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ABSTRACT

We argue that there are sound theoretical reasons for believing that an inflation targeting central bank might improve macroeconomic performance by reacting to asset price misalignments over and above the deviation of, say, a two-year ahead inflation forecast from target.

In this paper, we first summarize the arguments for our basic proposition. We then discuss some of the counter-arguments. Specifically, we counter those who argue that reacting to asset prices does not improve macroeconomic performance by claiming that they are attacking the 'straw man' under which central bankers react in the same way to **all** asset price changes. We continue to emphasize that policy reactions to asset price misalignments must be qualitatively different from reactions to asset prices changes driven by fundamentals. Hence, we stand by our earlier results and conclusions.

In practice, we do believe that central bankers can detect large misalignments (e.g. the Nikkei in 1989 or the NASDAQ in early 2000), and that they might be in a better position to react to long-lived bubbles than many market participants.

However, we recognize that our proposal may present communication challenges, and it is critically important that policy set to react to asset price misalignments both be explained well and that it be based on a broad consensus. It is also important to emphasize that our proposal is wholly consistent with the remit of most inflation-targeting central banks, as we are recommending that while they might **react** to asset price misalignments, they must **not** target them.

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Introduction.

Inflation targeting is being adopted by an increasing number of central banks. Almost every day another country is added to the list that contained only a handful a few years ago. It is surely no coincidence that inflation rates (actual as well as expected) have decreased substantially and, so far, durably in countries that have adopted this strategy for the conduct of monetary policy.

But what is the essence of inflation targeting, and how should it be implemented in practice? The straightforward answer to the first of these questions is that the central bank should strive to maintain inflation as close to a clearly specified target level as possible, while at the same time limiting fluctuations of real economic activity.[1] Interpreted in this way, inflation targeting is a statement of the objectives of monetary policy alone that allows for different methods of implementation.[2] It is sometimes suggested that a practical strategy for achieving the inflation-targeting objective is to follow a Taylor rule, whereby a short-term interest rate instrument responds to deviations of expected future inflation from the target rate and to deviations of output from its full-employment level.[3]

Several practical questions must be addressed before such a strategy can be implemented. The policymaker must choose the relative weights to attach to inflation and output, the precise horizon for expected inflation and output, the difficulties associated with measuring the full-employment output level, and whether there is any role in the policy rule for variables other than expected inflation and the output gap. This paper is about the last of these questions. Specifically we ask whether there is any role of asset prices in the formulation of monetary policy in a flexible inflation-targeting framework.

The most common answer to this question is contained in Bernanke and Gertler's influential study. They conclude that

[1] For more detailed discussions about the meaning of inflation targeting see for example Bernanke, Laubach, Mishkin, and Posen (1999) and Svensson (2001).
[2] See also Genberg (2001).
[3] While it can be useful to characterize monetary policy in this way in theoretical models, in practice monetary policy is never implemented according to a rigid rule. Furthermore, in their communication with the public, some inflation-targeting central banks speak only of reacting to an inflation forecast, making no explicit statements about responding to the output gap.

> "The inflation targeting approach dictates that central banks should adjust monetary policy actively and preemptively to offset incipient inflationary and deflationary pressures. Importantly, for present purposes, it also implies that policy should *not* respond to changes in asset prices, except in so far as they signal changes in expected inflation." (Bernanke and Gertler (1999), p. 78)

The primary exception to the view that asset prices do not belong in a Taylor-type interest-rate reaction function has arisen in an open-economy context. Ball (1999) finds that adding the exchange rate to the Taylor rule improves macroeconomic performance in a model where the exchange rate has a significant role in the transmission mechanism of structural shocks and monetary policy.[4] .

Cecchetti, Genberg, Lipsky, and Wadhwani (2000) [CGLW hereafter] claim, however, that a more general case can be made for central banks to react to asset prices in the normal course of policy making. There we argue that:

> "[a] central bank concerned with both hitting an inflation target at a given time horizon, and achieving as smooth a path as possible for inflation, is likely to achieve superior performance by adjusting its policy instruments not only to inflation (or to its inflation forecast) and the output gap, but to asset prices as well. Typically, modifying the policy framework in this way could also reduce output volatility. We emphasize that this conclusion is based on our view that reacting to asset prices in the normal course of policy-making will reduce the likelihood of asset price bubbles forming, thus reducing the risk of boom-bust investment cycles." (p. 2)

Before we proceed, it is crucial to emphasize what we mean by this statement. It is our view that central banks can improve macroeconomic performance by **reacting** to asset price misalignments. We are not now saying, nor have we ever said, that policymakers should **target** asset prices.[5]

In the remainder of this paper, we first summarize the main arguments made in CGLW (Section 1). In section 2, we discuss some of the recent work in this area. The implications of the recent research for our original view of the role of asset prices in the formulation of monetary policy are summarized in the final section of the paper. To anticipate, we believe that our original views remain valid. Criticisms have either adopted a too mechanical view of the conduct of

[4] See also Svensson (2000).

[5] As was the case in our previous work, this paper is **not** about what the central bank objective should be. Instead, we are concerned with how an inflation-targeting central bank can most effectively fulfill its objectives.

monetary policy or assumed that central bankers are incapable of distinguishing (even approximately) between different types of macroeconomic disturbances. As we explained in detail in our previous study, and as we reiterate below, we take a different view on both issues.

1. Asset Prices and Central Bank Policy: Cecchetti-Genberg-Lipsky-Wadhwani (2000).

In this section we restate the arguments presented in CGLW (2000) for how asset price misalignments should be used to guide central bank policy. We are primarily interested in examining whether and how asset price misalignments should influence monetary policy once other factors, such as the inflation outlook and the output gap, have been taken into account. In addition, we make a few brief comments both about the use of asset prices directly in the inflation measure targeted by the central bank, and about the information content of asset prices for inflation forecasts.

To avoid confusion or misunderstanding, we want to emphasize that we are **not** advocating that asset prices should be **targets** for monetary policy, neither in the conventional sense that they belong in the objective function of the central bank, nor in the sense that they should be included in the inflation measure targeted by the monetary authorities. Instead our principal claim is that central banks can improve macroeconomic performance by reacting systematically to asset price misalignments, over and above their reaction to inflation forecasts and output gaps. It is our view that central banks seeking to smooth output and inflation fluctuations can improve these macroeconomic outcomes by setting interest rates with an eye toward asset prices in general, and misalignments in particular. The main reason for this is that asset price bubbles create distortions in investment and consumption, leading to excessive increases and then falls in both real output and inflation. Raising interest rates modestly as asset prices rise above what are estimated to be warranted levels, and lowering interest rates modestly when asset prices fall below warranted levels, will tend to offset the impact on output and inflation of these bubbles, thereby enhancing overall macroeconomic stability. In addition, if it were known that monetary policy would act to “lean against the wind” in this way, it might reduce the probability of bubbles arising at all, which would also be a contribution to greater macroeconomic stability.

The rationale for our conclusions comes both from the intuition gained from simple theoretical models and from quantitative simulation results. In the remainder of this section we summarize these arguments.

1.1 The intuitive argument.

The first illustration of the potential usefulness of reacting to asset prices is an application of the basic insight of Poole (1970), that leaning against the wind of interest rate changes is useful when disturbances originate in the money market. In CGLW we generalized this argument slightly to allow for movements in equity (or real estate) prices in an economy where the stock market (or the housing sector) is particularly important and to allow for changes in the exchange rate in an economy where the external sector is crucial.

A straightforward application of Poole's analysis shows that moderating changes in asset prices diminishes fluctuations in economic activity so long as the underlying reason for the asset price movement can be traced to a disturbance in the demand and/or the supply of the asset in question. To be sure, the same logic implies that when asset prices change as a result of disturbances in other markets, for example if equity prices increase because of favorable productivity shocks, then the case for leaning against the wind of the asset price change disappears. It is important not to react automatically to any and all changes in asset prices, but to evaluate each situation separately and act accordingly.

The second illustration given in CGLW is based on a model due to Kent and Lowe (1997). Their model is dynamic and explicitly incorporates the notion of asset price misalignments. In their setup, when a bubble develops in equity markets, standard wealth effects drive current inflation up. Importantly, though, expected inflation may not change since there is a probability that the bubble will disappear by itself, reducing future inflationary pressures. A forward-looking central bank that sets the current interest rate in response to expected inflation (and does not take the equity price bubble into account) would not tighten monetary policy under such circumstances. As a result the bubble in the equity market will bring about even higher inflation in the future if it continues and an even stronger economic slow-down if it collapses from an even higher level. Although expected inflation (i.e. the probability weighted average of these two future scenarios) may be on target, the country will suffer from highly variable

economic activity as a result of the stance of monetary policy. By contrast, a policy of preemptively tightening in response to the emerging equity price bubble reduces this variability.

Similar mechanisms play a pivotal role in models in which monetary policy is transmitted via credit channels, and where the financial accelerator plays a significant role. In these cases, an emerging financial market bubble leads to higher investment as, given the higher value of their collateral, firms find it easier to borrow. More investment does stimulate aggregate demand and output in the short run, but in the end creates overcapacity and results in a sharp downturn. Even if average inflation is not affected significantly, the asset market bubble leads to higher output volatility. A central bank that reacts to the root cause of the instability – the asset price misalignment – will reduce the overall volatility in economic activity.

At an intuitive level, these arguments establish a prima facie case for taking asset price misalignments into account in the normal course of determining monetary policy, not only because they have an impact on expected inflation, but also because misalignments lead to unnecessarily large business cycle fluctuations. These conclusions are confirmed by the simulation results to which we now turn.

1.2 Reacting to asset prices in three macro models.

We summarize results from three simulation experiments. The first uses the small closed-economy model employed by Bernanke-Gertler (1999) to investigate the appropriate reaction of monetary policy to stock market bubbles. The second utilizes the small-scale open-economy model due to Batini and Nelson (2000) in which the exchange rate plays an important role. The third set of simulations explores the properties of a version of John Taylor's multi-country model originally developed to analyze international economic interdependence.

1.2.1 *A closed-economy model subject to a stock price bubble.*

The Bernanke-Gertler model can be characterized as a standard dynamic new-Keynesian model, modified to allow for financial accelerator effects and exogenous asset-price bubbles. Briefly, the economy comprises three sectors: households who consume and save; a government that manages fiscal and monetary policy; and a business sector composed of firms that hire labor, invest in new capacity, and produce goods and services.

Firms finance the acquisition of capital both through the use of internal funds and through external borrowing. The existence of credit market frictions means that there is a premium on external finance that affects the overall cost of capital and thus the real investment decisions of firms. This external finance premium depends inversely on the financial condition of potential borrowers. An improvement in a borrowing firm's position translates into a fall in the premium, which serves to magnify investment and output fluctuations. So, for example, an increase in a firm's share price, raising the net worth of the owners, will make the firm more creditworthy, reduce the external finance premium, thereby increasing borrowing and investment. This financial accelerator mechanism provides an additional channel through which monetary policy can affect spending. With a fall in real interest rates, for example, asset prices will rise, reducing the cost of external borrowing and providing an extra stimulus for investment.

For the purpose at hand, the crucial aspect of the Bernanke-Gertler model is the introduction of financial bubbles through the possibility that observed stock prices differ persistently from fundamental values, and that this difference grows exponentially. The consequence of this is that the bubble affects the quality of a firm's balance sheet, and so the cost of capital falls systematically when stock prices exceed fundamental values. The result is an increase in investment, resulting in both higher current aggregate demand and higher future potential output. When the bubble bursts, the financial accelerator operates in reverse leading to a reduction in both inflation and output.

To investigate the potential for monetary policy to moderate the influence of the financial bubble on the economy, CGLW study the consequence of the central bank setting the short-term interest rate according to the reaction function

$$R_t = \gamma_\Pi E_t \pi_{t+1} + \gamma_y (y_t - y_t^*) + \gamma_s s_{t-1} + \gamma_R R_{t-1}. \qquad \textbf{(1)}$$

where R is a policy-determined short-term interest rate, y is the log of real output, y^* is the log of potential or full-employment output, s is asset price misalignment, and *E* is the expectation operator. We assume that policymakers seek to minimize a loss function of the form

$$L = \alpha \,\mathrm{var}(\pi) + (1-\alpha)\,\mathrm{var}(y) \qquad \textbf{(2)}$$

where α is the relative weight on inflation variability in the objective function. CGLW examine whether the optimal value of $\gamma_s > 0$, i.e. can loss *L* be reduced by reacting to the stock price bubble?

The conclusion of the simulation experiments reported in CGLW was that "In the majority of the cases we study, it is strongly advisable for interest rates to respond [to stock price bubbles]. While the reaction may not be very large, it should clearly be there." (p.25)

1.2.2 *Monetary policy and the exchange rate in a small model of an open economy.*

CGLW present a second set of simulations designed to investigate whether a central bank in an open economy should pay attention to exchange rate movements when it sets interest rates. We employ a variant of the Batini-Nelson (2000) model. This is a relatively conventional small open-economy model based on an aggregate demand and an aggregate supply relationship together with an equation determining the exchange rate. Aggregate demand depends on expected future income in addition to the expected real interest rate, aggregate supply is modeled according to a partially forward-looking Phillips curve, and the exchange rate is determined by the condition of uncovered interest parity.

In the simulations we consider two types of shocks: pure financial shocks, corresponding to deviations from strict uncovered interest parity, and pure aggregate demand shocks unrelated to disturbances in income or the real interest rate. As before, CGLW were interested in finding out whether in addition to reacting to expected inflation, the central bank's interest-rate target should or should not respond to the exchange rate.

Not surprisingly, we found that the answer depends on the nature of the shock being considered. When financial disturbances hit the economy are the sole source of shocks, it is desirable to 'lean against the wind' of exchange rate changes. Doing so prevents these shocks from destabilizing the real sector of the economy. When the objective of the central bank is to minimize some combination of variability of inflation and output from their respective target values, taking action to eliminate the effects of financial disturbances is a good thing. On the other hand, when aggregate demand shocks are important as well, changes in the exchange rate typically serve a useful function of absorbing some of the adjustment, thereby lessening the fluctuations in prices and output. Leaning against the wind of such exchange rate changes is then counterproductive. The simulation results presented in CGLW confirm this reasoning.

It is possible that these simulation results actually understate the benefits from a monetary policy rule that, in part, works to counteract exchange rate misalignments. To take a concrete example, suppose that a bubble creates an unwarranted appreciation of the exchange rate, and that the bubble can be affected by monetary policy. Then it might make sense to keep interest rates lower than would be necessary to, say, have expected inflation at a fixed time-horizon equal to target, because such a policy would mitigate the domestic deflationary impact of the bubble and reduce the deviation of inflation from the target today, with the added benefit of reducing the size of the 'shock' from the bubble while it lasts. Moreover, since the bubble will be smaller on average under the proactive monetary policy, the destabilizing effects of the bursting of the bubble will also be also smaller. Hence, in this case, a monetary policy that takes the exchange rate misalignment into account could, under certain circumstances, reduce the average size of the (absolute) deviations of inflation from target measured over the entire future.[6]

1.2.3 *Reacting to the exchange rate in a large multi-country model.*

In a study designed to evaluate the consequences for macroeconomic stability if Switzerland were to join the Euro-area, Genberg and Kadareja (2000) provide evidence on the desirability of making Swiss monetary policy react to exchange rate movements. In contrast to the two previous sections, this is done in the context of a multi-country econometric model estimated with actual data. Specifically Genberg and Kadareja adapt the model originally developed by John Taylor in the early 1990s. Taylor's framework is useful for studying monetary policy interactions and spillovers between the countries, and the role of different types of exchange rate arrangements.

The Taylor model is a sophisticated Mundell-Fleming model with two important additions: a set of wage-price relationships on the one hand, and rational expectations on the other. Genberg and Kadareja modified the original setup by substituting Switzerland for Canada,[7] and re-estimating the model with data from 1980 to 1996.[8]

[6] See Wadhwani (2000) for further discussion.
[7] The countries retained were France, Germany, Italy, Japan, Switzerland, the United Kingdom, and the United States.
[8] The most comprehensive reference to the specification and performance of Taylor's model is Taylor (1993). The re-estimation of the entire model and the specification/estimation of the Swiss module are described in detail in Kadareja (2000).

In the stochastic simulations of the model the equations were shocked with random draws from a multivariate normal distribution with the covariance structure estimated from the data. In all cases the simulated outcomes were compared, variable-by-variable, with a baseline simulation of the model assuming no shocks. When comparisons between different monetary policy rules were made, the standard of reference was the root mean square percentage deviation from the baseline path.

Genberg and Kadareja proceeded to investigate the consequences of having the Swiss National Bank react to the exchange rate (relative to the Euro) in addition to inflation and the output gap. The results indicated clearly that some leaning-against-the-wind of exchange rate changes is always better than free floating, regardless of the relative weight put on output and inflation in the overall loss function, α in equation (2). How much exchange rate smoothing is optimal depends on this relative weight, however.

It is important to keep in mind that the Genberg-Karadeja results were obtained under the assumption that the SNB did not observe the underlying shock to the economy. Rather, the central bank simply reacted to the observed change in the inflation, output gap and the exchange rate. Had the authorities been able to distinguish shocks to asset markets from shocks to goods markets, a more sophisticated strategy, whereby the SNB reacts differently to the exchange rate depending on the nature of the underlying shock, would have been preferred.

These results are clearly consistent with those obtained using the Batini and Nelson model. In both cases we conclude that the results depend critically on the source and relative importance of the shocks that are hitting the economy. It is important to emphasize, however, that the Genberg-Kadareja results indicate that a policy of leaning against the wind would have been desirable given the estimated distribution of shocks over the 1980-96 period. (More on this in section 2 below.)

2. Selected opinions in the recent literature.

Not surprisingly, our view that monetary policy should react to asset price misalignments has generated responses from other economists, e.g. Professors Bernanke and Gertler, and Drs. Batini and Nelson have produced simulation results that, at first sight, do not seem to support our view.[9] In this section we review their studies in an effort to determine why there is an apparent

[9] See Bernanke and Gertler (2001) and Batini and Nelson (2000).

disagreement. Our conclusions are straightforward. The relationship between movements in equity prices and exchange rates on the one hand, and inflation and output on the other, depend critically on the underlying sources of shocks to the economy. It is therefore important that monetary policy does not react mechanically and in the same way to all changes in asset prices. Judgment needs to be exercised in reacting to exchange rates changes and share price movements just as it has to be in the interpretation of and reaction to fluctuations in the estimated output gap. Some believe that there is little hope of being able to infer anything from asset price movements that is useful for monetary policy purposes, partly because asset prices are so volatile and partly because central banks do not possess more information about equilibrium valuations than the private sector.[10] For reasons that we explained in some detail in CGLW and that we will summarize below, we believe that central banks can improve macroeconomic performance if they judiciously incorporate information in asset prices in their decisions on monetary policy.

A similar conclusion emerges from a recent paper by Professors J. Stock and M. Watson on the information content in asset prices for inflation forecasts.[11] As we stressed in CGLW, it is difficult to find univariate relationships between asset price movements and future inflation that are stable across countries and over time. The reason presumably is that such relationships depend both on the institutional structure of an economy and on the shocks that were experienced during the historical episode in the recorded data. Again, the implication is that monetary policy cannot be based on a mechanically fixed reaction to all asset price movements, but instead must depend on whether current asset prices can be justified by underlying fundamental determinants or are the results of misalignments due to portfolio shifts.

In the last part of this section we take note of the analysis in the 2001 Annual Report of the Bank for International Settlements which takes a sympathetic, if not openly supportive, view of the belief that monetary policy can have a role to play in reducing the imbalances caused by occasional misalignments in asset prices, especially in emerging markets.

[10] In his comment on our argument Mishkin (2001) brings up these same points. In addition he erroneously claims that our arguments imply that central banks should target asset prices. As we emphasize at the outset, this is definitely not the case.
[11] Stock and Watson (2000).

2.1 Responding to asset price bubbles in simulation models.

The conclusions in CGLW are, in part, based on results from simulations of two theoretical macroeconomic models, Batini and Nelson's minimal open-economy model in which the exchange rate plays an important role in the transmission of monetary policy, and Bernanke and Gertler's somewhat larger closed-economy model in which credit markets play a crucial role in the monetary transmission process. Two recent papers by the authors of these models reconsider the issue of what role asset prices should play in the formulation of monetary policy. In this section we review the conclusions of these papers and relate them to our own.

2.1.1 *Batini and Nelson (2000): Reacting to the exchange rate may be counterproductive.*

Recall from section 1.2.2 that the Batini-Nelson model we used for our simulations is a three-equation model of an open economy that determines the rate of inflation, the level of output, and the exchange rate. The three equations are an aggregate demand relationship in the form of a forward-looking IS curve, an expectations augmented (new) Phillips curve that serves as an aggregate supply relationship, and an uncovered interest parity condition linking domestic and foreign interest rates with the expected rate of change in the exchange rate. Shocks to aggregate demand, aggregate supply and the interest parity condition lead to fluctuations in the endogenous variables. The role of the central bank is to set the domestic interest rate so as to minimize the induced fluctuations in inflation and output around their respective target levels.

Batini and Nelson (2000) introduce an exogenous bubble into the exchange rate process and study how the central bank should react to exchange rate movements in the course of setting the interest rate. Crucially, they presume that policymakers are unable to distinguish whether financial or real shocks are the source of the exchange rate movement. As a benchmark, Batini and Nelson use a policy reaction function in which authorities react only to expected inflation rate and the lagged interest rate itself.

Their conclusions can be summarized in three points:

(i) When the economy is subject only to the three structural shocks (to aggregate demand, to aggregate supply and to interest parity), there is no benefit to be obtained from reacting

explicitly to the exchange rate, so long as policy's reactions to the expected inflation rate and the lagged interest rate are optimal.

(ii) If the exchange rate is also subject to a bubble process in addition to the structural shocks, then a central bank that systematically leans against the wind of exchange rate changes will stabilize output somewhat, but it will destabilize inflation, the interest rate itself, and, surprisingly, the exchange rate. Again, when the responses to expected inflation and the lagged interest rate are re-optimized, there is no gain from reacting separately to the exchange rate.

(iii) If the uncovered interest parity condition is replaced by a more ad hoc, but arguably less empirically flawed relationship, and exchange rate changes have a strong direct influence on inflation, then a policy that responds to the exchange rate over and above the response to expected inflation and the lagged interest rate appears desirable.

How, if at all, should our previous conclusions be modified in light of these results? First, result (i) confirms our view that the appropriate reaction of monetary policy to movements in endogenous variables such as the exchange rate depends on the underlying source for these changes. We illustrated this by showing that leaning against the wind of financial shocks is useful, whereas doing the same in the presence of real shocks is not. Batini and Nelson subject their model to a particular combination of shocks in their simulations. Apparently, when real shocks are sufficiently important, leaning against the wind of exchange rate fluctuations becomes counterproductive.[12]

Conclusion (ii) is surprising. If short-run exchange rate changes correspond to the prediction of the interest parity relationship and the private sector knows that a bubble is present and expects it to last indefinitely, then reacting to the exchange rate may be counterproductive. Batini and Nelson's simulations suggest that, under these circumstances, the interaction between the fully forward-looking behavior of the private sector and the central bank rule creates a type of instability.

We suspect that the result is model-specific, and its interpretation should in any case be tempered by the following considerations. First, is it realistic to assume that the private sector

[12] Recall the simulation results of Genberg and Kadareja, who, on the basis of the estimated distribution of shocks over the 1980-96 period, arrived at the opposite conclusion. Hence, this is clearly an empirical issue.

expects the bubble to last indefinitely even if the central bank is actively attempting to prevent the exchange rate from following the bubble path? It might be plausible to assume that a monetary policy that reacts to exchange rate misalignments affects both the probability of the bubble emerging in the first place and the length of its duration. We suspect that this might reverse their results, though introducing it formally into the simulations is difficult because it would require a model of the formation of the bubble in the first place.[13]

Secondly, perhaps the authorities should not react in a similar way to exchange rate bubbles as they do to normal exchange rate fluctuations? After all, these two types of exchange rate movements are fundamentally different, and so one would think that they should generate different policy responses. We therefore stand by the general conclusion in CGLW that monetary policy reactions to asset price fluctuations should be conditioned by the underlying sources of these movements, and that leaning against the wind can be helpful in certain circumstances

Finally, there is the issue of the empirical failure of the uncovered interest parity condition. Batini and Nelson clearly recognize this as a problem, and so examine the impact of potential substitutes. But what should the uncovered interest rate parity condition be replaced with? As conclusion (iii) reveals, the answer is crucial for the implications we should draw for monetary policy.

2.1.2 *Bernanke and Gertler (2001): Central Banks should not respond to movements in asset prices.*

In a brief article in the May 2001 issue of the *American Economic Review*, Bernanke and Gertler disagree with our view that it is desirable for a central bank to respond modestly to stock market bubbles over and above its reaction to inflation and the output gap. Using a modified version of their 1999 model (which they had kindly provided to us for the simulations described in CGLW), they maintain their judgment that reacting to share price misalignments is counter productive. What accounts for such different conclusions?

We believe that the apparent disagreements are largely due to different assumptions about whether a central bank can distinguish between financial and technology shocks. Let us explain why. The most comparable set of simulation results is the one in which there are no shocks to the fundamentals. In this case Bernanke and Gertler show that reacting to stock prices instead of

[13] See Allen and Gale (2000) for a theoretical model that might be built on.

reacting to the output gap results in inferior economic performance.[14] What this implies is that the central bank should not ignore the output gap and treat share prices as a substitute for other information about the economy. We certainly subscribe to this view, and indeed all our results show that both the output gap and the stock price should be included in the information that the central bank uses. However, we also argued that taking account of share prices in the process of setting monetary policy leads to an improvement of economic performance once inflation and the output gap has been accounted for. We continue to believe that this is the case.

In the simulations underlying their 2001 article Bernanke and Gertler introduce a second source of shocks that influence stock prices.[15] Whereas their original work examined the consequences of non-fundamental bubbles alone, now they have added the possibility of fundamental technology shocks as a source of movements in equity values. We did not study the appropriate policy response to technology shocks in our simulations, but argued on theoretical grounds that the monetary policy response to such shocks should be different from the response to financial shocks. Their simulation results confirm this.

Of course, if we simulate an economy where several types of shocks are present simultaneously, and assume that the central bank has no possibility to differentiate between underlying sources of movements in endogenous variables, then it is quite possible that it is best to ignore certain variables when we formulate policy. This would be the case for example when stock prices have increased, but we do not know whether this is due to a positive productivity shock in the economy or to a financial bubble.[16] There is no controversy here. The bottom line therefore is whether central banks should try to infer from information in financial markets as to what kind of underlying disturbance is affecting the economy. We certainly believe that they should, and that some useful information can be obtained from asset price movements. We shall return to this issue in the final section of the paper.

[14] Here and in the following we are of course assuming that the Central Bank reacts forcefully to the expected rate of inflation. On this there is no controversy.

[15] They also introduce some minor modifications of the model in the latest simulations. These relate to the response of investment to equity prices and the production function in the capital goods sector. But these changes are not responsible for our disagreement. Bernanke and Gertler also now allow the size of the stock price bubbles to be stochastic, while our simulations were, like their earlier simulations, based on fixed-size bubbles.

[16] The same principle would also lead us to be very cautious if the latest statistics showed an increase in output, but we had no way to telling whether that corresponded to an increase in the natural rate of output or not.

2.2 Asset prices, inflation forecasts and monetary policy.

Stock and Watson (2000) present an up-to-date review of the literature on the reliability of econometric forecasts of inflation and output growth for G7 countries, together with some new evidence of their own.[17] What stands out in their study is the difficulty of finding any indicator variable(s) that reliably predict future rates of inflation or growth. The literature contains many papers that report significant in-sample Granger-causal relationships linking some current asset price variable with future inflation, but these relationships frequently prove to be unstable when the sample period is altered. More importantly, in-sample performance usually breaks down in more realistic out-of-sample forecasting tests.

In CGLW we describe a possible reason for the potential instability between asset price changes and subsequent CPI inflation. It is as follows. Equity prices and exchange rates respond endogenously to disturbances that also affect inflation with a lag. Depending on the source of the underlying shocks to the economy, the relationship between an increase in an asset price and future inflation can vary in, both, size and direction. Econometric models measure the average relationship over a particular historical period, and to the extent that certain types of disturbances were dominant in some samples and other disturbances were more frequent in others, the relationship between asset prices and inflation will appear unstable in simple reduced-form models. Uncovering a stable relationship requires finding a way to control for the nature of the underlying disturbance.

In our earlier work we emphasize that monetary policy should react only to asset price misalignments, not indiscriminately to all asset price changes. It is crucial that policymakers differentiate between those asset price changes that are justified by underlying fundamentals and those that are not. It is only the latter that create the potential for significant future volatility.

A common attitude vis-à-vis the role of asset prices in the formulation of monetary policy is that they should be taken into account only in so far as they affect a fixed-horizon inflation forecast. The empirical evidence reviewed and presented by Stock and Watson implies that even this view does not allow us to be agnostic about the underlying source of asset price changes. The reason is that the signal carried by the asset price change about future inflation will be different depending on the source of the underlying disturbance that has created the changes in the first place.

According to this interpretation of the empirical evidence, we seem to be forced to take one of two positions about the role of asset prices in the formulation of monetary policy. On the one hand we can argue that it is hopeless to identify underlying causes of asset price changes, and therefore we will never be able to extract reliable signals from them about future inflation. This is the view that there is no role, direct or indirect (via inflation forecasts) for asset prices in the conduct of monetary policy. Alternatively we can adopt the position that it is possible to extract useful information from asset prices, which can be used both in inflation forecasts and in signaling future volatility. We clearly take the second of these views.

2.3 Financial liberalization, cycles, and policy response in emerging markets.

Chapter VII of the 2001 Annual Report of the Bank for International Settlements argues that liberalization of financial markets "…has increased the scope for pronounced financial cycles…" and that "…the damage caused by financial instability has been particularly serious for emerging market countries." [BIS (2001), p.123] The report contains an informative review of the mechanism by which developments in financial markets can lead to instability in the real sector of the economy. The particular role of property prices is discussed in detail, with an emphasis on its importance for inflation measurement and the problems it can create that require policy response.

The BIS report focuses primarily on the risks posed by financial instability and the regulatory and supervisory measures that can be instituted to make the financial system more resilient. The report is appropriately skeptical in our view of the possibility of using discretionary changes in the regulatory framework as a way of dealing with perceived misalignments as they occur. Although it points to difficulties in identifying asset price misalignments, the BIS report goes on to argue that "…these difficulties need not rule out the very occasional use of monetary policy in this way." (p. 141) In this context it also makes the very useful point that "…the case for a policy response need not depend on the ability of policymakers to make better judgments than the private sector. Rather, the fact that policymakers have different responsibilities and incentives may well mean that they respond quite differently to the same assessment of current trends." (p. 136) For example, market participants who feel that the stock market is "overvalued" may find it difficult to maintain an investment stance that is reflective of their views if the

[17] See also, Goodhart and Hoffmann (2000) for some similar evidence.

"bubble" is relatively prolonged. By contrast, policymakers may well be subject to less **short-termist** performance-related pressure.

3. Where do we stand now?

In CGLW we set out to examine whether there is any role for asset price developments in the formulation of monetary policy. Our analysis was set in a flexible inflation-targeting framework in which the objective of monetary policy is to stabilize the inflation rate and the output level around some attainable target levels. In practice this is usually implemented by the central bank setting its interest rate instrument in response to deviations of an inflation forecast at a chosen horizon (usually somewhere between one and two years) from the target rate and, sometimes, a measure of the deviation of actual output from its potential level. We argued that if the central bank were to react also to estimates of misalignment of asset prices, macroeconomic performance could be improved.

Has subsequent research led us to modify our view in this respect? The short answer is no.

In a very general sense, the differences of opinion seem semantic. Virtually everyone agrees that information contained in asset prices should be taken into account in so far as they have a direct or indirect impact on inflation in the future. Hence, if we take a sufficiently wide view of 'having an impact on future inflation', all the relevant information is already incorporated into the policy decision.[18]

In practice, however, inflation forecasts that enter policy decisions often refer to a fixed horizon, at least in public statements by the central bank. This means that consequences of asset price misalignments that may emerge at some other frequency might not be given sufficient weight in policy decisions. Furthermore, to the extent that asset price changes are included in forecasting equations in the manner suggested in the recent literature,[19] the potential effects of such misalignments may not be captured at all. Yet, as the BIS (2001) argues, financial cycles brought about in part by asset price movements can create real economic imbalances, and it is indeed possible to point to concrete examples where this has occurred. We therefore continue to

[18] This is certainly true if the objective of policy can be expressed in terms of inflation and output stability alone. If stability of asset prices has an independent role, then there might be an additional reason to react to asset price changes. Note in this context that stability of the interest rate is often included in the policy objective in order to rationalize the sluggishness of interest rate adjustments observed in practice. Whatever argument justifies this inclusion could perhaps be extended to other asset prices such as the exchange rate.

[19] For example, Cecchetti, Chu, and Steindel (2000) and Stock and Watson (2000).

believe that monetary policy decisions must be based on more than a fixed-horizon inflation forecast combined with an estimate of the current output gap.

A non-trivial and unresolved issue relates to the communication challenges presented by our proposal. Setting policy on the basis of conscious deviations of expected inflation from target at, say, the two-year horizon could hurt credibility. There is a significant risk that policy becomes less predictable and less transparent, thereby potentially jeopardizing accountability. In practice, attempts to set interest rates at a level that is different from what is necessary to achieve the target level at a two-year horizon must be accompanied by a justification that is explained simply and that commands broad agreement. Policymakers who consciously aim away from their target at a two-year ahead horizon (in order to reduce inflation volatility at other horizons) will attract suspicion if their explanation for doing so is complex and not well-understood, or, even worse, if a significant group of commentators does not agree that aiming away from the two-year ahead target will actually reduce inflation volatility. We recognize these to be critically important considerations when deciding on the implementation of our proposal.

What about the recent simulation results of Batini-Nelson and Bernanke-Gertler? These show clearly that it is important not to react mechanically to all asset price changes regardless of their source. We certainly do not want to quarrel with this view, which is why our original argumentation emphasized the need to identify asset price changes that can be justified by underlying fundamentals and those that can not.[20] This of course requires a certain amount of judgment on the part of policymakers, but that is par for the course. [21]

It has been suggested that central bank officials will never be able to determine whether asset prices are misaligned in the sense we use the term here. After all, the argument goes, markets have incorporated all available information into prices and what do policymakers know that market participants do not?

We find this argument to be specious because it assumes that 'incorporating all available information' automatically eliminates misalignments. But unless strong-form market efficiency holds in practice, this is not the case. Furthermore, our proposal does not call for central banks to respond to small misalignments. We agree that these are difficult to detect and are unlikely to have very strong destabilizing effects in any case.

[20] This is not unique to asset prices. For example, an increase in inflation that is due to a fall in aggregate supply should in principle be treated differently from the same increase due to an increase in aggregate demand.

On the other hand, there are clearly times when egregious misalignments exist. Recent examples include Japanese stock and land prices in 1989, and the NASDAQ in late 1999 and early 2000. While some portion of these high price levels may have been justifiable based on fundamentals, few people would deny that a significant component was due to asset market disturbances. Ultimately, in terms of reducing inflation and output volatility, it is important that central bankers respond to these large relatively 'obvious' misalignments.

As we have already discussed, central bankers might find it easier to respond to long-lived bubbles that generate these 'obvious' misalignments as compared to the skeptical market participants who may have been steadily impoverished by the longevity of the bubble.

While we agree that it is difficult to estimate the degree to which an asset price is misaligned, it is not obvious that it is easier to estimate an output gap or the NAIRU, measures that are commonly used in helping frame monetary policy. Indeed, one could argue that assumptions about asset price levels, and the extent of misalignments, are essential inputs into the process of estimating something like an output gap. The output gap estimate depends importantly on underlying productivity growth (which affects prospective potential output) and the equilibrium equity risk premium (which affects corporate investment, which in turn, affects trend growth) – the same uncertain inputs that are to be necessary to estimate the degree of stock price misalignment. Moreover, one's estimate of the prospective output gap also depends on what is likely to happen to the actual level of output, which, through the standard wealth effect, depends directly on the degree to which asset prices are misaligned. As we see it, if you cannot estimate asset price misalignments, you cannot forecast inflation either.

Putting our argument slightly differently, we are not persuaded that one should ignore asset price misalignments simply because they are difficult to measure. The standard response to noisy data is to use econometric methods to extract the signal. This is common practice in the use of statistics in a policymaking environment. If central bankers threw out all data that was poorly measured, there would be very little information left on which to base their decisions.

Two additional points have at times been suggested in arguing that asset prices should be ignored. The first is based on the view that there are times when different asset prices give conflicting signals. For example, housing prices may suggest potential inflationary pressures, whereas movements in the exchange rate point in a different direction. This clearly complicates

the inference one might be able to draw from asset prices, but it does not imply that one should ignore them. Instead, it means that one should look at *all* relevant asset prices.

Another argument notes that asset price misalignments in small economies may be caused mainly by developments in financial markets elsewhere, and that monetary policy in the small country will be unable to alter them significantly. Again, this does not invalidate our proposal. We are not arguing that monetary policy should target any particular level of share prices, and so the fact that these prices are determined mainly abroad does not prevent reacting to them. In addition, the potentially destabilizing effects of asset price misalignments can occur regardless of what causes these misalignments. Economic policy therefore must be ready to respond.

The conclusions we reached in 'Asset Prices and Central Bank Policy' therefore remain. Monetary policy that pursues an inflation-targeting strategy should attempt to identify and respond to asset price misalignments. Counter-arguments claiming that it is difficult to interpret asset price movements are correct, but they apply to other aspects of inflation targeting as well, so they do not eliminate the case for taking account of asset price misalignments in the conduct of monetary policy.

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