What Do Asset Prices Tell Us about the Future?

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IT IS FAIRLY OBVIOUS THAT IN MARKET-BASED ECONOMIES PRICES ACT AS A CONSTRAINT ON INDIVIDUAL BEHAVIOR. GIVEN LIMITED RESOURCES, PRICES PROVIDE A MEANS BY WHICH GOODS AND SERVICES FLOW TO THOSE MOST WILLING AND ABLE TO PAY FOR THEM. BUT IN MANY SITUATIONS PRICES PLAY AN ADDITIONAL ROLE IN THE ECONOMY—THAT OF SIGNALS CONCERNING THE FUTURE STATE OF AFFAIRS.

Consider, for example, the routine betting that takes place daily on horse races. Before the race starts, no one knows for sure which horse will win. Suppose that $1 would get you $2 if you bet on Streak of Lightning to win while the same $1 would pay you $20 if bet on Molasses to end up in the winner's circle. Stated differently, the "price" of a stake in Molasses is much less than that of the same stake in Lightning because bettors view a future in which Molasses wins as much less likely than one with Lightning wearing the flowers.

In the same way, prices, or variables derived from prices, aggregate bettor views concerning what they think will happen in the future—in this case, which horse will win the race. Purchasing securities is much like horse betting. Payment today entitles one—one hopes—to cash flows in the future. Logically, the larger future cash flows are expected to be, the more one is willing to pay. But securities are just claims against real assets; so, the logic goes, if investors start bidding up the prices of securities, they must do so because they, collectively, anticipate a future with economic growth stronger or less volatile than what they expected before the change in prices.

Indeed, one can carry the argument further by saying that the price system, if operating properly, should direct resources to their best uses, on the basis of collective information, some of which is public knowledge and some of which is known only to subsets of the population. Prices act as signals, informing decision makers where resources should go.

This argument regarding the informational role of prices is articulated eloquently by Friedrich Hayek: "We must look at the price system as . . . a mechanism for communicating information if we want to understand its real function. . . . The most significant fact about this system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action. . . . [B]y a kind of symbol, only the most essential information is passed on" (quoted in Grossman 1981, 555). But if the price system has this ability to be a kind of shorthand for society's collective knowledge of the future, then prices today, whether relative to money or relative to each other, should reveal something regarding the private information held by investors concerning the future state of the economy.

The purpose of this article is to provide a review of the discussion regarding the informational role of financial asset prices and interest rates and whether this type of information can be used to forecast macroeconomic variables, such as output and inflation. Moreover, accurate forecasts of variables such as these are of the first order of importance to policymakers concerned with taking actions that help to avoid bad economic outcomes rather than simply reacting to events that have already taken place.

The first section discusses what it means for markets to be informationally efficient and when one might expect the price system to act as a literal summary statistic for beliefs regarding the future state of economic affairs. The set of assumptions needed in order for prices to reveal all of the available private information regarding the future turns out to be quite restrictive.

Following the discussion of the theory is a review of the literature regarding whether the prices of financial assets today provide any information at all regarding future realizations of important economic variables like consumption, output, and inflation and whether this information is obtainable from other public sources. This section also contains information on the literature that seeks to examine whether certain financial asset prices can be used to forecast directional changes in the economy—in particular, whether prices can help forecast recessions. The evidence about the information in prices is quite mixed: Financial prices appear to contain some information regarding future realizations of inflation and output, but the bottom line appears to be that either (a) financial asset prices are very noisy signals or (b) economists have not devised a good general algorithm for use in extracting the desired information.

Two examples of how information from financial assets can be used in the making of monetary policy follow the review of empirical studies. A summary and discussion of potential benefits and costs to policymakers and others contemplating the use of prices, or changes in prices, as inputs in their deliberations concludes the discussion.

When Are Prices Informationally Efficient?

Economists have long realized that, in making decisions, producers and consumers may combine their limited personal information concerning the future with whatever they might glean from prices. However, it is generally acknowledged that it was Muth (1961) who first suggested one way in which this combining of information takes place. Muth studied the properties of an economy in which individuals—in this case producers—make decisions regarding production based on what he called the rational expectations hypothesis.[1]

This breakthrough profoundly influenced work in many fields of economics. While applicable to problems in many areas of economics, the idea that prices contain information about collective private knowledge regarding the future has received a great deal of attention by students of financial markets, and these markets are the focus of this article.

Given the available evidence, it is difficult to argue that monetary policymakers should give more weight to financial market variables in their quest to make "good" decisions.

A market is said to be fully efficient in an informational sense when prices work as a perfect shorthand for society's collective knowledge regarding the future, as Hayek suggested many years ago (Grossman 1981). When will prices have this remarkable property? In an important article, Grossman (1976) showed that, if there are no transactions costs or other financial frictions in the market, today's price of a financial asset will perfectly aggregate all private forecasts of tomorrow's price.[2] Thus, to the extent that financial assets are claims on future output, financial asset prices today should provide some information regarding the future of the economy.

While later authors' findings have altered or weakened Grossman's assumptions, it seems that theirs are still very restrictive requirements, ones not likely to hold in practice.[3] In fact, in a well-known article, Grossman and Stiglitz (1980) look at an economy that would, if information were costless, be informationally efficient in the sense used earlier. However, they show that if information is costly to acquire, prices cannot reveal everything. This finding makes sense because, if prices did reveal everything, there would be no incentive to collect information.[4] This paradox helps clarify

1. *In Muth's example, production takes time and production costs are known but future demand is not known. Producers interested in maximizing expected profits equate marginal costs to expected future prices. This assumption in turn generates aggregate supply. Equilibrium occurs when the price reflected in aggregate supply equals that used by the individual producer.*
2. *The key additional assumption is that investors have constant absolute risk-aversion preferences.*
3. *Other conditions that lead to the property of "fully revealing" prices are given by Grossman (1981) and Madrigal and Smith (1995), among others. In particular, constant and absolute risk aversion is a subset of the preferences Madrigal and Smith used.*
4. *Jackson (1991) provides one means of resolving the paradox by dropping the assumption that every individual trader acts as if his/her demand for shares does not influence price.*

the limits to which the notion can be pushed that prices provide all anyone needs to know about the future for purposes of planning today.

But even if prices can provide no crystal ball foretelling the future, it still seems reasonable to suppose that individuals with information regarding the future may look to prices for additional information. In this case, prices provide a summary for some, but not all, of the information dispersed throughout the economy, and prices are said to be partially revealing of the information economic actors hold.

While such a less than perfectly revealing price system raises potentially deep questions regarding what constitutes the best framework for organizing economic activity, the purpose of the next section is simply to provide a review of the evidence regarding two questions. First, do financial market prices (or variants of prices—for example, yields) provide reliable information concerning future movements in inflation or output? This is a question of potential interest to individuals and policymakers. Indeed, some ex-policymakers (for example, Johnson and Keleher 1996) have called for using only financial asset and commodity prices as guides for making monetary policy. The evidence regarding work related to a second question—do today's financial prices help to forecast recessions?—is also selectively reviewed.

According to theory, financial asset prices should aggregate at least some information regarding the future realizations of economically important variables.

Are Financial Asset Prices Useful in Forecasting Inflation?

As is often the case, the answer to this question depends on whom you ask and, to some degree, what period of time he or she looks at in the search for evidence. Given that the published literature in this area is voluminous, the review provided here is necessarily incomplete.[5]

The notion that certain financial prices or interest rates set today are capable of forecasting future values of inflation goes back at least to work by Fama (1975), who draws on earlier work by Fisher (1930) regarding the relationship between inflation and interest rates. Fisher's basic idea was that, whatever factors were involved in determining the growth of the real sector, rational investors should not suffer from what he called money illusion. Money illusion would occur, for example, if an investor is willing to pay more for a security if the money payoff is doubled but each dollar is worth only half its original value. The absence of money illusion implies, therefore, that, if a security pays off at some time in the future in money, an investor will offer a lower price (demand a higher interest rate) if he or she thinks the money will be worth less in the future in terms of its purchasing power over goods and services.

This idea led Fisher to conclude that nominal (or money) interest rates should reflect the sum of (a) the return demanded by investors in the absence of inflation, the so-called real rate of interest, and (b) the anticipated rate of inflation. In particular, higher anticipated inflation should lead investors to demand higher rates today on securities that pay off in money in the future. For example, if investors demand an inflation-free return of 2 percent and anticipate that the inflation rate over the coming year will be 3 percent, they will, if they are unconcerned about risk, demand a nominal return on bonds of roughly 5 percent.

Assuming for the moment that investors are concerned only about expected inflation, this idea can be stated in equation form as

$$r = R + I^{expected}, \qquad (1)$$

where r is the money or nominal rate of interest, R is the real (or zero-inflation) rate of interest, and $I^{expected}$ is the inflation rate expected over the coming period.[6] At any time the interest rate on government securities, r, is known. So, in order to solve equation (1) for $I^{expected}$, some estimate of R is needed. Notice, however, that if R is assumed to be a constant and if actual future inflation equals expected inflation plus noise, one can run a simple regression of the form

$$I^{future} = \alpha + \beta r + e, \qquad (2)$$

where I^{future} is the actual future inflation rate, e is an error term with mean zero, and, if the Fisher hypothesis is correct and R is a constant, $\alpha = -R$ and $\beta = 1$.

Note that this formulation of the proposed relationship provides a simple example of what is called the joint hypothesis problem. If, for example, the coefficients do not turn out as expected, one does not know whether it is because the Fisher hypothesis is false or R is not constant and varies in a way that is correlated with the unobservable expected inflation rate.

Using monthly data from the mid-1950s to the early 1970s, Fama finds that interest rates set today on one- to six-month Treasury bills provide statistically reliable forecasts of inflation one month in the future (although his estimates of β are substantially less than one for some of the longer-term bills used in the study). While this work has been criticized along a number of dimensions, Fama's approach is similar to later models that use regression-based methods to explain the fluctuations in future values of inflation and interest rates.[7] Mishkin (1990) provides an early example of this extension. He argues that the difference between long- and short-term nominal rates should provide a forecast of changes in the inflation rate. For example, if r_1 and r_2 denote per period nominal rates with maturities of one period and two periods, respectively, it should be the case, using equation (1), that

$$\begin{aligned} r_1 &= R + I_1^{expected} \\ r_2 &= R + I_2^{expected}, \end{aligned} \tag{3}$$

where $I_1^{expected}$ and $I_2^{expected}$ represent per period inflation expected over the next period and two periods, respectively. So, using equation (2), it should be true that

$$I_2^{future} - I_1^{future} = \alpha + \beta(r_2 - r_1) + e. \tag{4}$$

Since R is assumed constant, $\alpha = 0$ and $\beta = 1$ are the relevant values to use for testing hypotheses. Mishkin finds that regressions of this sort are reliable for forecasting changes in inflation up to three years in the future. However, the percentage of the total variation in inflation that can be explained using this approach is typically small (3 percent to 7 percent).[8] Moreover, using more sophisticated econometric techniques, Mishkin (1992) provides evidence that any statistically significant relationship between nominal interest rates and subsequent inflation occurs only during periods in which both series display a trend. Thus, the bottom line from these regression-based tests that start by assuming a constant real rate is that nominal rates provide some, but not much, information regarding future inflation.

In today's markets there is an alternative to assuming that the real rate of interest is a constant or is generated by some other assumed process. If, for example, an inflation-adjusted bond with the same maturity as the nominal government security is traded, its rate can be used as a proxy for R. Subtracting this figure from r provides a direct estimate of $I^{expected}$ if the Fisher hypothesis is true and investors are unconcerned about risk. Indeed, the U.S. Treasury now issues, roughly speaking, exactly such bonds, so-called Treasury inflation protection securities (TIPS). These bonds pay a fixed rate plus whatever the inflation rate turns out to be, yielding essentially a known real return.[9]

For example, on February 9, 1999, a TIPS maturing in July 2002 was yielding 3.7 percent on an annual basis. An ordinary nominal government security maturing in the same month was showing a yield of 4.9 percent. So, with this simple approach, the estimate of inflation for the next three and a half years is 1.2 (4.9 – 3.7) percent per year.[10]

This basic approach to forecasting future inflation is employed by Barr and Campbell (1997). They look at data from the United Kingdom on indexed and nonindexed government bonds and note that, like TIPS, the U.K. index bonds are adjusted for lagged values of inflation. By assuming a particular process for the unobservable expected real rate and expected inflation series and using

5. *One obvious limitation comes from the fact that almost all of the studies reviewed deal with data from only the United States. For an example of how one financial variable, the difference between long-term and short-term rates, fares in forecasting similar variables in other countries, see, for example, Estrella and Mishkin (1997).*
6. *This calculation is an approximation that ignores compound interest. Since investors are assumed to want both their principal and interest protected against inflation, and because they care about the price of money in terms of goods (not goods in terms of money), a more technically proper specification is given by* $1+ r^{nominal} = (1+ r^{real})/(1+ p^{expected})$, *where* $p^{expected}$ *is the expected percentage change in the purchasing power of money. To get equation (1), cross-multiply by* $1+ p^{expected}$ *to get* $1+ (r^{nominal}) + (p^{expected}) + (r^{nominal})(p^{expected}) = 1+ R$. *Assuming* $(r^{nominal})(p^{expected})$ *is small, this result can be written as* $(r^{nominal}) = R - p^{expected}$. *Finally, since* $p^{expected}$ *is approximately equal to the minus of* $I^{expected}$, *one gets equation (1).*
7. *See, for example, Joines (1977), Carlson (1977), and Nelson and Schwert (1977). In particular, Joines and Carlson argue that other variables known today—the wholesale price index and unemployment, respectively—contain information about future inflation not incorporated in today's interest rate. Nelson and Schwert provide convincing evidence that the real rate of interest is not a constant. In his reply Fama (1977) argues, essentially, that these variables are of, at most, "second order" in importance and that his original conclusion, that interest rates summarize most of the information in the market concerning future inflation, still has validity.*
8. *This approach to forecasting inflation has been extended by Frankel and Lown (1994). These authors allow for short-term variation in the real rate,* (R). *Their results are somewhat stronger than Mishkin's (they can be no worse since Mishkin's setup is a special case of Frankel and Lown), but the biggest portion of variation in actual inflation remains unaccounted for.*
9. *Technically, the rates are adjusted for the inflation rate with a lag of about eight months. Barr and Campbell make adjustments for this lag in their attempt to find better forecasts for inflation than those currently used in the literature.*
10. *While these calculations are straightforward, there are some potential drawbacks to using TIPS for purposes of estimating the real rate. The first involves the fact that the liquidity in the market for TIPS is much lower than the liquidity in standard government securities. The result may be an excessively high estimate of the real rate of interest due to the extra yield required to compensate for low liquidity. The second is that with TIPS, unlike with standard bonds, one must pay taxes on the accrued principal, even though the payment of principal does not occur until the maturity of the bond.*

data from nominal and index bonds of multiple maturities, they are able to adjust for these lags. Barr and Campbell go on to provide evidence that their measures of expected inflation provide much more reliable forecasts of inflation one year ahead than forecasting models like Fama's based solely on nominal interest rates.[11]

Both of the examples discussed thus far have implicitly assumed that investors are concerned only about expected inflation and expected returns, not about inflation risk. However, if investors are concerned about such risks, they may demand a higher return on the nonindexed bond than that suggested by equation (1). In particular, if they demand a premium for this inflation risk on the nominal bond, then equation (1) would be replaced with a generalized version of the Fisher hypothesis. Mathematically,

$$r = R + I^{expected} + I^{premium}, \quad (5)$$

where $I^{premium}$ represents an additional return to compensate investors for inflation risk.[12] Although in principle this term could be positive or negative, the point is that, even armed with index bond rates, if equation (1) is used when equation (5) is correct, one will get either an overestimate (if $I^{premium} > 0$) or an underestimate (if $I^{premium} < 0$) of $I^{expected}$.[13]

Financial Asset Prices as Predictors of Real Sector Variables

Individuals and at least some policymakers are interested in more than just forecasts of inflation. They may also be interested in whether or not asset prices contain information regarding variables like consumption and output. For example, one of the classic articles in this area involves Hall's (1978) test of the permanent income hypothesis. Roughly speaking, the permanent income hypothesis states that consumption should be a function of permanent income (or, when discounted, permanent wealth) and should not depend on transitory income measures. Hall finds that, in addition to current real consumption, the current level of real stock prices is useful in forecasting future consumption.

Hall provides a test of this idea by formulating a simple specification of investor preferences and assuming a constant real rate of interest.[14] Under these circumstances he shows that, if the permanent income hypothesis is true, only current consumption, and not current or past measures of income, should be useful in forecasting future consumption. Consistent with his hypothesis, Hall finds no statistically significant relationship between current and past measures of income and future consumption. However, he does find that the current level of real stock prices is useful in helping to explain variations in the level of consumption up to four quarters ahead.

The idea that changes in stock prices cause changes in permanent income and, therefore, changes in consumption is not universally supported by existing data, as discussed below. However, many policymakers have at least implicitly acknowledged their belief in some link between stock prices, wealth, and spending. For example, at a meeting of the Federal Open Market Committee (FOMC), Federal Reserve Chairman Alan Greenspan observed that "potential movements in those [equity] prices posed risks on both sides of the most likely forecast: A future substantial increase would bolster wealth and spending, but a sharp decline also could not be ruled out" (FOMC 1998, 6).

Other authors have argued that interest rates or spreads do a much better job of forecasting variables like consumption than stock prices. Indeed, Mankiw (1981) illustrates that in an expanded version of Hall's model it is lagged values of an interest rate (the prime rate) that help forecast consumption while stock prices have almost no forecasting power.[15]

While Mankiw specifically discusses his results in the context of Hall's model, other authors also have found the levels of certain interest rate series to be helpful in forecasting real sector macroeconomic variables. For example, Sims (1980) showed that the current commercial paper rate explained a great deal of the variation in future values of industrial production (as far ahead as four years).

This result is somewhat puzzling from the point of view of traditional asset-pricing models since in these models it is the level of real, not nominal, interest rates that should contain information regarding consumption growth. The idea is that, if investors want to smooth their consumption over time, rising real rates of return are needed to encourage them to give up increasingly large amounts of current consumption for future consumption. However, to the extent that this process works, high current rates should indeed forecast high consumption levels later.

A number of other authors have also investigated the link between interest rates and real output. While the list of works is voluminous, Bernanke (1990) provides a valuable summary of the early work in this area. He concludes that a number of money market rates (for example, fed funds, three-month T-bills, and six-month commercial paper rates) are useful in helping to explain the variation of such variables as the growth rate in industrial production and housing starts.

Interestingly, Bernanke, following up on work by Stock and Watson (1989) on leading indicators, finds that the spread (or difference) between certain money market rates is an even better indicator of the future performance of the economy than any single interest rate variable measured in levels. In fact, he argues that "the best single predictor among interest rate variables has been found to be the spread between the commercial paper rate and the Treasury bill rate" (1990, 52). He further tests to see if this information is not contained in other easily available data and finds that, even after controlling for things like the growth in money, this spread remains statistically significant.[16]

Thoma and Gray (1998), on the other hand, argue strongly that financial variables do not provide any predictive power in terms of forecasting future real activity, specifically the growth in industrial production. First, they focus their attention on whether these financial variables can predict real activity beyond the period of time used to estimate the model. This approach is generally viewed as the true test of a forecasting model. Second, they argue that much of the predictive power of the financial variables comes from one or two observations during the time periods used in these earlier studies. These results cast severe doubts on the idea that interest rates or interest rate spreads contain information regarding future movements in real sector variables that is not contained in other public information.

Can Financial Variables Predict Recessions?

While forecasting turning points in the economy is a notoriously difficult task, the literature on this topic has expanded rapidly over the past ten years or so. The idea involves asking not whether financial variables are capable of forecasting the actual growth of, say, real gross domestic product (GDP) or industrial production but instead whether they have any power in predicting the likelihood that the economy will fall into official recession.[17]

A recent article by Estrella and Mishkin (1998) is representative of this type of work. The authors come to conclusions not unlike those of earlier researchers in the area. Estrella and Mishkin consider a number of variables, both individually and together, to see how well they perform in forecasting recessions over the period from 1959 to 1995. Importantly, the authors use only data that a policymaker or investor would have had at the time the forecast was made; that is, they look only at the out-of-sample performance of their model.

Using indexes of leading indicators, measures of real monetary aggregates, and past values of real GDP, the authors find that these variables provide no additional help in forecasting recessions once one accounts for the slope of today's term structure and the level of stock prices. Indeed, they argue that the difference between the ten-year government bond rate and the three-month Treasury bill rate alone provides reliable information concerning the onset of a recession up to two years in the future. In particular, the authors find that when the difference between these two variables, sometimes called the spread, is higher than average, there is a lower-than-average probability that the economy will enter a recession over some future period. Moreover, while other variables (for example, the level of stock prices and the real value of the monetary base) add marginal explanatory

11. *This result should not be surprising since any reasonable specification of the Fisher hypothesis that does not force the real rate to be a constant will typically provide estimates no worse than a specification that does force the real rate to be time invariant.*

12. *Using a fairly standard economic model in which investors are risk-averse,* $I^{premium}$ *will be positive if inflation is negatively correlated with real output or consumption and vice versa if the correlation is positive. The intuition is that if the correlation is negative, real returns on nonindexed bonds will be low just when the investor has the lowest level of wealth or consumption. Thus nonindexed bonds are a bad hedge against recessions and therefore require a premium relative to the index bond. Notice also that it is not the volatility of inflation per se that results in the premium being nonzero but rather its covariation with what investors really care about—their real wealth or consumption. A discussion of this issue can be found in, for example, Shome, Smith, and Pinkerton (1988).*

13. *The problem here involves the fact that one needs an independent estimate of either* $I^{premium}$ *or* $I^{expected}$ *in order to solve for the other. Shen (1998) shows how* $I^{premium}$ *can be estimated using independent (survey-based) measures of* $I^{expected}$*, while Ireland (1996) shows how to generate forecasts of future inflation by using asset pricing theory to put bounds on the risk premium* ($I^{premium}$).

14. *Hall essentially assumes that investors have quadratic utility functions. This formulation implies some predictions that appear to be at odds with casual observation; for example, if investors have quadratic utility, a result contrary to casual observation, wealthier individuals will invest absolutely less in risky assets than their poorer neighbors. Nelson (1985) provides evidence that, if one makes more realistic assumptions regarding preferences, current and lagged income do have predictive power in forecasting the percentage change in consumption.*

15. *Mankiw allows for durable goods and depreciation in his model, and Hall does not. This difference has implications for the observed consumption process if the permanent income hypothesis is true.*

16. *Weber (1998) provides a model designed to provide an economic rationale for why this paper bill spread should be able to forecast consumption growth. Importantly, his model requires that holdings of government debt be included as an independent argument in the utility function. Presumably, this government debt provides some services (beyond income) not provided by private assets.*

17. *A recession is defined by the National Bureau of Economic Research (1999) as "a recurring period of decline in total output, income, employment, and trade, usually lasting from six months to a year" (1999, 1).*

power one to three quarters ahead, the spread variable alone is, they claim, capable of forecasting recessions as far ahead as eight quarters (two years).

One problem with using the slope of the yield curve, or the paper bill spread discussed below, as a forecaster of recessions is that the short-term government bill rate itself may be heavily influenced by the current level of the federal funds rate. The potential problem arises because the FOMC has historically used the funds rate as their intermediate target in the conduct of monetary policy. However, Estrella and Mishkin (1998) note that adding a variable that reflects the stance of monetary policy does not alter the predictive ability of the slope of the yield curve.

Other authors (for instance, Friedman and Kuttner 1998), using similar post–World War II data, have argued that the spread between the short-term commercial paper (a private IOU) and Treasury bills plays a similar role to that of the difference between yields on long-term and short-term government bonds. Contrary to the bond/bill spread, however, a high (relative to average) value of the paper bill spread (the commercial paper rate minus the Treasury bill rate) today would suggest a high chance of being in a recession two to three quarters into the future.

However, this spread failed to forecast the last U.S. recession, in the early 1990s. More generally, Estrella and Mishkin note that the predictive power of the paper bill spread falls off rapidly as the forecast horizon gets longer. In fact, they argue that, when combined with the Treasury bond/Treasury bill spread, the paper bill spread provides no additional forecasting power, even when the forecast horizon is as short as one or two quarters.

Others, including some policymakers, have taken similar positions regarding the informational role of credit spreads when it comes to forecasting recessions. For example, Poole, discussing credit spreads, clearly states that "in almost all cases historically, spreads widened only *after* a recession was clearly under way" (1998).[18] Poole argues that this finding makes sense in the context of recessions being associated with lower earnings, thus involving higher risk to debtholders. However, there is no presumption here that the holders of bonds anticipated the downturn before the fact.

Making Policy Decisions Based on Financial Data

The conduct of monetary policy involves having ultimate and intermediate targets. Managing (or not) an intermediate target such as the monetary base with the ultimate goal, or target, of price stability is an example often advocated by some policymakers and economists.[19]

Policymakers typically gather information that they hope will give signals regarding the stance of current monetary policy vis-à-vis their ultimate objective(s). Given the earlier selective review of the literature concerning the ability of financial variables to forecast real growth, inflation, or recessions, one might ask if there is the possibility of a more formal linkage between the information in financial market prices and the management of intermediate targets.

This section presents two examples intended to provide an idea of the range of ways that are being put forth for using financial information in the conduct of monetary policy. Both discuss policy decisions in the context of short-term interest rate targeting on the part of the central bank.[20]

The first example comes from a paper by Taylor (1993). Taylor argues that a specification like the one below explains the behavior of the monetary authorities well, at least since World War II. In particular, Taylor provides evidence that if the actual fed funds rate, r^{actual}, is greater than the target rate, r^{target}, then the monetary authorities have on average moved to reduce the fed funds rate and vice versa when $r^{target} > r^{actual}$. The target rate is calculated as

$$r^{target} = R + I^{actual} + .5(I^{actual} - I^{target}) + .5(o^{gap}), \quad (6)$$

where R is an estimate of the long-run real rate of interest, I^{actual} is the current actual inflation rate, I^{target} is the target inflation rate, and o^{gap} is a measure of the output gap.[21]

Suppose that the central bank adopted this approach as a policy rule, believing, for example, that on average their past behavior was optimal in some sense and therefore should be continued. How could financial information be used in this context beyond being used to observe the current actual fed funds rate? At a minimum, financial market information can be used to provide an estimate of the real rate of interest. One approach would be to estimate R from a simple historical average of $r^{actual} - I^{actual}$. A somewhat more ambitious use of financial information would be to let the yield on a TIPS serve as an estimate of R. In any case, this example illustrates how financial information can be used, along with other information, in the formulation of monetary policy.

A less formal, but much more ambitious, role for information extracted from financial data is proposed by Johnson and Keleher (1996). They argue, given their assumed objective of price stability, for manipulating the intermediate target, the fed funds rate, on the basis of information obtained from three primary sources: the yield curve, the value of the dollar, and commodity prices. The first two variables clearly fall under the rubric of financial market data. Johnson and Keleher are less formal than others in developing hard and fast rules, but they do outline scenarios under which they believe these data provide unambiguous signs that policy should be changed in the form of either an increase or a decrease in the fed funds rate.

Their basic idea is straightforward. Suppose, for example, that the policymaker observes increasing commodity prices, a steepening yield curve due to increasing long-term rates, and a depreciating dollar. Johnson and Keleher interpret these facts, taken together, as an unambiguous signal that policy is too loose; that is, the fed funds rate is below what they call the natural rate, and policy should therefore become tighter (operationally, there should be an increase in the fed funds rate).

The logic is that the rise in long-term rates indicates that participants in bond markets expect interest rates to increase in the future. In light of the earlier discussion of the Fisher hypothesis, this increase in rates suggests that bond traders view the future to be associated with increasing inflation. Moreover, if the dollar is depreciating with respect to other currencies, traders must fear that the dollar will suffer more depreciation (in terms of purchasing power) in the future when compared with other currencies.[22] Finally, rising commodity prices are taken as further evidence that the purchasing power of money is declining, contrary to the stated goal of price stability. The converse set of facts would indicate that policy is too tight and should be loosened by instituting a decrease in the fed funds rate.

Johnson and Keleher admit that there will be situations in which the information obtained from all three sources, taken together, provides ambiguous signals concerning the proper management of the intermediate target. For example, as of this writing (June 1999), the following facts are known. First, the level of long-term rates is lower than it was a year ago, but the yield curve is steeper. Moreover, according to the Federal Reserve Bank of Atlanta Dollar Index, the dollar has remained relatively unchanged over the past year. Finally, most commodity price series have declined over the past year. Johnson and Keleher (1996) argue that the information from the level and structure of interest rates is a signal that policy is "appropriately easy" (194–95), but the combination of declining long-term bond yields and declining commodity prices is evidence that policy is too tight. Combining these facts with the relatively neutral information from the dollar, a policymaker following this approach would be forced to conclude that either these mixed signals are offsetting and the fed funds rate is currently at the right level or that he or she needs to look for more information.

The point here is that this market-based approach to monetary policy, like other approaches, sometimes presents mixed information signals. The policymaker may in turn need to look at other sources of data in the attempt to make the best decision regarding the level of the intermediate target, in this case the fed funds rate.

Conclusion

What do asset prices tell us about the future? Apparently the answer to this question depends on what one wants to know regarding the future and who is asked the question. In principle, financial asset prices should aggregate private information concerning the future values of variables like output and inflation. To the extent that market participants do not consistently make biased forecasts of the future, one should be able, in principle, to extract this information from asset prices. Finally, to the extent that the information in prices is not redundant, policymakers could use this information as input to help in determining monetary and fiscal policy.

This article provides a brief review of the theory regarding the extent to which asset prices aggregate information. It then presents a selected review of the evidence regarding the ability of financial asset prices to forecast inflation, real output or consumption, and recessions. Finally, two examples showed how financial information could be used in the management of intermediate targets in the area of monetary policy.

Reviewing the extant theoretical literature suggests that financial asset prices would reflect some private information, although the conditions sufficient to guarantee that prices reflect all available information were quite restrictive. Thus, even before examining the data, one should not have expected financial asset prices to be the only source of information needed to forecast future changes in output and prices.

By and large, the empirical work reviewed here can be viewed as confirmation of this intuition. In particular,

18. The credit spreads examined by Poole involved longer-maturity securities than those studies that employ the paper bill spread. However, the logic regarding why the spreads change is the same in both cases.

19. A constant money growth rule, such as that attributed to Friedman (1968), is a passive management rule of the intermediate target with the ultimate outcome being price stability if the money growth rate is set equal to the long-term real growth rate in the economy.

20. This focus is not meant to imply that this target is necessarily the most efficient intermediate target. Addressing this issue is well beyond the scope of this article. Interest rate targeting is chosen for the examples at least in part because of its historical importance in the conduct of U.S. monetary policy.

21. The variable o^{gap} measures the percentage deviation of real (inflation-adjusted) GDP from its potential.

22. The authors note that this comparison is most useful when made with respect to other currencies for which the stated goal of monetary policy is also price stability.

some authors have argued that variables such as the level of short-term interest rates or the spread between the rates on private commercial paper and Treasury bills have had significant power in forecasting inflation and output and that these same variables could have been employed to forecast recessions. However, even these authors acknowledge that the predictive power of financial variables has declined over the past two decades.

Other authors have argued that the predictive power of financial variables found in the data is an illusion. They argue that these financial variables have had no forecasting power when the forecasts involved data outside the period used to estimate the model. Moreover, they argue that the good performance of financial variables, even in sample, was due to a few extreme data points that made it appear that there was some relationship where on average none existed.

Despite the controversy regarding the evidence, there have been a number of proposals put forth regarding how financial data could be used in the formulation of monetary policy. Proposals have ranged from suggestions for using financial data in fairly mechanical ways, like estimating the unobservable real rate of interest, to ones that place financial data at the forefront of information sources to be used in policy formulation.

Given the available evidence, it is difficult to argue that monetary policymakers should give more weight to financial market variables in their quest to make "good" decisions, whether "good" means price stability or hitting some combination of inflation and real growth targets.

What can be argued is that, according to theory, financial asset prices should aggregate at least some information regarding the future realizations of economically important variables. To the extent that empirical researchers have had, at best, mixed success in documenting this linkage, future research should move down one of two avenues that, it is hoped, will converge at some point in the future.

The first would involve explaining why the theory regarding the informational role of financial assets is logically incorrect and working to make it logically correct. The second avenue of research would be to argue that the theory is correct and would investigate why current statistical methods have been unable to identify the channels through which today's information in financial prices provide a forecast for future values of real economic variables or inflation.

One promising approach along these lines involves looking at the economic system as a whole rather than equation by equation—that is, formally recognizing, for example, that while interest rates may forecast inflation, the central bank may change short-term rates in reaction to inflation shocks. Thus, there is feedback from actual inflation to interest rates. These multiequation approaches, used, for example, by Leeper, Sims, and Zha (1996), may ultimately prove useful in understanding the transmission mechanism, if any, between the information in financial prices and important macroeconomic variables. Indeed, using just such an approach, Mehra (1998) concludes that, while increases in long-term interest rates were followed by subsequently higher inflation during the 1960s and 1970s, this relationship no longer held true in the 1980s and 1990s. He argues that the Fed's strong reaction to anticipated inflation (reflected in long-term bond rates) during this later period resulted in actions that warded off subsequently higher-than-average levels of actual inflation.

While more sophisticated statistical models like those described above show promise, more work along both theoretical and statistical lines is essential for collectively figuring out what role, if any, financial asset prices or yields should play in forecasts used in conducting policy. Until these issues are resolved, asset prices and yields will remain at most a source of information that policymakers can choose to use as a supplement to more traditional indicators.

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