs a better technician than one pegging an exchange rate. But the peg is still just a technical issue.

2.2.1 The Lead Time

So far, we have discussed the idea of targeting nominal income forecasts made today for a year or two in the future. How should the lead time be chosen? If the forecast lead time is short, pegging the forecast will come close to achieving the nominal income target itself. That is, the error in a forecast for nominal income next quarter is smaller on average than the error in a forecast for four or eight quarters in the future. Thus a short lead time yields a policy with little slippage relative to the target. On the other hand, a short lead time means that the target—the forecast for the near future—is not very responsive to monetary policy. Large swings in interest rates, exchange rates, and related variables may be needed to keep the forecast on target.

Moreover, it is not entirely clear whether closer achievement of the nominal income target is desirable. Nominal income targeting puts a large implicit weight on price stability. Using a forecast for nominal income well into the future to guide monetary policy is more tolerant of short-term disturbances in the price level. It may therefore result in an economy that performs better than one that is held to a tight short-term nominal income target.

2.3 The Time-Series Behavior of Nominal Income and Its Forecasts

In this section we examine the time-series behavior of actual nominal income and forecasts of nominal income. First, we examine the predictive power of the consensus forecast; we show that the power is substantial, so that the forecast makes sense as a target. Second, we comment on what type of nominal income rule comes closest to describing the Fed's actual policies over the past two decades.

2.3.1 The Predictive Power of the Consensus Forecast

How predictable is growth in nominal income over the next year? In tables 2.1 and 2.2 we present regressions of the change in the log of nominal gross national product (GNP), denoted x, over four quarters on variables one might use to forecast this variable, including the consensus forecast. The residual

Table 2.1 The Efficiency of Nominal Income Forecasts, Part I

	Dependent Variable $x_{+4} - x$				
	(0)	(1)	(2)	(3)	(4)
Constant	.011	.009	.007	.003	.002
	(.014)	(.018)	(.013)	(.015)	(.014)
Forecast	.825	.790	1.108	.870	1.180
	(.178)	(.170)	(.189)	(.184)	(.207)
$x - x_{-1}$		.139			
		(.333)			
$x_{-1} - x_{-2}$		.039			
		(.284)			
$x_{-2} - x_{-3}$		.019			
		(.226)			
$x_{-3} - x_{-4}$		.067			
		(.285)			
$p - p_{-1}$			1.198		1.216
			(.516)		(.536)
$p_{-1} - p_{-2}$			−.311		−.382
			(.505)		(.516)
$p_{-2} - p_{-3}$			−.953		−1.152
			(.539)		(.609)
$p_{-3} - p_{-4}$			−1.308		−1.232
			(.714)		(.795)
$y - y_{-1}$				.109	−.192
				(.391)	(.307)
$y_{-1} - y_{-2}$				.131	−.095
				(.273)	(.279)
$y_{-2} - y_{-3}$				.177	.181
				(.205)	(.216)
$y_{-3} - y_{-4}$				.311	.225
				(.279)	(.290)
$\bar{R}^2$	.38	.35	.43	.38	.42
p-value		.95	.16	.56	.12
S.E.E.	.023	.023	.022	.023	.022

Note: Standard errors are in parentheses. These are computed allowing for heteroskedasticity and an MA(3) error term.

Table 2.2 **The Efficiency of Nominal Income Forecasts, Part II**

	Dependent Variable $x_{+4} - x$			
	(0)	(1)	(2)	(3)
Constant	.011	.0006	.0067	.044
	(.014)	(.016)	(.014)	(.016)
Forecast	.825	.845	.668	.880
	(.178)	(.177)	(.217)	(.137)
$M1 - M1_{-1}$		.193		
		(.216)		
$M1_{-1} - M1_{-2}$		−.086		
		(.255)		
$M1_{-2} - M1_{-3}$		−.069		
		(.247)		
$M1_{-3} - M1_{-4}$		.489		
		(.333)		
$M2 - M2_{-1}$			.561	
			(.289)	
$M2_{-1} - M2_{-2}$			−.132	
			(.248)	
$M2_{-2} - M2_{-3}$			−.126	
			(.282)	
$M2_{-3} - M2_{-4}$			.559	
			(.348)	
r				−2.15
				(1.32)
r_{-1}				−1.01
				(2.07)
r_{-2}				1.41
				(2.54)
r_{-3}				−2.74
				(1.98)
$\bar{R}^2$	.38	.38	.39	.57
p-value		.25	.15	.00
S.E.E.	.023	.023	.022	.019

Note: Standard errors are in parentheses. These are computed allowing for heteroskedasticity and an MA(3) error term.

from such a regression should follow a moving average process, so we report robust standard errors. We examine the period 1971:2–1992:4, for which we have data on the consensus forecast. We obtained the consensus forecast from Steven McNees of the Federal Reserve Bank of Boston. These consensus forecasts are the median of the forecasts of several large forecasting firms.

The regression in the first column of table 2.1 indicates that the consensus forecast by itself is a good indicator for the future path of nominal income. The R^2 of the regression with only the consensus forecast is 0.38. Other forecasting variables contribute little beyond the consensus forecast. The other columns of table 2.1 try lags of nominal GNP, prices (p), real GNP (y), and prices and real

GNP together. The regressions in table 2.2 try traditional indicators of monetary policy: the growth in monetary aggregates and the federal funds rate (r).

If the consensus forecast were fully rational, it would aggregate all available information, so that none of the other variables would help forecast nominal GNP growth. The evidence on this point is almost, but not quite, decisive. In all these regressions, the coefficient on the forecast is close to the theoretically predicted value of one. In most cases, the hypothesis that the coefficients on the other lagged variables are zero cannot be rejected at conventional significance levels. The only exception is regression (3) in table 2.2: lagged interest rates appear to help predict growth in nominal income. This apparent rejection of forecast rationality may be the result of the small sample bias discussed in Mankiw and Shapiro (1986).

Overall, the results in tables 2.1 and 2.2 suggest that substantial information is contained in the consensus forecast of nominal income. This finding is broadly supportive of the plan of using the consensus as the target for monetary policy. That is, the consensus is a reasonable indicator of future values of a key nominal quantity.

2.3.2 The Fed's Historical Policy

Although the Fed has never adopted any formal nominal income target, it is interesting to see to what extent the actual behavior of nominal income and its forecast have corresponded to any form of nominal income targeting. The line marked with squares in figure 2.1 shows the data for the four-quarter ahead consensus forecast of nominal GNP growth. Data on forecasted growth are useful to examine because they eliminate noise coming from short-run surprises.

The data show no sign of any policy of stabilizing the forecasted *level* of nominal GNP. Under a level policy, forecasted growth in nominal income would be low when nominal income was above the target path and *vice versa*. The line in figure 2.1 marked with circles shows the deviation of the level of nominal GNP from its trend path over the period from 1969 through 1991. For the decade from 1971 to 1981, nominal GNP rose further and further above trend, but there was no systematic decline in forecasted nominal growth. Toward the end of the period, when nominal income was much closer to trend, forecasted nominal GNP growth was actually lower than at almost any earlier time.

Another approach to determining if policy has followed a level target is to look at the serial correlation of nominal income growth itself. Under level targeting, the serial correlation would be negative, as policy would depress growth in later quarters if nominal GNP grew excessively in one quarter. But the actual autocorrelations of nominal income growth are somewhat positive.

There is also little evidence that the Fed has followed a policy of keeping nominal GNP *growth* constant. In contrast to what would occur under growth-rate targeting, forecasted nominal income growth fluctuated substantially

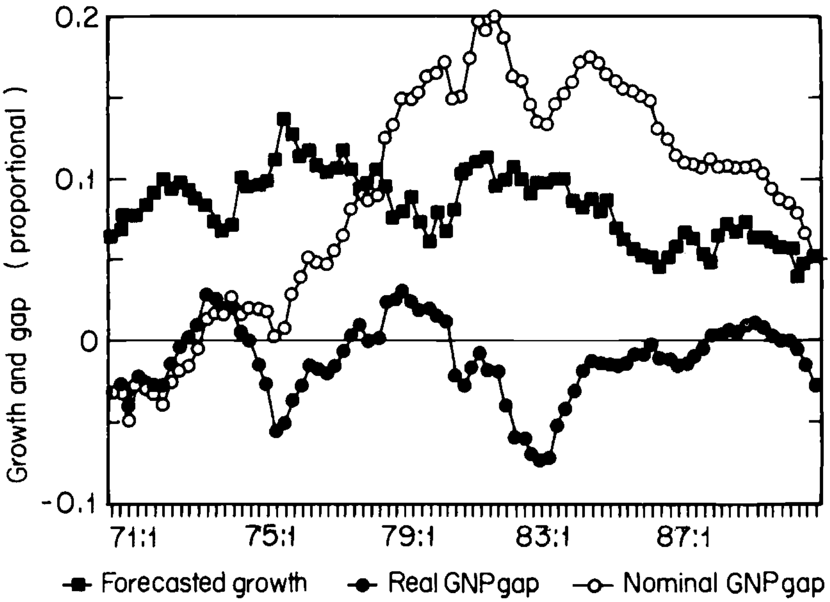

Fig. 2.1 Forecasted nominal GNP growth

through 1980. Starting in 1980, however, the data are roughly consistent with the idea that policy adopted the rule of gradually slowing nominal income growth through 1985, and then holding it at a constant level of about 6 percent per year.

The data show some support for the idea that the Fed pursued a policy similar to hybrid targeting. The lower line shows the real GNP gap at the time of the forecast. The hybrid policy would call for higher forecasted nominal growth when the output gap was negative and lower forecasted growth when the output gap was positive. There are signs of high forecasted growth at the troughs of 1971 and 1975. Yet in late 1982 and early 1983 there is no support for the hybrid policy's strategy of raising forecasted nominal income growth when the economy is far below potential.

As a general matter, one might interpret figure 2.1 as suggesting that the Fed pursued hybrid targeting in the 1970s, and growth-rate targeting in the 1980s. Yet, throughout this period, the mean level of nominal income growth was too high to prevent chronic inflation.

2.4 A Historical Counterfactual

Our goal in this section is to examine how economic performance might have differed historically if the Fed had pursued a policy of targeting nominal income. We specify a simple model of the economy, calibrate it to U.S. data, and then use it to examine this historical counterfactual. The model allows for monetary nonneutrality because of short-run price stickiness, and it can be described in the familiar terms of aggregate demand and aggregate supply. The behavior of aggregate supply is summarized by a backward-looking Phillips curve. Aggregate demand is summarized by the behavior of nominal income. Expressing all variables in logarithms, we can write nominal income as the sum of the price level and real income:

$$x = p + y. \tag{1}$$

We do not look into the details of aggregate demand, but rather assume that the Fed can expand or contract as needed to keep the nominal income forecast exactly on target. We are interested in comparing historical performance with three policies for the rule governing growth in nominal income.

The first policy is *growth-rate targeting*. Under this policy, the Fed tries to keep nominal income growth stable, but it allows base drift. That is, past shocks to nominal income, whether reflected in output or prices, do not influence future nominal income growth. Therefore, growth in nominal income is white noise around a constant mean:

$$\Delta x = \mu + \varepsilon. \tag{2}$$

We interpret this equation as the aggregate demand schedule, with the policy rule treated as an endogenous element of aggregate demand. The disturbance, ε, represents the influence of factors that cause policy to miss the nominal income growth target. With policy based on pegging the consensus forecast exactly, the disturbance is precisely the error in the consensus forecast.

The second policy is *level targeting*. Under this policy, no base drift is allowed. Shocks to nominal income, whether reflected in output or prices, are reversed in the following year, as the Fed takes action to return nominal income to the target level. Therefore, nominal income obeys

$$x = \mu t + \varepsilon. \tag{3}$$

Again, ε is the forecast error in the consensus forecast.

The third rule is *hybrid targeting*. In contrast to the previous two policies, this policy treats output and prices differently. Under hybrid targeting, the Fed raises nominal income growth when output falls below the natural rate, but it does not adjust nominal income growth when the price level deviates from target. We express this policy as

$$\Delta x = \mu + \varepsilon + (y^N - y)_{-1}. \tag{4}$$

The last term is the difference between potential and actual real output observed at the time the forecast is made (four or eight quarters in advance).

For all three of these policies we set the mean level of nominal income growth μ to be 2.5 percent per year.

2.4.1 The Model

We use a traditional expectations-augmented Phillips curve. In particular, inflation depends on past inflation, the deviation of output from its natural rate, and supply shocks. That is,

$$\Delta p = \pi + \lambda\,(\Delta p_{-1} - \pi) + \alpha\,(y - y^{N})_{-1} + \nu, \tag{5}$$

where π is the mean rate of inflation for the monetary regime, λ measures the persistence of inflation, and α governs the short-run trade-off between prices and output. To determine the natural rate of output, we use smoothed actual real GNP.[1]

To calibrate the model, we need to choose the key parameters α and λ. We apply the model to quarterly data and use λ of 0.9 and α of 0.05. These parameter estimates imply that a shock to nominal income falls about three-fourths on output and one-fourth on prices at the end of the first year. This estimate is broadly consistent with studies of U.S. data, such as Ball, Mankiw, and Romer (1988).

Next, we find the time series of shocks (ε and ν). The time series for ν is chosen to make the Phillips curve fit history exactly (the series has mean zero as a result of estimating the mean rate of inflation for the monetary regime as the average over the period). As an estimate of ε, we use the actual forecasting errors over four- and eight-quarter horizons, as provided by McNees.

These estimates of the forecasting errors surely overstate what would have occurred under a policy of nominal income targeting. One element of the actual forecasting errors comes from instability in monetary policy itself. For example, actual nominal GNP growth for the four quarters ending in the first quarter of 1973 was 12.4 percent, whereas the forecast made four quarters earlier was 10.1 percent. Much of this error is probably attributable to expansionary monetary policy in 1972. Similarly, unexpectedly contractionary policy was partly responsible for the huge overprediction of nominal GNP in the period ending in the first quarter of 1982, when actual nominal income fell short of forecast by 6.5 percent. These spontaneous changes in policy would not have occurred under a monetary policy rule. To take into account the increase in forecasting accuracy that would result from such a rule, we also carry out simulations with zero forecasting errors. The actual magnitude of the forecasting errors under nominal income targets probably lies somewhere between the two cases we calculate.

1. To be more specific, potential output is .98 times its own lagged value plus .02 times current real GNP, all multiplied by a constant so that the average level of potential is the same as the average of actual real GNP.

2.4.2 Results

Table 2.3 shows the simulation results. The first line describes the historical performance of three key macroeconomic variables from 1972 to 1991. Because of chronic inflation, the price level had a huge standard deviation of 34 percent. The rate of inflation had a relatively modest standard deviation of 2.5 percent at annual rates, but with a mean of almost 6 percent per year. The root mean squared deviation, which includes both the random deviations from the mean and the mean itself, was over 6 percent. The standard deviation of the gap between actual output and equilibrium was about 2.5 percent, and the standard deviation of the annual rate of growth of output was almost 4 percent.

The next major block presents the results under the three alternative policies discussed above, based on targeting the forecast of nominal income four quarters ahead. The lower block of table 2.3 has the same format, except that the policy execution errors, ε, are taken as zero rather than historical actuals (the price disturbances are taken as historical actuals, however). Note that, with perfect achievement of the target, the level and growth policies are the same.

Table 2.3 yields several conclusions. First, the volatility of the price level would have been much lower under any of these policies than it has been historically. This result is not surprising, of course; it follows directly from the lower mean growth of nominal income. The differences among the three alternative policies are substantial. Level targeting is the policy that would have yielded the most stable price level. The growth and hybrid policies both introduce an integrated (random-walk) element into the price level. Over a long enough period, the standard deviation of the price level would become large

Table 2.3 Performance under Alternative Four-Quarter Ahead Targets

	Price Level	Inflation (annual rate)	Output Gap	Output Growth (annual rate)
Actual				
Standard deviation	34.09	2.51	2.49	3.97
Mean		5.74		
Root mean squared deviation		6.27		
	Standard Deviations			
Simulated, actual forecast errors				
Growth	4.43	3.26	5.15	18.60
Level	1.92	2.14	3.20	6.64
Hybrid	2.34	1.74	2.26	6.28
Simulated, perfect achievement of target				
Growth and level	1.82	1.89	1.72	1.91
Hybrid	1.86	1.62	1.12	2.22

without limit. It is only good luck that causes the growth and hybrid policies to deliver reasonably low volatility of the price level. Only the level policy guarantees low volatility of the price level over long periods.[2]

Second, these policies would have yielded a more stable inflation rate than has been experienced historically. The magnitude of this result is significant: any of the nominal income targets would have reduced the average deviation of the inflation rate from zero by at least half. (Remember that much of the penalty associated with actual policy arises from the chronic inflation it produced.) The growth-rate target is less successful in stabilizing inflation than are the two other policies.

Third, the volatility of real income around its equilibrium level depends crucially on which nominal income target one considers. Growth-rate targeting scores badly by this standard, with about double the actual historical volatility, and level targeting is also above the actual. Hybrid targeting would have delivered a slightly lower volatility of real output.

The lower block of table 2.3 shows what a perfect nominal income target would achieve. The volatility in all four measures that comes from price shocks alone is around 2 percent, substantially below the volatility when forecast errors are included. Forecast errors are a major source of volatility for policies that peg forecasted future levels. The magnitude of the improvement in economic performance that would result from one of these policies depends crucially on how much forecasting would improve.

Table 2.3 shows that actual policy has been *inefficient.* A hybrid policy would have delivered better output stability and better price stability, even if the forecast errors with the policy in operation had been as large as those that had actually occurred. And the improvement in both dimensions would be even greater in the likely case that the forecast errors were smaller in the presence of a stable policy. Alternatively, a level policy could have delivered more stable prices with somewhat more output volatility, in the conservative case of historical forecast errors, and considerably lower output volatility with smaller forecast errors.

Although our explorations in this paper do not go outside the territory of policies based on nominal income, table 2.3 contains a strong hint (confirmed by calculations not presented here) that a policy that combined features of the hybrid and level policies would dominate all others. The hybrid policy gives better output performance because of its response to the level of output relative to potential. But it suffers from paying no attention to the price level. A policy that pegs the consensus forecast of a weighted average of the price level and real output, with most of the weight on output, can produce the low output

2. If there is a random-walk element in real output (a property that cannot be refuted by the existing data), targeting the level of nominal income introduces a complementary random-walk element into the price level. By contrast, a growth-rate targeting introduces a random-walk component into the price level even if real output is stationary around a deterministic trend.

volatility of the hybrid policy without incurring the cost of the integrated component of the price level.

Figures 2.2 through 2.5 illustrate the findings of table 2.3. Figure 2.2 shows the historical deviations of real GNP from potential, for comparison with the simulated deviations in the later figures. We cannot present any meaningful version of price deviations because the price level rose so much during the period.

Figure 2.3 shows our simulations for the four-quarter ahead growth policy. There are two reasons visible in the figure for the high volatility of output. First, the policy permits a collapse of output in early 1983. Under growth-rate targeting, unlike the other two policies we consider, the Fed would not alter future nominal income growth in response to the low growth in nominal and real income during the recession in 1981–82. Second, there is a sawtooth pattern to the level of output, especially after 1983. A growth-based policy propagates any such pattern into the future once it gets started. In a quarter when nominal GNP is high, a growth policy requires that the target for that quarter in the following year be correspondingly higher. The figure also shows the random walk that a growth-based policy introduces into the price level. All told, figure 2.3 amply illustrates the defects of the strict policy that considers only the rate of growth of nominal income.

Figure 2.4 shows the simulated performance of a four-quarter level policy.

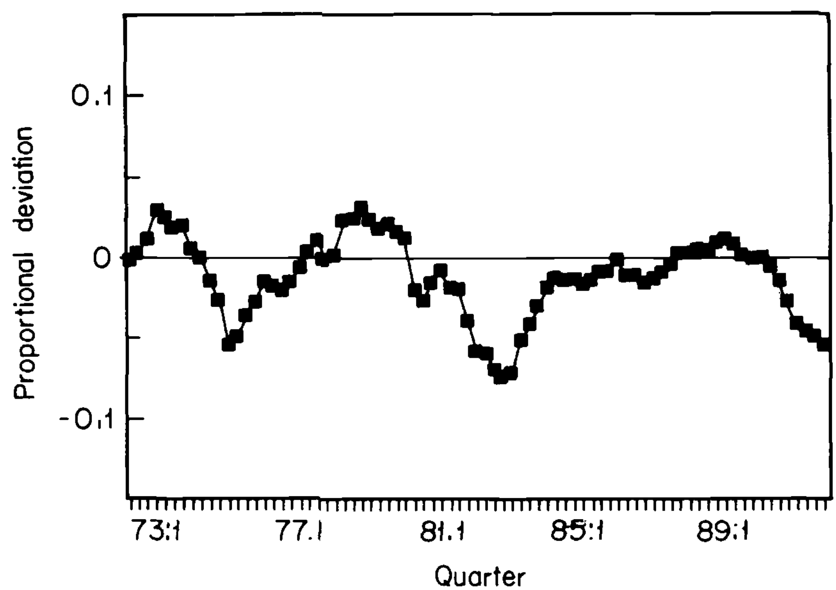

Fig. 2.2 Output deviation
Note: Actual.

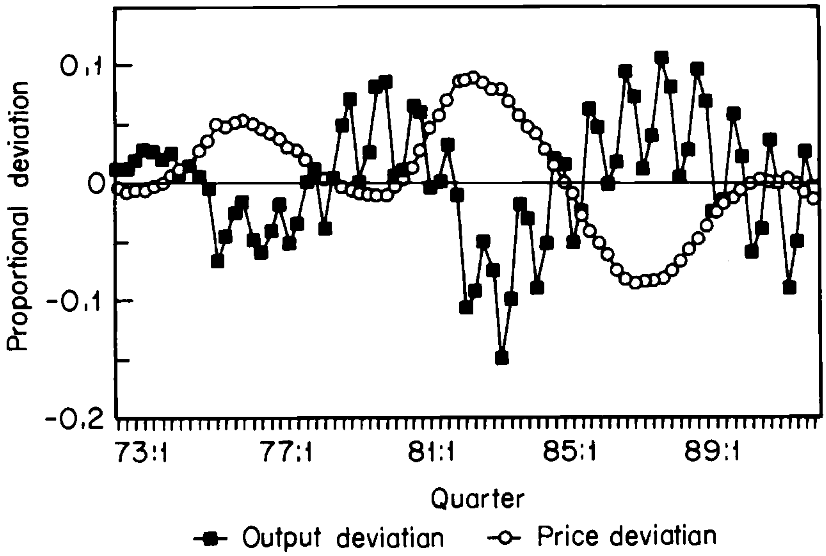

Fig. 2.3 Price level and output
Note: Four-quarter ahead growth policy.

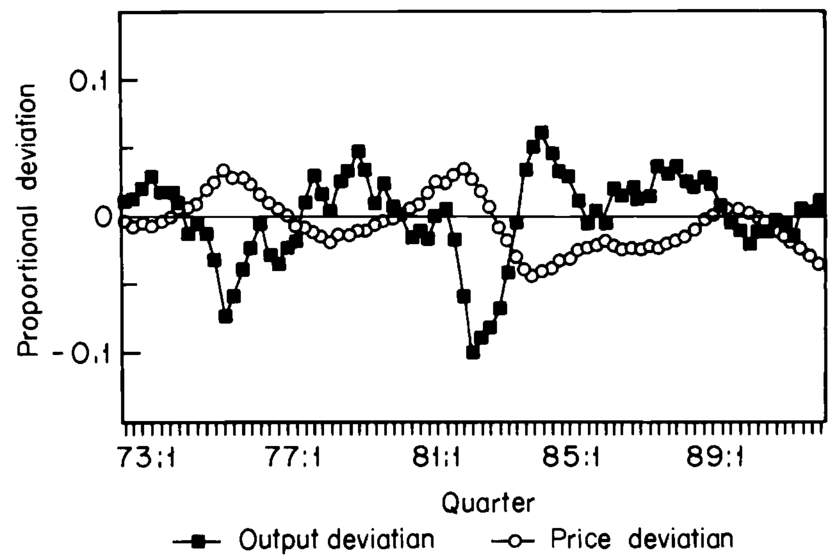

Fig. 2.4 Price level and output
Note: Four-quarter ahead level policy.

Output volatility is lower than for the growth policy, but is higher than actual. A deep recession occurs in 1981–82, based on the conservative view that the forecasting errors actually made during that period would have happened anyway and were not the result of unexpected instability in monetary policy. The price shocks around 1980 are also partly responsible for the depth of this recession. Under a level target, any short-run accommodation of price shocks must be subsequently reversed in order to return nominal income to its target path.

Figure 2.5 shows the simulation record of the hybrid policy. Its single-minded attention to keeping real output at potential makes it deliver much less output volatility than the other policies. The recession in late 1981 is about as deep as actual, but is reversed much more quickly than actually occurred. On the other hand, the drift of the price level is quite evident.

Table 2.4 provides information about the issue of the lead time for the forecasts used as policy targets. It compares four- and eight-quarter ahead targets for the three types of policy. The results in table 2.4 indicate that longer lead times may be desirable. For growth-rate targeting, the volatilities of all four measures of performance are substantially lower in the eight-quarter case. For the level and hybrid policies, price stability is comparable for both lead times, and output volatility is lower for the eight-quarter lead time.

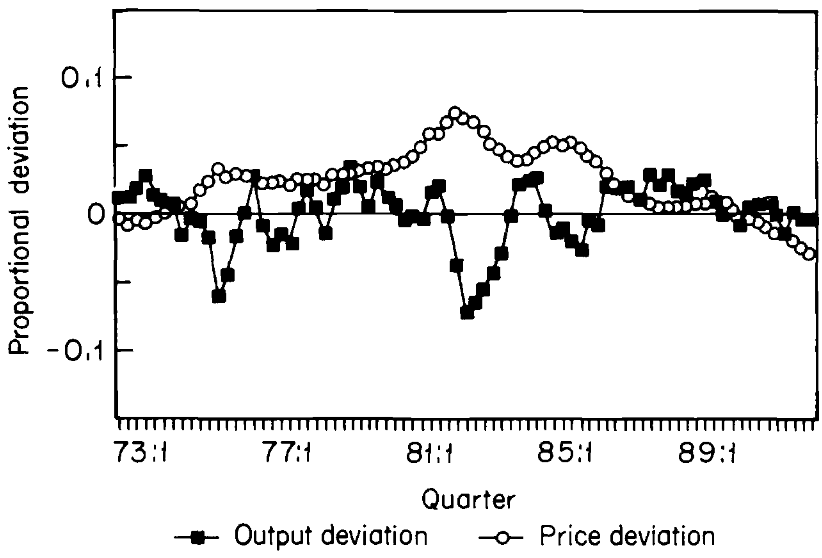

Fig. 2.5 Price level and output
Note: Four-quarter ahead hybrid policy.

Table 2.4 **Comparison of Four-Quarter and Eight-Quarter Ahead Targets**

	Price Level	Inflation (annual rate)	Output Gap	Output Growth (annual rate)
Simulated, actual forecast errors				
Target	Standard Deviations			
Growth				
Four-quarter ahead	4.43	3.26	5.15	18.60
Eight-quarter ahead	3.21	2.00	2.58	6.33
Level				
Four-quarter ahead	1.92	2.14	3.20	6.64
Eight-quarter ahead	1.99	2.20	2.72	4.53
Hybrid				
Four-quarter ahead	2.34	1.74	2.26	6.28
Eight-quarter ahead	2.26	1.58	1.90	3.56

2.5 Conclusion

Although nominal income targeting is not a panacea, it is a reasonably good rule for the conduct of monetary policy. Simulations of a simple macro model suggest that, compared to historical policy, the primary benefit of nominal income targeting is reduced volatility in the price level and the inflation rate. Under conservative assumptions, real economic activity would be about as volatile as it has been over the past forty years. If the elimination of spontaneous shifts in monetary policy improves forecasts markedly, real activity could be much less volatile.

We have discussed various ways in which a central bank might formulate a nominal income target. We have emphasized three in particular, which we call growth-rate targeting, level targeting, and hybrid targeting. Our calculations indicate that none of these policies clearly dominates all the others, although growth-rate targeting seems to yield the least desirable outcomes. Which targeting scheme a central bank should adopt depends on the relative costs of volatility in price levels, inflation rates, real income levels, and real income growth rates. These are topics on which more research is needed.

Our discussion has stayed within the domain of nominal income targets, guided by the principle of simplicity. But our results suggest that, if the monetary authorities will consider a slightly more complicated policy, one that looks primarily at the level of real activity and secondarily at the level of prices, they can achieve a considerably more appealing combination of output and price stability.

We have avoided discussion of the place of monetary policy rules in the world economy. In effect, we give a prescription for the activities of the central bank of a nation or monetary union which does not look beyond its own geographical boundaries. We have not considered the possible merits of making the rule of one monetary authority depend on outcomes beyond its borders. There is no question that each major central bank influences other economic units. But there is no consensus on the way in which monetary policies should be coordinated. Just as important, any attempt to impose coordination by policy formula would plainly violate the principle of simplicity.

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Comment Kenneth D. West

This is a thoughtful and sensible paper. It makes an important, and policy relevant, contribution to our understanding of how nominal income targeting might affect the U.S. economy. But its conclusion in section 2.5 that "nominal income targeting is . . . a reasonably good rule for the conduct of monetary policy" is, in my view, premature.

Let me begin by reviewing what Hall and Mankiw have done. They have a two-equation model. Let p_t be the price level, y_t output, y_t^N the natural rate of output, $x_t = p_t + y_t$ nominal income. One equation is a Phillips curve,

$$\Delta p_t - \pi = \lambda(\Delta p_{t-1} - \pi) + \alpha(y_t - y_t^N) + v_t.$$

The second equation is a nominal income rule:

$$\text{level rule: } x_t = \mu t + (x_t - E_{t-4}x_t)$$
$$= \mu t + \varepsilon_t,$$
$$\varepsilon_t = \text{MA(3) error in consensus forecast;}$$
$$\text{growth rule: } x_t - x_{t-4} = \mu + \varepsilon_t;$$
$$\text{hybrid rule: } x_t - x_{t-4} = \mu + \varepsilon_t + (y_{t-4} - y_{t-4}^N).$$

Hall and Mankiw also experiment with eight- instead of four-quarter rules.

Given time series for y_t^N, v_t, and ε_t (computed from the actual data, and assumed not to change from simulation to simulation), the Phillips curve and the nominal income rule are two equations in the two unknowns p_t and y_t. In each simulation, the constant π in the Phillips curve is adjusted so that the average value of $y_t - y_t^N$ is zero.

It seems to me that the hypothetical nominal income policies do not fare particularly well relative to actual policy. Tables 2.3 and 2.4 indicate that when actual forecast errors are used, the growth and level policies invariably yield higher standard deviations for the output gap and output growth rates than the actual policy did. While the hybrid policy generally does better than the actual on these measures of output volatility, it exploits information that would not be available if the Fed were trying to follow such a rule, in that it uses the final, revised, and rebenchmarked figures for y_t and y_t^N. Whether use of data actually

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available would make much difference I do not know; the fact that it might make a difference suggests caution.

All the hypothetical policies tend to do better on volatility of inflation and remarkably better on price-level volatility. For the latter, it is important to note that this is true essentially by assumption. In all the simulations, the mean rate of nominal income growth is fixed at 2.5 percent, the mean rate of output growth to that actually observed in the sample. This fixes the mean rate of inflation; one can see from figures 2.3 to 2.5 that this implied rate is such that there is essentially zero (in fact, slightly negative) inflation over the period. Since prices have a marked trend in the actual data, and essentially no trend in the simulations, the standard deviation is much larger in the actual than in the simulated data.

Of course, a basic advantage of a nominal income rule is that it may yield stable prices; as the authors note, there are well-known reasons why discretion tends to lead to inflation. But this is not necessarily an argument for a nominal income rule rather than a price or inflation or money-growth rule, or, for that matter, an old-fashioned textbook rule that aims to minimize a weighted sum of inflation and/or price and/or output volatilities. Indeed, the class of nominal income rules considered seems to me to be inefficient in the sense defined by Hall and Mankiw in section 2.1. Suppose for concreteness that one cares about the variability of inflation and of output growth, and considers the nominal income growth rule. This rule minimizes the variance of the sum of inflation and output growth, a variance that depends in part on the covariance between inflation and output growth. In conventional models, one can get lower variability of both inflation *and* output growth by ignoring the covariance term.

It is possible that rules that yield substantial efficiency gains relative to nominal income rules will be so complicated that holding the Fed accountable to the theoretically preferable rules will be difficult in practice. But an analysis of the trade-off between efficiency and accountability remains to be done. To take just one example, why not target not the consensus forecast of nominal income, but a weighted sum of the consensus forecasts of real output and the price level, the weight reflecting the relative cost of output and price variability?

This is the sort of question I would like to see answered before I conclude that nominal income targeting is a reasonably good rule.