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ECONOMIC PERSPECTIVES

A review from the
Federal Reserve Bank
of Chicago

Is there a role for gold
in monetary policy?

Long-run labor market dynamics
and short-run inflation

FEDERAL RESERVE BANK
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Though gold no longer plays the role it once did in monetary policy, there have been proposals to help maintain the purchasing power of money by giving gold an enhanced role in policy. This article evaluates these proposals by looking at the nature of the market for gold and how it influences the relationship between gold prices and prices in general. The article concludes that neither a gold standard nor using gold prices as indicators of changes in inflation is likely to produce the best monetary policy.

Does wage growth help predict inflation? Price inflation aids in forecasting wage growth, but wage growth does not predict future inflation. Unemployment appears to play an important role in predicting both wage and price growth.

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Is there a role for gold in monetary policy?

Robert D. Laurent

Gold has played a major role in the history of money and monetary policy. With the abandonment of convertible money and the adoption of fiat money, the integral role of gold in monetary policy disappeared. Nevertheless, there continue to be proposals to bring gold back into a more prominent role in monetary policy. These proposals essentially take two tacks. One argues that governments should readopt convertibility of currency into gold. The second argues to retain fiat money, but to use the price of gold as an early indicator of changing price pressures. Both of these proposals imply an enhanced role for gold in monetary policy. This article examines both proposals.

The article begins by describing the role of gold in the development of money and monetary policy. It traces how the unique characteristics of gold account for its prominent role in a specie money system and led gold to play a central role in a convertible money system. When gold was abandoned with the adoption of a fiat money system, a credibility problem arose for the future purchasing power of money. While some believe that returning to the gold standard would solve this problem, this article argues that it would not. Indeed, analysis of the operation of a gold standard makes clear that even if the credibility problem could be solved, other systems would be superior to the gold standard.

The second proposal, to use gold prices as an early indicator of changes in inflationary pressure under a fiat money system, rests on the assumption that gold prices and general prices move closely together. The price of gold and general prices do tend to move reasonably closely over long time horizons, but in fact the price of gold tends to be much more erratic over shorter time horizons. While a number of factors produce the erratic short-term movements in gold prices relative to general prices, two of the most important are the complex nature of the decision to shift between gold and fiat money as stores of value, and shifts in foreign demand for gold. This suggests that gold prices are not particularly closely related to small incipient fluctuations in the inflation rate. Moreover, a cursory examination of the evidence suggests that other commodity indices would serve at least as well as gold prices in the role of early indicators of changes in inflationary pressures. Indeed, it appears that the unique quality of gold makes its price more useful for gauging substantial shifts in the public's attitude toward fiat money, as for example when policy is attempting to eliminate deep-seated expectations of increasing inflation.

Coinage

Money is one of the great innovations in history. It is so simple and common, and its use so ubiquitous, that most users never think about the significance of its function. Money greatly facilitates the exchange of goods and services, allowing the specialization in employment that characterizes all modern societies.

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In a society in which each economic unit produces all the goods and services it consumes, there is no need for money. As specialization of labor develops, however, people begin exchanging goods and services. The simplest mode of exchange is swapping (or bartering) goods and services directly. But as the variety of goods and services grows, bartering becomes increasingly difficult. Consider the problem of a watch repairman who requires medical treatment for a sore back. The repairman must find an orthopedist who needs exactly the right amount of watch repair, or barring that, the repairman must string together a chain of swaps linking people requiring watch repairs with people willing to provide something the orthopedist wants. The difficulties are obvious.

Far simpler and more efficient is a system in which people exchange a common commodity in return for goods and services. This commodity is called money. Money is defined not by what it is, but by the function it performs. Any commodity used as money must of necessity also serve as a store of value between the time it is acquired and the time it is spent. As a result, money facilitates saving. Economists express this dual function of money by saying that it is both a means of transaction and a store of value.

The degree to which money facilitates savings is an important part of its function. What is critical in this regard is not merely money's value—what it can buy—but also how that value is expected to change in the future. The value of money is determined by the supply and demand for it. The demand for money is simply the quantity of goods and services offered in exchange for it; the supply is the quantity of money offered in exchange for goods and services. An increase in demand raises the value of money, while an increase in supply lowers it. What can be particularly damaging for money's role as a store of value are expectations that its supply will increase rapidly, lowering its future value.[1]

A large number of commodities have served as a means of transfer and a store of value at different times over history.[2] Gold has probably played those roles in more societies and for a longer time than any other commodity, including the fiat money that currently dominates. Indeed, many people in many parts of the world still consider gold a better store of value than fiat money. There are many reasons for this. Gold does not decay or corrode. It has a lustrous appearance and is extremely malleable, so that it can be worked into ornamental pieces from which the gold can later be easily recovered. In addition, while gold is widely distributed around the earth, it has always been relatively rare compared to iron, copper, or even silver, so that an amount small enough to be easily hidden and carried has always been sufficient to purchase a large amount of whatever could be produced by human labor of the time.

Initially, gold was probably transferred in the form in which it was found—as nuggets, grains, or simply gold dust. But it is difficult to know the quantity or purity of gold in these forms. As metalworking technology developed, the attraction of coinage became clear. Since the quantity of metal in a coin is usually less than the amount that could be purchased in a free market with the minted coin, there is typically a return to the minter of coins.[3] This return is called *seigniorage*. It reflects the excess face value of the minted coin above the value of the metal and the costs of processing it into a coin. The value of the coin is thus determined by the minting process, rather than by the inherent value of the metal in it.[4] As a result, not only is there a return to the minting process, there is also an incentive for counterfeiting—the production of unauthorized replicas. The development of coinage also opens up the possibility that the coins will be deliberately nicked or shaved to remove metal from the coin.[5] This is the reason for the front and back stamping and the milling that sometimes appears on the edge of a coin. Nevertheless, throughout history, coins have been debased not only by their holders, but also by their issuers. By reducing the amount or the value of metal in a coin, the issuer raises the seigniorage return and increases revenue.[6]

Convertible money

At this point, money consisted of coins of different denominations made of varying amounts of different metals—principally iron, nickel, copper, silver, and gold. The value of money was supported by the scarcity of the metal used to make it. The more valuable metals such as gold were typically used for the highest denomination coins, which were used most often to store wealth and least often for

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transactions.[7] Because gold coins were used only rarely for transactions and their value was relatively high, it was risky to hold them on one's person or at home. Depositories were established where holders could deposit coins or other valuables for safekeeping. Depositors paid for the safekeeping services rendered and were given receipts indicating ownership of the coins on deposit.

Some important developments flowed naturally from these depositories. First, depositors came to realize that when they wanted to make a transaction, they could simply sign over (endorse) the receipt for coins on deposit to the payee. This was easier and safer than withdrawing coins from the depository and transferring them to the payee, who most likely would simply redeposit them. As payees became accustomed to accepting endorsed deposit receipts, it was but a small step to allow payers to endorse over some portion of their deposits to a payee—and thus were born modern-day checks. Depositories also began issuing standard receipts in various denominations, redeemable by the bearer for coins on deposit. These generalized depository obligations, called bank notes, were precursors of paper currency.

Depository managers soon realized that only a small fraction of the coins on deposit were typically withdrawn at any given time. As a result, depositories could lend some of the money to borrowers and earn interest. Initially, depositories made these loans surreptitiously to keep depositors from knowing that not all their funds were being held in storage. But soon they began lending openly and assuaged depositors by paying interest on their deposited funds. At this point, depositories essentially became banks, making loans, paying interest on deposits, and (most importantly of all) creating money.

With this development, convertible money had appeared, that is, money that had value because it could be converted into something intrinsically valuable, such as gold. For the first time, goods and services could be purchased not only by coins (specie), but also by promises to pay specie. Money consisted of coinage, deposits at banks on which checks could be written, and bank notes—the latter two redeemable in specie at banks. The circulation of convertible money and the transfer of deposits through checks were substantial improvements over a system consisting solely of coinage. Convertible money and checks increased convenience and safety. Additionally, bank depositors could earn interest on their funds, which in turn encouraged further savings. Moreover, since mining metal and minting coins involve a substantial expenditure of real resources, the new banking system was less costly to society. Creating deposits on a bank's books and printing bank notes cost far less than mining and minting metal.

Though the appearance of banks and convertible money was a substantial improvement, it created a new problem. The quantity of circulating convertible money redeemable in coin (specie) was now much greater than the specie held in banks. Money was no longer constrained by the amount of available specie. If enough of a bank's depositors tried to redeem their deposits, the bank would fail. What might cause depositors to do such a thing? Anything that led them to believe that the bank could not honor redemption requests. Even a rumor that the bank had suffered losses on its loans which made it insolvent, or a fear that others might try to redeem their deposits, could lead to a bank run. This explains the critical role that confidence plays in banking.

To protect themselves, banks held specie in their vaults, deposits at other banks, and some very liquid assets that could be sold for specie in an emergency. These reserves could help a bank survive a surge of redemptions. In addition, a solvent bank experiencing a run could acquire additional specie by borrowing from other banks. They would have an incentive to help in order to maintain confidence in all banks.

If an individual bank were experiencing redemption pressures, the help of other banks in providing specie could easily be decisive. But if runs were occurring at many banks, the problems would be much greater. In such a case, the quantity of specie in the entire banking system would no longer be nearly sufficient to redeem all deposits, and many banks would fail. Indeed, many of the protections for individual banks were much less effective if many banks were facing runs. Drawing on deposits at other banks simply redistributed a fixed quantity of specie. A widespread sale of liquid assets could drive down asset prices,

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weaken banks' capital positions, and cause even more bank runs.

Any factor that causes depositors to believe that banks collectively cannot redeem deposits will cause simultaneous runs on many banks. Historically, events such as war and civil disorder have often had this effect. (The U.S. during the Civil War and England during the Napoleonic Wars suspended convertibility of deposits and bank notes into specie for many years.) In addition, the development of a banking system introduced an entirely new factor that could cause runs. When economic activity waned, depositors began to fear that if loans could not be repaid, deposits could not be redeemed. Depositors withdrew specie, causing a further fall in money, economic activity, and prices. When economic activity waxed, depositors felt more confident of banks' ability to redeem deposits, and they deposited more specie, increasing money, economic activity, and prices. Convertible money may not have initiated fluctuations in business activity, but it clearly amplified the size of the fluctuations.

A banking system that creates convertible money amplifies cyclical fluctuations and price movements. The gold standard—the convertible nature of the money that allows it to be exchanged for gold at a pegged price—acts to stabilize money and prices over longer periods of time. Imagine a situation in which the prices of all goods and services are rising, and the equilibrium market price for gold rises above the pegged price.[8] Producers and sellers of gold will then sell in the market rather than selling to banks at the pegged price. Conversely, buyers of gold will bring dollars to banks, rather than to the market, to purchase gold. These actions will reduce gold in the banks by a quantity sufficient to bring the market price of gold down from the equilibrium price to the pegged price. With a reduced quantity of gold in the banking system, the amount of money created will fall, as will the prices of all goods and services.

On the other hand, if the equilibrium price of gold falls below the price at which gold is pegged (presumably reflecting falling prices of all goods and services), then producers and sellers of gold will bring it to the banks at the pegged price instead of selling in the market, and buyers will purchase in the market rather than from banks. The quantity of gold held by banks will rise, and as a result, the amount of money will increase and the prices of goods and services will rise. As these examples illustrate, a gold standard stabilizes prices by automatically producing changes in the supply of convertible money when the equilibrium market price of gold deviates from the pegged gold standard price. The gold standard will stabilize the prices of all goods and services to the extent that movements in the equilibrium price of gold match movements in general prices.

The gold standard also stabilizes relative prices across countries. When two countries peg the value of their convertible moneys in terms of gold, they effectively peg an exchange rate between their currencies. This enables each country to translate foreign prices into its own currency easily and precisely. If the prices of goods in the first country rise relative to those in the second country, the second country's goods will be more attractive in both countries, and more net goods will be shipped from the second country to the first. Since gold is the medium of international payments, there will be an increased net shipment of gold from the first country's banks to the second country's banks. As a result, convertible money will contract in the first country and expand in the second country until prices return to equilibrium in the two countries.[9]

Fiat money

The experience with convertible money made clear that something could serve as money that was not even intrinsically valuable. People exchanged convertible money for goods and services even if there was no guarantee that it could be converted into specie. At times, the money continued circulating long after convertibility had been suspended. What mattered most was the confidence that it would continue to be accepted in exchange for goods and services in the future, and the expected rate at which it could be exchanged. This rate depended primarily on how scarce money was expected to be in the future.

Given these realities, it was clear that a monetary system could be based on something other than convertible money. The logical choice was a note, physically similar to the old bank note but not convertible into anything. Such notes are called fiat money; as the name implies, their status derived entirely from law.

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Fiat money has a number of advantages. First, it reduces the real cost of providing a monetary system to a minimum, since mining and minting costs dwindle almost to zero. Accordingly, seigniorage returns to the money issuer increase. Second, fiat money can be controlled more readily. Banks tended to lose specie when the economy was contracting. This led to further contractions in money and economic activity. By contrast, under a fiat money system, while banks still have convertible deposits, those deposits are convertible into fiat money. The issuer of fiat money can offset the outflow of reserves from the banking system by supplying more fiat money, something it cannot do under a system of money convertible into gold. Fiat money thus gives the central bank full powers of monetary policy and raises the possibility of smoothing out cyclical fluctuations. Indeed, a number of the world's central banks were established in hopes that they could dampen economic cycles by providing an "elastic currency."[10]

Despite these benefits, replacing the gold standard with a system of fiat money creates an important potential problem. As long as a gold standard is in place and money is redeemable by something in limited supply, there is a cap on money creation. By contrast, fiat money makes it possible for government to raise revenues by issuing excessive money. This may seem more attractive than raising revenue by borrowing or increasing taxes.[11] But an excessive issue of fiat money will cause prices to rise, and thus imposes a "hidden tax." Instead of the burden of the increased revenue falling on present or future taxpayers, the costs will be borne by those holding currency or assets accruing payments in money (for example, bonds). Advocates of a gold standard argue that it protects against this danger.[12]

Advocates may well be right in arguing that a gold standard maintains the purchasing power of money better than fiat money does. Certainly, the historical record supports that conclusion.[13] Yet the movement around the world has been toward fiat money.[14] This appears to be because governments are not always willing to be constrained by a past commitment to maintain the long-run purchasing power of money. The difficulty is not getting governments to adopt a gold standard; rather, it is getting them to stay on it, or barring that, to get them to return to the standard at the old price of gold. History is replete with examples of countries going off the gold standard and not returning to the old price of gold. There is no way to force a sovereign power to adhere to a gold standard if the costs of adhering to it become high.[15]

Indeed, even if countries could be forced to remain on a gold standard, it would not be the best way to achieve price stability. The analysis in the previous section showed that a gold standard works to maintain the purchasing power of money by producing changes in convertible money. If the government were willing to bear the costs of allowing money to respond to deviations of the price of gold from its pegged price, then an actual gold standard would not be necessary. The cost of mining and minting gold could be saved by simply moving fiat money in response to deviations of the price of gold from target. In fact, even better would be a system in which the money stock was directly adjusted in response to deviations in the prices of all goods and services from target levels. This would remove the possibility that a change in the relative price of gold would affect general prices. In summary, if government has the discipline to follow a gold standard, gold is not necessary; if government does not have the discipline to follow a gold standard, even gold will not help.[16]

Though governments may not be willing to commit themselves to a gold standard, there is still a strong constituency in favor of price stability. One approach advanced by this constituency is to give more independence to the central banks that issue fiat money so as to insulate them from government influence, and buttressing this independence with legislation charging the central bank to achieve some measure of price stability.[17] Indeed, there does appear to be some movement in this direction.[18]

Gold markets

Under a fiat money system, a central bank has the task of creating fiat money to dampen cyclical economic fluctuations while simultaneously maintaining the long-run purchasing power of money, formerly maintained by a gold standard. Some propose that the bank use changes in the price of gold as a signal to adjust the quantity of fiat money in order to maintain

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price stability. Gold prices can serve this role if their movements tend to match general price movements. This is somewhat similar, as noted earlier, to the operation of the gold standard, in which the price stabilization properties of gold depended upon the stability in its relative purchasing power. The data in figure 1, covering the period from 1800 to 1992, indicate that over long periods of U.S. history, movements in gold prices have corresponded quite closely with movements in the general level of prices. This correspondence is impressive considering that the price of gold was pegged for substantial subperiods, and that wholesale prices over this period increased by about six times.

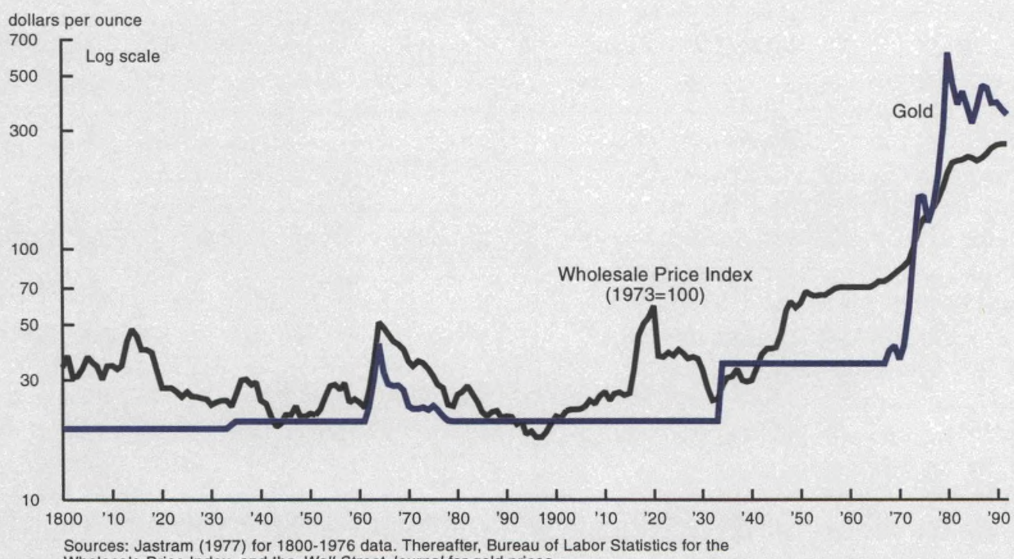
A major reason for this long-run stability is that, as the purchasing power of gold rises, more resources are devoted to discovering and extracting it. This may not seem to be the case, since the best known examples of gold production appeared to be accidental "discoveries." However, the total production of gold in such discoveries has generally been small and short-lived compared to the scale of overall gold production. After the initial surge in a discovery, the production of gold has generally returned to an expensive process of extracting the metal from difficult-to-reach veins or from difficult-to-process ore. In such circumstances, higher gold prices are required to elicit higher gold production.[19]

A second characteristic of the gold supply is that it does not change much in the short run. Since the present stock of gold includes virtually all the gold that has ever been mined, the immediate impact of any sudden supply change is likely to be minimal. Even major events such as the "discovery" of gold in the New World by the Spaniards, the California and Australian gold discoveries, and the development of the cyanide process to mine South African ores affected total gold stock and gold prices only gradually.

As a consequence of these supply characteristics, the most volatile short-term movements in gold prices reflect changes in the demand for a relatively fixed quantity of gold. The demand for gold is basically for three uses—commercial and industrial, ornamental and jewelry, and as a pure store of value. The commercial and industrial demand for gold is relatively small and diffuse, facts that contribute somewhat to the stability of the total demand for gold.[20] In the typical commercial use of gold, there are no ready substitutes, and the amount used is generally of small value relative to the price of the final product. As a result, the cost of developing substitutes is likely to be uneconomical.[21]

FIGURE 1

Wholesale prices and the price of gold
(1800-1992)



Sources: Jastram (1977) for 1800-1976 data. Thereafter, Bureau of Labor Statistics for the Wholesale Price Index, and the *Wall Street Journal* for gold prices.

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The gold demand for ornamental and decorative purposes is quite large but is not likely to be very responsive to changes in price unless prices become extreme. History has inculcated in much of the human race the opinion that gold is a very desirable medium with which to create art and adorn jewelry. By tradition, gold is the preferred medium in which to express many sentiments; witness wedding bands and gifts for a "golden" anniversary.[22]

As described earlier, tradition and history have also placed gold in a unique position as a store of value and an alternative to fiat money. Unlike the other two main uses of gold, the demand for gold purely as a store of value can be quite erratic and price-insensitive. A significant shift between the large quantity of fiat money and the relatively fixed quantity of gold available over the short run is likely to produce very sharp changes in the exchange rate between them—that is, in the price of gold. Any events that affect the relative attractiveness of fiat money, primarily through expected changes in the value of fiat money, may have this consequence, such as changes in internal social stability, the tides of war, or anything that affects the desirability of raising revenue through seigniorage.

The above analysis suggests that in the short run, sharp fluctuations in the price of gold are likely to stem from shifts in the demand for gold as a store of value. If this is true, then short-run movements in the price of gold may be useful for monetary policy by providing an early signal of changes in expected inflation rates. Yet three other aspects of the gold market make it difficult to translate a change in gold price directly into an expected change in general prices.

The first aspect is that, given gold's high ratio of value to weight and its wide acceptability, it has an international market. As a result, the price of gold in two countries (adjusted for the exchange rates between their two fiat currencies) is not likely to deviate much. If the price of gold or the value of currency rises in the first country, then gold will be shipped from the second country to the first. Indeed, this is precisely the key mechanism of an international gold standard, as described earlier. Clearly, it implies that changes in the domestic price of gold could result from changes in gold demand in a foreign country, rather than signaling changes in expected inflation at home.

A second aspect of the demand for gold concerns the common wisdom that the price of gold rises in response to inflation. As figure 1 shows, while gold prices and general wholesale prices have typically moved closely over long periods of time, the relationship is much more complex over short time periods. Short-term movements in gold prices are much more volatile than those of the general level of prices. In part, this may be the natural result of comparing a single price against the average price of an entire basket of goods and services. But in addition, economic theory strongly suggests that in the short run, the relationship between gold prices and general prices should not be as simple as a close lock step.

Under ordinary circumstances, holding gold purely as a store of value would not seem attractive. The holder of gold must either risk theft or pay storage costs, as well as forgo any interest return. Given these facts, the motivation for increasing one's demand for gold as a store of value would not simply be expected inflation, but an internal calculation that the price of gold is likely to rise more (even after storage costs) than the return available from fiat money. In addition, since there are costs in shifting wealth between fiat money and gold, there should be some expectation that these conditions will endure for a while. In practical terms, this is likely to mean a situation in which inflation is increasing and real interest rates are low or negative. Conversely, gold prices are likely to weaken when inflation declines and real interest rates are high.[23]

The third aspect of the demand for gold is that when there is also an international market for fiat moneys as stores of value, the situation is likely to be even more complex. The price of gold will be most sensitive to movements in the real interest rate on that fiat money which offers the highest real rate. While a change in the real rate on any fiat money is likely to have some impact on the price of gold, a change in the real rate on a fiat money with a relatively low real rate is not likely to have a great influence on gold prices, since holders of that money have available to them as stores of value not only gold, but also better fiat monies. In the case of a change in real rates on a relatively unattractive fiat money, the major reaction is likely to be a change in its exchange rates with

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other fiat moneys. However, a change in the real rate on the fiat money with the highest available real rate is likely to have an impact not only on exchange rates, but even more on the demand for gold, because this fiat money represents the closest alternative to gold. As international capital markets become more integrated, this role of the best alternative fiat money should become more important in interpreting gold price movements.

Gold prices and inflation

This analysis of gold markets suggests that it will not be easy to translate changes in gold prices into predictions about future inflation rates. While the supply of gold appears sufficiently price-elastic to produce a stable relative gold price over long periods of time, demand factors can cause the relative price to be very erratic over the short term. This is due to the international character of the gold market and the complex nature of the calculations that lead to shifts between fiat money and gold. Shifts in foreign demand, including those arising from the monetary policy actions of other fiat money issuers, can affect the domestic price of gold. In addition, small and incipient moves in inflation are not likely to be matched by shifts between gold and fiat money, or changing gold prices. As a practical matter, gold prices are likely to be affected only in situations in which inflation has already been changing, and in which short-term real interest rates set by the monetary authority indicate that change is likely to continue for some time. Accordingly, gold should be particularly good not for forecasting small fluctuations in inflation from small changes in gold prices, but for capturing large shifts in the public's attitude toward fiat money from large changes in the price of gold that are likely to be associated with significant changes in inflation. Large falls in gold price are likely to be particularly helpful in gauging the success of monetary policy in reversing expectations of sharply increasing inflation.[24] The following discussion presents data on gold prices and general prices and interprets them in light of this analysis.

From 1934 to 1968, gold prices in the U.S. were fixed at $35 per ounce. This price was applicable only to foreigners, as legislation in 1933 had made it illegal for U.S. residents to hold any monetary form of gold. During those years, wholesale prices increased approximately threefold. This explains the deterioration in the purchasing power of gold over the same period, shown in figure 1. Following World War II, the Bretton Woods agreement made the U.S. dollar an international reserve currency and, through the price of gold, fixed its exchange rates with other currencies. This meant that the U.S. essentially acted like a bank, and other nations' central banks acted like depositors. As a result of this system, all countries enjoyed the benefits of fixed exchange rates in foreign trade, and the U.S. enjoyed the benefits of seigniorage that accrue to money issuers. But the system depended on the U.S. not overissuing dollars. By 1968 foreigners had more dollars than they were willing to hold, and the equivalent of a bank run developed. The U.S. had to stop redeeming dollars from foreign central banks for gold at $35 an ounce and allow the price to move. In addition, by 1971, U.S. citizens had regained the right to hold gold.

Figure 1 shows that since 1968, the price of gold has increased almost three times as much as the Wholesale Price Index. As the figure also indicates, this more rapid increase has helped move the longer-term increase in gold price into line with the longer-term increase in wholesale prices; thus it has made up for the long period from 1934 to 1968 in which gold prices were frozen while wholesale prices rose. The data in figure 2 give, in somewhat more detail, the behavior of gold prices and the Consumer Price Index (CPI) over the period since 1968. While the CPI has risen steadily, with changes in slope reflecting variations in the rate of inflation, the gold price has experienced steep and extended declines. Indeed, the current gold price is well below its 1980 peak of nearly $700 an ounce (on a monthly average basis). This is consistent with the observation that the relationship between gold prices and general prices can be very volatile in the short run.

Even though gold prices are much more volatile than prices in general, changes in gold prices (if properly scaled) might still be of value in predicting changes in general inflation. Figure 3 plots year-over-year changes (appropriately scaled) in both gold and the CPI. In periods of large moves in the rate of growth of gold prices and the CPI, the rate of change in gold prices does tend to precede the major part of the fluctuations in inflation.

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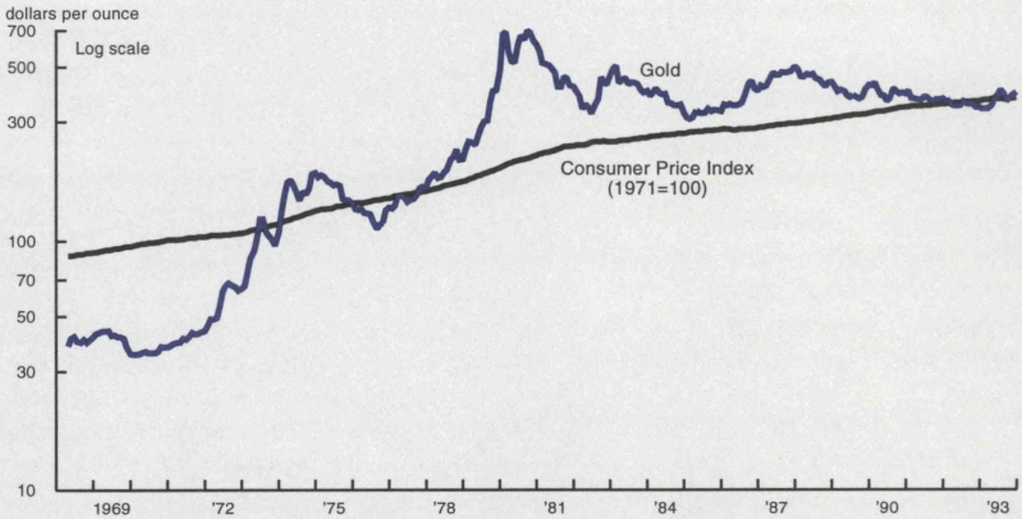
FIGURE 2

Consumer prices and the price of gold
(April 1968-December 1993)



However, over other periods, such as the last decade when the rates of price change have not fluctuated much, there appears to be little connection. This is again consistent with the conclusion that small movements in gold price were not likely to be closely associated with changes in inflation. Figure 3 also indicates that gold prices have been particularly quiescent over the last three or four years.

The analysis of the gold market in the previous section indicated that a shift in demand from fiat money to gold would not be triggered simply by public expectations of inflation, but by expectations that inflation would continue increasing. In practice, this is likely to mean low, if not negative, real interest rates. Figure 4 plots gold prices and the real federal funds rate and shows that sharp moves

FIGURE 3

Year-over-year changes in gold prices and consumer prices
(April 1969-December 1993)

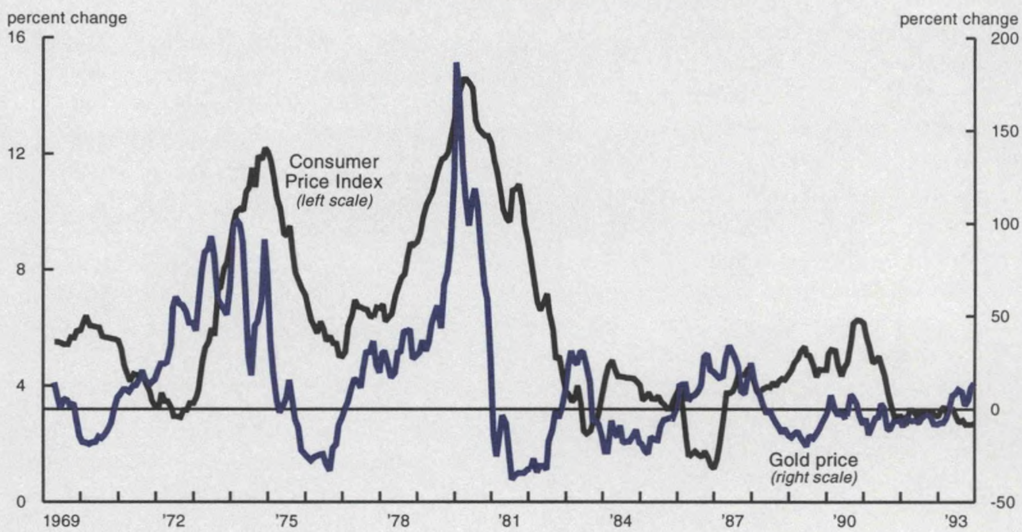


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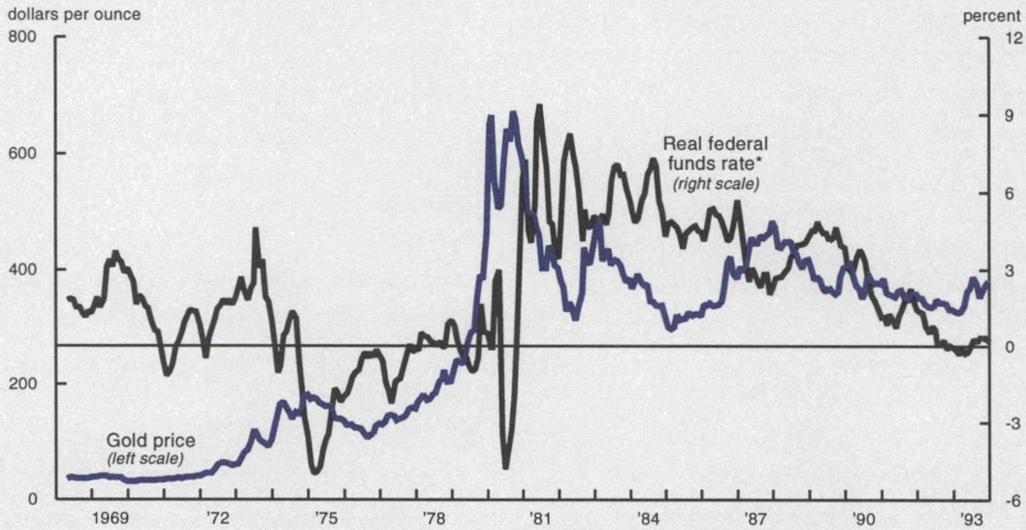
FIGURE 4

Gold prices and the real federal funds rate
(April 1968-December 1993)

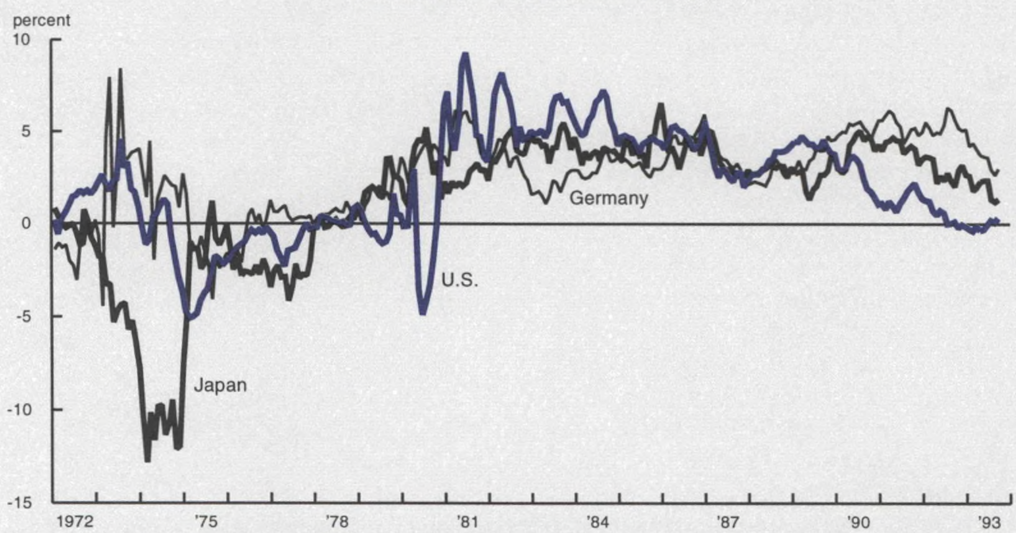


*Real federal funds rate is the funds rate minus the year-over-year change in the Consumer Price Index.

in gold prices are preceded by real interest rates of the opposite sign. This is particularly noticeable around 1980, when there was a major shift in the real federal funds rate. In the period before 1980, the real federal funds rate was low if not negative, while in the period after 1980 it was very high. In addition, figure 3 shows that inflation, as measured by the CPI, was increasing before 1980 and decreasing thereafter. Finally, figure 4 shows a striking contrast in the behavior of gold prices before and after 1980.

FIGURE 5

Short-term real rates in the U.S., Japan, and Germany
(January 1972-September 1993)



Note: Real rates are short-term rates minus year-over-year change in the Consumer Price Index. Short-term rate for U.S. is the federal funds rate. For Germany and Japan it is the money market rates from the International Monetary Fund.
Source: *International Financial Statistics*, IMF.

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The previous section also described how the behavior of foreign issuers of fiat money can affect the price of gold. Figure 5 shows that the U.S. was not the only country in which real short-term interest rates increased sharply in the early 1980s. Real money market rates in Germany and Japan also increased sharply. The combined effects of the initial low real interest rates and the sharp rise in real rates in these countries helps explain the very sharp rise and subsequent fall in gold prices.

The ability of gold prices to predict inflation may also be compared to the predictive power of other commodity prices. Table 1 presents the results of seven linear regressions done to forecast the monthly changes in the CPI. Each regression enters changes in the previous 24 months for either one or two price series. Four of the regressions enter changes in only one of four independent variables—gold prices, the *Journal of Commerce* Industrial Price Index, the sensitive materials prices included in the index of leading indicators, and the CPI itself. The other three regressions enter lagged changes in the CPI in combination with changes in each of the commodity price measures. The $\bar{R}^2$ figures indicate the fraction of variance in the monthly CPI explained by the variable(s) in each regression. As the table makes clear, the other two commodity indices explain fluctuations in the CPI at least as well as gold prices do.[25]

TABLE 1

Forecasts of monthly percentage changes in the Consumer Price Index (CPI)
(January 1972-November 1993)

Lagged independent variables[a]	$\bar{R}^2$
Gold prices	.271
Journal of Commerce Industrial Price Index	.330
Sensitive materials prices	.362
CPI	.510
Gold prices and CPI	.516
Journal of Commerce Industrial Price Index and CPI	.556
Sensitive materials prices and CPI	.560

[a]24 lagged monthly percentage changes for each variable.

Finally, the second quarter of 1993 witnessed a spurt in gold prices that some suggested at the time might be an early warning of increasing inflation. This episode provides an opportunity to apply the analysis of gold markets presented earlier. As figure 4 indicates, at this time the real federal funds rate had fallen nearly to zero, suggesting that perhaps the stage could be set for an increase in inflation. However, as figure 3 shows, by historical standards, the period's increase in gold prices was quite mild, certainly nothing like the increases that had signalled sharp rises in the CPI in the past. Second, as figure 3 also shows, inflation had not been increasing in the period preceding the rise in gold prices. On the contrary, it had been exceptionally stable. Third, in this period inflation increased in China, a country where gold holds an esteemed historical position and where foreign fiat money investment alternatives to the yuan are few.[26] It is likely that some of the increase in gold prices in the period stemmed from the increased Chinese demand for gold. Fourth, in this period the Bundesbank, which probably had the highest short-term real rates among central banks that attract international capital, sped up its pace of lowering short-term real rates (see figure 5).[27] Finally, this was a period in which sensitive materials prices and the *Journal of Commerce* Industrial Price Index were falling, not rising. For all of these reasons, and in light of the analysis in the previous section, it would seem reasonable to conclude that the rise in gold prices in mid-1993 was probably not signaling a significant increase in U.S. inflation.

Summary and conclusion

This article has examined the question of whether gold should play a more prominent role in monetary policy. After examining the role that gold has played in the development of money and monetary policy, the article argues that making fiat money convertible into gold does not guarantee the willingness to achieve long-run stability in the purchasing power of money. Even if this willingness could be guaranteed somehow, there are better alternatives than a gold standard on which to base monetary policy.

Moreover, gold is not likely to serve as a useful early indicator of changes in inflation under a fiat money system. While gold prices and general prices have moved together over long periods of time, short-term movements of

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gold prices have been much more erratic than movements in general prices. Interpreting the inflationary message of small short-term changes in gold prices is complicated primarily by foreign influences in the gold market and by the complex factors that induce shifts between fiat money and gold. Further, even cursory investigation indicates that other commodity indices are likely to provide better early warnings of fluctuations in inflation than gold. Applying these relationships between gold prices and general prices helps explain much of the behavior in the price of gold since it was freed in 1968, including why the mid-1993 rise in gold prices was not likely to be cause for alarm.

FOOTNOTES

[1]If rapid inflation is occurring and expected to continue, then the future prices of all goods and services are likely to be much higher than the present prices, and other commodities may replace money as a store of value. Far rarer is a potential fall in the value of money savings because of a fall in the quantity of goods offered for money. An example might be the price of food and medicine in a city under siege.

[2]For an extensive description of commodity money, see Jevons (1903).

[3]If it were otherwise—if the value of the metal in the coin were greater than the face value of the coin—then one could expect the coins to be melted down and to disappear from circulation. In relatively recent years, this happened to silver coins in the U.S. and almost happened with copper pennies.

[4]This process is usually, though not necessarily, supported by the force of law giving the coinage legal standing in discharge of debts.

[5]Stories are told of cases in the Middle Ages when coins were placed in burlap bags and shaken vigorously for a long time so as to nick off bits of gold that could later be retrieved.

[6]One of the most famous laws in economics, Gresham's law, deals with such situations. Gresham's law states that when two moneys are forced to exchange at relative prices different than their inherent values, the money with less inherent value will drive the dearer money out of circulation.

[7]Using more valuable metal for higher denomination coins is widely practiced, leading to coins of more uniform and convenient size than would be the case if the same metal were used for all coins.

[8]The equilibrium market price is what the price would be in the absence of purchases or sales of gold by the banks or by the mint.

[9]For a more complete description of the operation of a gold standard, see Humphrey and Keleher (1982), chapters 5-6, and McCloskey and Zecher (1976).

[10]For example, the Federal Reserve System was created in 1914 in response to the Panic of 1907.

[11]This explains why authorities in extreme straits such as the Continental Congress in the Revolutionary War, or the Confederacy in the Civil War, resorted to issuing paper money. It also explains why there is often a flight from convertible money into specie in wartime, as in Great Britain during the Napoleonic Wars.

[12]For discussions of the merits of gold in a monetary system, see U.S. Congress (1982) and Paul and Lehrman (1982).

[13]See Jastram (1977) for extended data for the United States and United Kingdom.

[14]Among major central banks, only Switzerland maintains convertibility of its currency into gold.

[15]The importance of the lack of enforcement power is clear. One way citizens can try to insulate themselves from the potential depreciation of fiat currency is to conduct their business in other money (for example, the money of other countries). But the courts are likely to rule in favor of whichever party tries, to its advantage, to require payment in domestic fiat money. Indeed, the Supreme Court of the United States ruled in the 1930s that previous contracts, specified to by both parties in gold, could not be enforced.

[16]One possible argument for the gold standard is that while it cannot guarantee the goal of price stability, it does make it clear when the goal is being abandoned, for it is difficult to hide the abandoning of convertibility.

[17]In comparing this approach to a gold standard, one should note that either legislation or personnel at the central bank can be changed if government later decides that achieving price stability is too costly.

[18]The central bank of New Zealand recently received a charter directing it to achieve price stability.

[19]In many cases, particularly in South African gold mines, the quality of the ore processed is adjusted inversely to the price of gold, so that richer ore is processed when gold prices fall and production facilities are run at a fairly constant rate. Such a practice tends to produce an even more stable supply of gold.

[20]While figures on the demand for commercial and industrial use of gold are not precise, estimates in the *Annual Bullion Review* (1982-1986) imply that commercial and

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industrial use accounts for slightly less than 14 percent, and jewelry usage slightly over 48 percent, of the total demand for new gold supply in those years.

[21]By contrast, two other precious metals—silver and platinum—are more intensively used commercially where they account for a significant part of the cost of the final product. In recent years, both silver and platinum prices have been hit sharply by the possibility of these metals' being replaced in commercial use (silver in photography and platinum in emission control) by substitutes.

[22]An interesting case of the making of "tradition" is provided by the rapidly growing use of diamonds for engagement rings in Japan. This practice is being promoted by ads from the diamond marketer De Beers. To the extent this campaign is successful, the demand for diamonds is likely to grow and be less sensitive to price.

[23]Moreover, while a shift between gold and fiat money as alternative stores of value is likely to be preceded by changes in inflation, the shift itself will further reinforce any initial changes in inflation. An increase in inflation that helps induce a shift from fiat money to gold as a store of value will cause the fixed quantity of fiat money to be used more intensively for transactions, thus raising prices further. Conversely, a shift from gold to fiat money will reduce the use of fiat money in transactions, further lowering prices. This reinforcement process means that large short-term changes in the gold price are even more likely to be associated with large changes in general prices.

[24]In theory, sharp rises in gold prices could also be useful indicators that monetary policy is succeeding at reversing a period of steepening deflation, but as a practical matter this is not likely to be a concern for any monetary authority.

[25]It should also be noted that sensitive materials prices may not be available on as timely a basis as the other two series, and appear subject to substantial revisions.

[26]China initiated an anti-inflationary policy in spring 1993 that reportedly included an increase in interest rates from 10 percent to 35 percent. However, some reports indicate that by late summer the policy had been eased.

[27]Some believe this easing was prompted more by the desire to help maintain the European Monetary System than by German domestic monetary policy considerations.

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Long-run labor market dynamics and short-run inflation

Jeffrey R. Campbell and Ellen R. Rissman

Looking back on the experience of the 1970s, Arthur Okun commented that "some insidious ratchet has gone into operation, giving inflation a far greater degree of persistence than it ever had before."[1] His observation appears just as insightful today as when it first appeared. With nominal productivity-adjusted wage growth averaging only 4.1 percent over the 1980s, why has inflation remained stubbornly at 4.5 percent?

The tangled relation between price and wage inflation has been the subject of much debate and little consensus among macroeconomists. The Keynesian revolution provided a somewhat unified view of the macroeconomy but gave aggregate demand issues more attention than aggregate supply. As a result, inflation and its relation to nominal wage growth remained poorly understood aspects of the economy. Although monetarists such as Friedman (1968) were quick to point out the potential difficulties of ignoring nominal issues, the point was not of central concern to macroeconomists until the 1970s, when inflation inexplicably picked up. The relative indifference until that time was probably due partly to the fact that Keynesianism and its derivatives were reasonably able to explain the pre-1970s workings of the macroeconomy. Also, since aggregate supply was more or less stable through the 1960s, inflation was not an important issue.

Until the 1970s, wage growth was successfully explained by a short-run Phillips curve in which nominal wage growth is assumed to depend on the degree of labor market tightness, usually measured as some function of the unemployment rate. Although not formally developed in a cohesive theoretical structure, the conceptual appeal of the Phillips curve is quite apparent. As the labor market becomes tighter (that is, the unemployment rate declines), it becomes increasingly difficult for firms to find and keep qualified workers at the existing wage rate, and employers are forced to raise their salary offers. Knowing that wages are rising and that other jobs are available at higher wages, workers can successfully demand higher wages. The converse is also assumed, namely, that as the unemployment rate rises, wages decline—although whether they decline as quickly as they rise is open to debate. The typical theoretical model linked wages to prices via some sort of markup in which inflation equals nominal wage growth net of productivity growth. Furthermore, productivity was believed to grow at a roughly constant rate.

The stable 1960s gave way to the stagflation of the 1970s, in which inflation remained high in the face of an apparently excess aggregate supply. It appeared that the Phillips curve

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was no longer stable, and that lower inflation could be achieved only with ever higher levels of unemployment, as inflationary expectations caused workers to demand increasing compensation. The weak link in the Keynesian model had failed.

During the 1970s and early 1980s, in an attempt to "fix" the Phillips curve, economists sought to shed light on the relationship between nominal wage growth and inflation. They recognized that in addition to measures of labor market activity, inflationary expectations were also potential determinants of nominal wage growth.[2] Economic thinking of this period suggested that if workers care only about their real compensation, then they incorporate their expectations for inflation into their wage demands. If their current expectations of inflation depend on previous inflation, then past inflation would determine nominal wage growth, which in turn would determine current inflation via a markup.[3]

In addition to emphasizing the joint determination of wages and prices through an expectations mechanism, several researchers including Gordon (1977), Perry (1980), and Hamilton (1983) have suggested that the instability of the Phillips curve in the 1970s was the result of special factors such as the acceleration and termination of the Vietnam War, the implementation of wage and price controls, and the oil price shocks. These hypotheses have met with only modest empirical success in that even after such factors have been accounted for, the parameters of the Phillips curve still appear to have shifted.

Other economists such as Sachs (1980), Barro (1977), and Taylor (1980) have theorized that underlying structural changes occurred in the inflation process that caused the instability of the Phillips curve. An increase in the use of longer-term labor contracts and a public belief that monetary and fiscal policy would be used to promote high employment and stable prices worsened the trade-off between inflation and unemployment. Finally, Rissman (1993) suggests that the instability of the Phillips curve is the result of structural changes in the economy that have altered the relative importance of cyclical and structural unemployment, and that cyclical unemployment is the relevant determinant of nominal wage growth.

Essentially, the Phillips curve in its narrowest context deals with the determination of nominal wage growth given the level of economic activity. How nominal wage growth relates to inflation is open to debate. Indeed, even the direction of causality between nominal wage growth and inflation is open to debate. Discussion of the high inflation rates that prevailed in the 1970s focused on the "wage-price spiral," and economists differentiated between two distinct types of inflation: cost-push and demand-pull. Cost-push inflation relates the rate of growth of the cost of factors of production to price increases. Depending upon the structure of production, firms are more or less able to pass on cost increases in the form of higher prices. In turn, higher output prices reduce the real income to factors of production, the owners of which attempt to raise factor prices. In this scenario, wage growth and inflation quickly spiral, with wage growth causing inflation, which in turn causes additional wage growth. Perry (1978), for example, focuses entirely on wage inflation as an underlying cause of price inflation. Okun (1981) also assigns a central role to the labor market in his model of inflation and business cycles.

Demand-pull inflation is the result of somewhat different forces. Excess aggregate demand causes output prices to increase, and consequently, real earnings to factors of production are reduced. The owners of these factors demand compensation and frequently are rewarded as firms' profits rise and firms are able to absorb the higher cost of production. In this scenario, the direction of causality runs from prices to wages.[4]

Both of these scenarios imply a direct link between nominal wages and prices. One foundation for this conviction is the paradigm of the profit-maximizing firm operating in competitive product and labor markets. Such a firm will increase employment until the cost of hiring an additional worker exactly offsets the revenues he or she generates. If workers are homogeneous and employed in a spot market for labor, the cost of an extra labor unit is simply the going wage rate. If the firm sells its product in a competitive spot market, the additional revenue generated from hiring an extra worker is the market price of the good multiplied by the extra physical output he or she produces. In such a market, the price is determined by the

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price of inputs and their productivity. An implication of this is that productivity-adjusted nominal wages always grow at the current rate of inflation.

This idealization of labor and product markets abstracts from potentially important market imperfections. For example, some firms enjoy monopsony power in labor markets. The employment decisions of large firms in small geographic regions impact local wage rates. Similarly, a firm which is the only employer of workers with a special skill has a degree of control over their wages. When a firm acts as the sole employer in a labor market, the labor supply curve to the firm is no longer infinitely elastic at the going wage rate. Instead, the monopsonist faces an upward-sloping supply curve of labor. In order to attract an additional worker, the monopsonistic profit-maximizing firm must increase the wage rate paid to all workers, thereby creating an additional hiring cost. This creates a wedge between the marginal product of labor and the wage rate. The wedge breaks the simple framework's tight connection between wage inflation and price inflation.

By changing the firm's level of employment, adjustment costs are another potentially important source of friction that can create a wedge between the marginal product of labor and the wage rate. On the hiring side, it may take some time to find qualified workers and then additional time to train new hires in the specifics of their jobs. When reducing its work force, the firm faces the costs of low morale, severance pay, and potentially higher unemployment insurance payments. These considerations make it prohibitively expensive to adjust employment instantaneously to its optimal level. Only in the long run after some gradual adjustment of employment will the marginal or equilibrium condition hold.

In a competitive product market with many firms producing similar products, all firms equalize the cost of producing additional output with the market price. However, a firm producing a good with no close substitute can set its price above its marginal cost of production. If only a few firms serve a market, they can collude to raise the market price above its competitive level. Changes in firms' markups also cause wage inflation to differ from price inflation. For example, if firms fight a temporary price war, then price inflation will be less than wage inflation.

These caveats suggest that the static equilibrium condition between productivity-adjusted nominal wages and prices implied by profit-maximizing behavior will not hold at every point in time. Imperfections in the labor and product markets can cause the rates of price and wage inflation to differ in the short run. There will be a tendency for the firm's static equilibrium condition to hold only in the long run. Although at any given time there will be a gap between the rate of growth of nominal wages (adjusted for productivity growth) and the inflation rate, this gap will tend to disappear over time. This observation is central for assessing the accuracy of arguments about inflationary pressures stemming from nominal wage growth; it is also important for the modeling, interpretation, and forecasting of wage and price inflation.

This article analyzes a simple forecasting model of wage and price inflation. Economic theory affords useful insight into the long-term relationship between wage and price inflation, but less insight into their short-term dynamics. By using the error corrections framework studied by Engle and Granger (1987), the model accounts for the long-run restriction on wage and price inflation, but leaves their short-run dynamics unconstrained.

Although it is useful to examine the joint behavior of wages and prices in a bivariate context, models of the Phillips curve have long suggested that the level of economic activity has an important impact on the degree of wage inflation. In particular, greater unemployment dampens wage growth, which then translates into lower price inflation. The baseline forecasting model uses only wage and price inflation to forecast their future values. An extension of this bivariate model incorporates the unemployment rate in the analysis in keeping with the literature on the Phillips curve.

The analysis focuses on the short-run predictive power of wage inflation and price inflation using simple F-tests for this purpose. The estimation of the baseline model suggests that price inflation is useful for predicting wage inflation, but that the converse is *not* true. In fact, wage inflation has no discernible short-run impact on prices, so that information about current wage growth cannot help predict the path of future prices. Although in the long

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run the gap closes between productivity-adjusted wage growth and inflation, it is wage growth that adjusts to close the gap.

Including the unemployment rate into the model further strengthens the conclusion that wage inflation has little bearing on price inflation. Once unemployment has been admitted into the model, however, price inflation ceases to be a short-run determinant of wage growth in spite of the long-run relationship between the two. Using different methods, Gordon (1988) and Mehra (1993) reached similar conclusions. Test results indicate that the unemployment rate is a short-run determinant of both price and wage inflation. Unlike the bivariate model, wage inflation does not respond directly to the gap between wage and price growth. Rather, the unemployment rate first responds, then wage inflation reacts to the change in unemployment via a Phillips curve type of channel.

The remainder of this article is divided into four sections. The first section considers the theory of labor demand in more detail and analyzes its implications for short- and long-term behavior of wages, productivity, and prices. The next section presents the data used to estimate the forecasting model and discusses their time-series properties. The section that follows uses the model to test the short-term predictive power of wage inflation for price inflation under the maintained hypothesis that the long-run wage-inflation gap is zero. The final section provides a brief summary of the results and some concluding remarks.

Labor demand

The paradigm of the profit-maximizing firm underlies the theory of labor demand. A firm choosing its labor force to maximize its profit will hire until the revenue generated by an additional worker equals the costs of her employment. Let $r(L)$ and $c(L)$ respectively denote the revenue received and cost incurred from hiring an additional worker when the firm already employs L workers. These functions are called the marginal revenue and marginal cost of labor. The profit-maximizing firm hires additional labor up to the point where

(1) $r(L) = c(L)$.

If this equilibrium condition did not hold, then the firm could raise or lower its level of employment to attain a higher level of profits.

The marginal revenue associated with hiring an additional unit of labor is the value of the extra output generated. If a firm operates in a competitive market, it cannot influence the price of its good. In this case, the marginal revenue product of labor equals the market price, P, multiplied by the physical output attained from employing an additional worker. Suppose that a production function, $Q = f(L)$, describes a firm's production technology. The physical output produced with L workers is Q. The first derivative of the production function, $f'(L)$, is the additional output produced from hiring an additional worker. With this production technology, this firm's marginal revenue is $r(L) = Pf'(L)$.

If this firm also operates in a competitive labor market without any costs of adjustment, then the cost of hiring an additional worker is her wage, W. In this simple case, the equilibrium condition from equation 1 can be simplified to

(2) $W = Pf'(L)$.

In an economy populated by such firms, the price of output always equals the productivity-adjusted wage, $W/f'(L)$. This also constrains the price's growth rate, price inflation, and the growth rate of the productivity-adjusted wage, wage inflation. Taking logarithms of equation 2 and subtracting it from itself across two adjacent time periods, t and $t-1$, yields

(3) $\Delta w_t - \Delta z_t = \pi_t^p$,

where

$\Delta w_t = \ln W_t - \ln W_{t-1}$ and is the growth rate of nominal wages;

$\Delta z_t = \ln f'(L_t) - \ln f'(L_{t-1})$ and is the growth rate of labor's marginal physical product; and

$\pi_t^p = \ln P_t - \ln P_{t-1}$ and is the rate of price inflation.

If we define $\pi_t^w = \Delta w_t - \Delta z_t$ as the rate of productivity-adjusted wage inflation, then equation 3 implies that the growth rates of price and wage inflation equal one another. In this simple world, the price inflation-wage inflation gap always equals zero.

Relaxing the assumption that firms are price-takers in labor and product markets can

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weaken the tight connection between wage and price inflation. In the case of monopoly or oligopoly, the output price no longer equals the competitive price. The monopolistic firm faces a downward-sloping demand curve for its product; that is, it is unable to sell all additional units of output it produces at the current price. When production is increased, the price of all units of output declines. The profit-maximizing monopolist must internalize this price effect in determining its optimal level of output and employment. In effect, because a degree of monopoly power is introduced, a wedge is introduced in the equilibrium condition of equation 2 so that the term on the right-hand side of the equation exceeds the wage rate. A similar wedge is introduced when the firm is the sole purchaser of a given labor service. In the case of a monopsonist, the firm faces an upward-sloping supply curve for labor; that is, it cannot hire additional labor input at the existing wage rate. Instead, if the firm increases the level of employment, the wage paid to all labor rises accordingly so that the marginal cost in fact exceeds the wage. The equilibrium condition of equation 2 no longer holds. Instead a wedge is introduced that causes the value of the marginal product of labor to exceed the wage.

Let μ be the markup, that is, the amount by which the output price, P, differs from the productivity-adjusted wage rate, $W/f'(L)$. The equilibrium condition then becomes

(4) $P\mu = W/f'(L)$,

where $\mu > 1$. The markup is determined by the degree of monopoly and monopsony power in the particular market. Furthermore, the markup can change over time. In an oligopolistic industry, price wars cause the markup to decrease. Decreasing the markup shifts the labor demand curve outwards. The increased demand for labor that results should be associated with a decline in the unemployment rate. Similarly, the monopsonist markup depends upon the number of close competitors for labor services. As the monopsonist's markup declines, the demand curve for labor services effectively shifts outward, again producing a decrease in the unemployment rate.

Other models of the labor market also suggest a wedge between the nominal wage rate and the value of the firm's marginal product of labor. For example, suppose that the firm incurs substantial hiring and firing costs when adjusting its labor input. Hiring costs can reflect such items as search and training costs. Firing costs can reflect problems with worker morale, legal fees, and higher unemployment insurance expenses. Costs such as these, that are incurred when the firm changes its level of employment, are referred to generally as adjustment costs. The profit-maximizing firm must assess how its current hiring and firing decisions affect its future production. By increasing its level of employment, the firm incurs not only the direct cost of wages, but also an additional adjustment cost that depends on the change in the level of employment. If the firm's level of employment is nearly optimal, then adjustment costs will be relatively small and the equilibrium condition of equation 2 holds reasonably well. However, adjustment costs can be substantial, with significant deviations from the equilibrium condition.

According to this model, the deviations are not completely random. Suppose, for example, that the firm finds it optimal to increase its labor force. It does not increase it to the new equilibrium level all at once, but gradually so as to avoid incurring large adjustment costs. During this period of adjustment, the value of the firm's marginal product of labor exceeds the wage rate with the gap declining over time. The model suggests that the productivity-adjusted wage-price gap should at some times be positive and at other times negative. Moreover, the gap should adjust slowly over time so that, for example, if it is positive today, it is likely to continue to be positive tomorrow; that is, the gap is positively serially correlated.

In the case in which adjustment costs are captured by $(c/2)(L_{t+1} - L_t)^2$, the equilibrium condition becomes

(5) $Pf'(L) = W + c(L_{t+1} - L_t) - c\beta(L_t - L_{t-1})$,

where β is the discount factor and t indexes the time period. In the long run after the firm is at its optimal level of employment where $L_{t+1} = L_t = L_{t-1}$, the last two terms in equation 5 disappear so that the familiar marginal condition holds. In the short term, deviations will occur from the equilibrium described in equation 2.

This simple model does not directly address the issue of unemployment. However, it is reasonable to expect that periods of time

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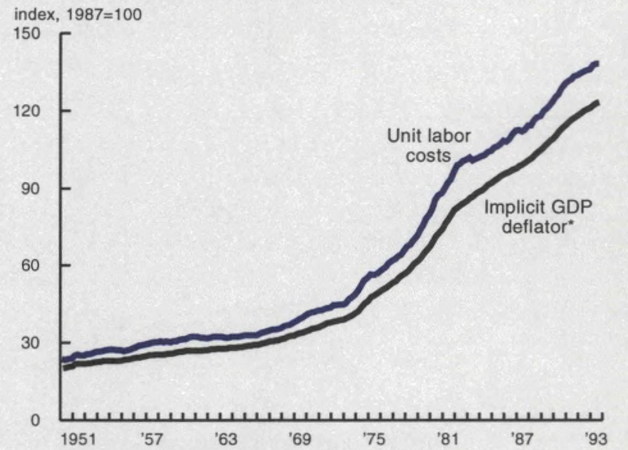
during which firms are rapidly increasing their level of employment will coincide with periods of falling unemployment. Conversely, when firms lay off workers, the unemployment rate should rise. This observation suggests that while in the long term the rate of growth of productivity-adjusted wages equals the inflation rate, short-term deviations are correlated with the unemployment rate.

FIGURE 1

Wage and price trends



*Nominal nonfarm nongovernment gross domestic product divided by real nonfarm nongovernment gross domestic product.
Source: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings.*

The data

The theory of the profit-maximizing firm presented above suggests that there is a specific long-run relation between wage inflation and price inflation. Short-term deviations may occur, but there is a tendency for these variables to converge to their equilibrium relation expressed in equation 3. The analysis that follows includes data for the United States nonfarm business sector. Agriculture and government are omitted from the discussion because of the difficulty in imputing wages in the former sector and the noncompetitive nature of the latter. The price level variable, denoted as *PGDP*, is defined as the implicit gross domestic product (GDP) deflator for the nonfarm business sector. This has been constructed by dividing nominal GDP less government and farm output by the analogous real quantity. The unemployment rate, *UR*, is that of the civilian labor force. The Bureau of Labor Statistics measures unit labor costs for the nonfarm business sector, *ULC*, as $w * L/y$ where y is real output, L is labor hours, and w is the nominal wage.[5] If production can be described by a Cobb-Douglas technology, the average and marginal productivity are identical. Unit labor costs therefore measure productivity-adjusted nominal wages.

The data cover the period beginning the first quarter of 1950 and ending the third quarter of 1993. The price level (*PGDP*) and productivity-adjusted nominal wages (*ULC*) are shown in figure 1. The two series follow each other quite closely, with price and wage growth accelerating through the late 1970s and slowing markedly in the 1980s. Growth rates of the two series (π^p and π^w) are shown in figure 2. Again the time-series pattern between the two are quite similar. Both exhibit increasing growth over the 1960s with a significant decline in the 1980s. However, neither inflation nor productivity-adjusted nominal wage growth appears to revert to its mean. In fact, the most salient feature is the persistence of both inflation and productivity-adjusted wage growth. Inflation tends to increase at the same

FIGURE 2

Growth rates of prices and wages

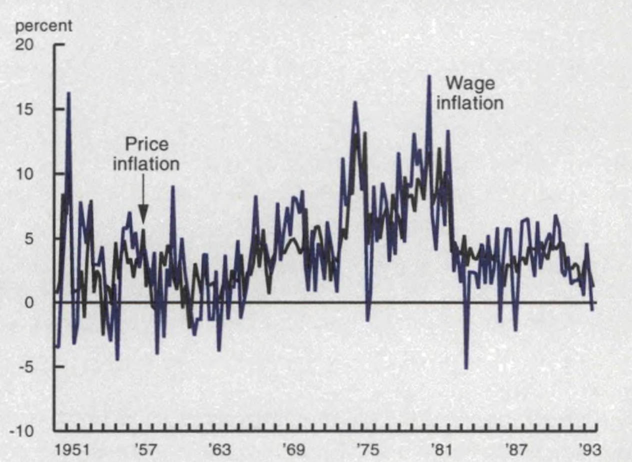


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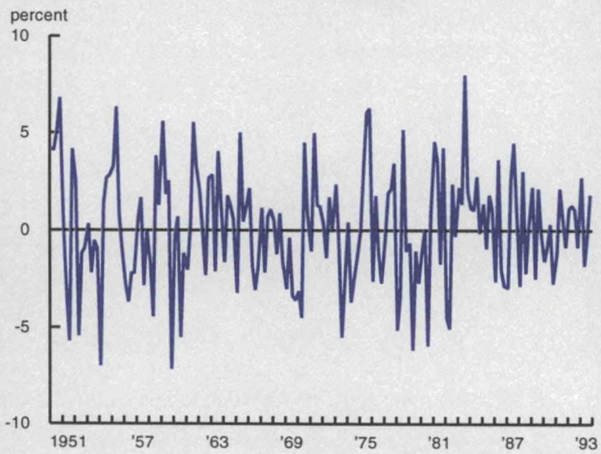
FIGURE 3

Price inflation less productivity-adjusted wage growth



EC should exhibit some positive serial correlation and revert to its mean over time; that is, it should be stationary. The evidence in figure 3 clearly supports this interpretation.

Finally, the civilian unemployment rate is shown in figure 4. Although there does appear to be an increase in the unemployment rate over the 1970s and early 1980s with a subsequent decline, formal tests of whether there is a "normal" long-run level of unemployment to which it reverts are inconclusive.

Table 1 reports summary statistics for inflation (π^p), productivity-adjusted nominal wage growth (π^w), the disequilibrium term (*EC*), and civilian unemployment (*UR*). All growth rates are expressed in annual percentage terms and are calculated as the log first difference in the variable.

The table clearly shows the increase in inflation from 2.8 percent in the 1950s to 6.7 percent in the 1970s with a decline in the 1980s to 4.5 percent. Similar behavior holds true for productivity-adjusted wage growth. In the 1950s, wage growth averaged 2.8 percent, increasing over the 1970s to 6.8 percent and declining in the 1980s to 4.1 percent. Although the two series are similar in magnitude, wage growth is much more volatile. As expected, the disequilibrium term *EC* shows no tendency to rise or fall over time. Finally, the unemployment rate shows a slight upward trend through the 1960s, increasing dramatically in the 1970s and 1980s.

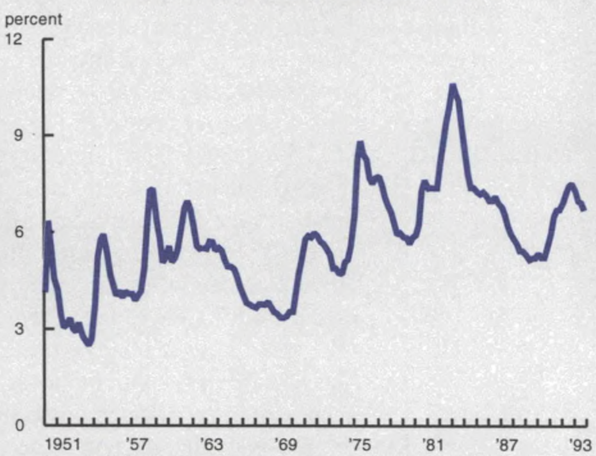
The crude descriptions of the variables' time-series behavior suggests that empirical models of wage and price dynamics should incorporate the following behaviors. First, inflation has no long-term "normal" level, and shocks to inflation appear to be persistent. In other words, disturbances to inflation tend to be permanent. In addition, although inflation and wage growth both exhibit some persistence, with no

time that wage growth is rising. Although simple correlations do not imply causality, the similarity in time-series behavior between inflation and wage growth suggests that there may be some superficial justification for the contention that lower wage growth should lead to lower inflation rates.

The difference between inflation and productivity-adjusted nominal wage growth ($EC = \pi^p - \pi^w$) reflects deviations away from long-run equilibrium. The disequilibrium term, *EC*, is shown in figure 3. According to the theory of the firm discussed above, this term should be zero in the long run. In terms of its time-series behavior, this suggests that

FIGURE 4

The civilian unemployment rate



Source: U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*.

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tendency to revert to a mean rate of growth, there does appear to be a stable long-term relation between the two series, with disturbances to one apparently affecting the other in much the same way. Finally, we interpret abnormally high or low levels of unemployment as being transitory, so that there is some stable "normal" unemployment rate, regardless of its current value.

Forecasting

A forecasting framework that accounts for these features of the data and the long-run restriction on wage and price inflation is the error corrections model. Engle and Granger (1987) discuss the econometric restrictions which this model imposes. In the simplest form of this model, the changes in wage and price inflation are linear functions of the price-wage inflation gap plus a random error term:

$$(6)\quad \Delta\pi_t^p = \alpha^1(\pi_{t-1}^p - \pi_{t-1}^w) + \varepsilon_t^1$$
$$\Delta\pi_t^w = \alpha^2(\pi_{t-1}^p - \pi_{t-1}^w) + \varepsilon_t^2.$$

The error terms, ε_t^1 and ε_t^2, are normally distributed and have zero mean. They are possibly correlated with each other, but they are independent over time. In the short run, changes in price and wage inflation respond to the price-wage inflation gap. If the system were left undisturbed, these adjustments would eliminate the gap in the long run. Because the error terms constantly disturb the system, however, the gap never closes to zero. Rather, it fluctuates around it.

The system's short-run dynamics are very simple. If $a^1 < 0$ and $a^2 > 0$, then price inflation decreases and wage inflation increases to eliminate the price-wage inflation gap. In this case, only the current price-wage inflation gap is useful for constructing inflation forecasts.

TABLE 1

Summary statistics, 1950:Q1 – 1993:Q3

	π^p		π^w		EC		UR	
Decade	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
1950s	2.80	2.90	2.82	4.15	–0.02	3.50	4.51	1.28
1960s	2.53	1.85	2.61	3.27	–0.08	2.50	4.78	1.08
1970s	6.70	2.74	6.78	4.20	–0.09	3.10	6.22	1.17
1980-93	4.54	2.48	4.09	3.74	0.45	2.65	7.11	1.39

Note: S.E. indicates the standard error.

Including lagged changes in price and wage inflation on the right-hand side of model 6 enriches the system's short-run dynamics without altering the long-run restriction on the price-wage inflation gap:

$$(7)\quad \Delta\pi_t^p = \alpha^1(\pi_{t-1}^p - \pi_{t-1}^w) + \Sigma_{j=1}^k \gamma_j^1 \Delta\pi_{t-j}^p + \Sigma_{j=1}^k \lambda_j^1 \Delta\pi_{t-j}^w + \varepsilon_t^1$$

$$\Delta\pi_t^w = \alpha^2(\pi_{t-1}^p - \pi_{t-1}^w) + \Sigma_{j=1}^k \gamma_j^2 \Delta\pi_{t-j}^p + \Sigma_{j=1}^k \lambda_j^2 \Delta\pi_{t-j}^w + \varepsilon_t^2.$$

These equations use the price-wage inflation gap and *k* lags of changes in price and wage inflation for forecasting. With this richer specification, previous changes in wage inflation are potentially useful for forecasting price inflation. The model's parameters are not known, but they can be estimated using ordinary least squares.

Whether wage inflation is useful for forecasting price inflation depends upon the model's parameters. If either $\alpha^1 \neq 0$ or $\lambda_j^1 \neq 0$ for some *j*, then data on wage inflation help forecast price inflation. If this is not true, then forecasts using only price inflation data are adequate. Therefore, a test of the null hypothesis,

$$(8)\quad H_0 \begin{cases} \alpha^1 = 0 \\ \lambda_1^1 = 0 \\ \vdots \\ \lambda_k^1 = 0, \end{cases}$$

will indicate whether wage inflation can help forecast price inflation.

It is simple to test hypothesis 8 by estimating the first equation of model 7 and estimating an analogous equation eliminating lagged changes in wage inflation and the price-wage inflation gap. If the first equation fits the data significantly better than the second equation, then the hypothesis can be rejected with confidence. An *F*-test can be used to quantify the relative fit of the two equations. An *F*-statistic compares the estimated standard error of ε_t^1 from the original (unrestricted) equation, σ_{1u}, and that estimated from the restricted equation, σ_{1r}. These standard errors are measures of the equations' forecast accuracy. If σ_{1u} is much larger than σ_{1r} then including data on wage inflation produces much more

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accurate forecasts. In this case, the F-statistic will be large, providing evidence against the hypothesis that wage inflation does not help forecast price inflation. To decide whether the F-statistic is large enough to warrant rejecting the null hypothesis, it can be compared to the critical values of its distribution when hypothesis 8 is true. If the F-statistic exceeds one of the conventional critical values, then the null hypothesis can be rejected with confidence.

TABLE 2

***F*-tests, bivariate error corrections model**

Dependent variable	Excluded data	Test statistic	Degrees of freedom		Lags
$\Delta\pi^p$	π^w	0.55	5	140	4
$\Delta\pi^p$	π^w	0.79	7	136	6
$\Delta\pi^p$	π^w	0.88	9	132	8
$\Delta\pi^w$	π^p	5.99***	5	140	4
$\Delta\pi^w$	π^p	3.59***	7	136	6
$\Delta\pi^w$	π^p	3.30***	9	132	8

***$p < .01$

Table 2 presents F-statistics that test the null hypothesis 8 and those testing the converse hypothesis for the second equation of model 7, that price inflation does not help forecast wage inflation:

$$(9)\quad H_0 \begin{cases} \alpha^2 = 0 \\ \gamma_1^2 = 0 \\ \vdots \\ \gamma_k^2 = 0. \end{cases}$$

The F-statistics were calculated using 4, 6, and 8 lags of price and wage inflation changes as regressors in both the restricted and unrestricted equations. The reported statistics use the entire data sample for estimation. Removing the Korean War period (1950-1953) does not significantly alter the results.

For price inflation and wage inflation to move together in the long run, either $\alpha^1 \neq 0$ or $\alpha^2 \neq 0$. Otherwise, neither variable would respond to the price-wage inflation gap. In the bivariate model, this implies that one of hypotheses 8 and 9 is false. Separately applying F-tests to the price and wage inflation equations of 7 could possibly generate the nonsensical result that neither hypothesis 8 nor 9 can be rejected. This did not occur in practice.

The results of the tests are clear, and they contradict the view that wage inflation is a good short-run predictor of price inflation. With every lag length examined, the F-test provides no evidence against hypothesis 8, that wage inflation is *not* helpful for forecasting price inflation. In contrast, the F-tests universally reject hypothesis 9, that price inflation is not a useful predictor of wage inflation. The estimated error corrections model suggests that wage inflation responds to price inflation and to the price-wage inflation gap, but that price inflation has a life of its own.

These results illustrate the pitfalls of extrapolating from the long run to the short run. In the estimated version of the error corrections model, wage inflation and price inflation move together. This says nothing about how they adjust in the short run. They move together because wages adjust to close the price-wage inflation gap, not because price inflation responds to wage inflation.

One advantage of the simple bivariate error corrections model is its parsimony. However, the model focuses on the price-wage inflation gap, when there may be other important short-run determinants of price and wage inflation. One obvious candidate for such a determinant is the unemployment rate. By tightening and loosening the labor market, changes in the unemployment rate can have short-run effects on wage inflation. To the extent that firms' prices reflect changes in their labor costs, the unemployment rate can also cause short-run movements in price inflation. To incorporate these effects into the error corrections model, one can include lags of the unemployment rate in the wage and price inflation equations. Augmenting those equations with an unemployment equation completes the trivariate error corrections model:

$$(10)\quad \Delta\pi_t^p = \alpha^1(\pi_{t-1}^p - \pi_{t-1}^w) + \Sigma_{j=1}^k \gamma_j^1 \Delta\pi_{t-j}^p + \Sigma_{j=1}^k \lambda_j^1 \Delta\pi_{t-j}^w + \Sigma_{j=1}^k \delta_j^1 u_{t-j} + \varepsilon_t^1$$

$$\Delta\pi_t^w = \alpha^2(\pi_{t-1}^p - \pi_{t-1}^w) + \Sigma_{j=1}^k \gamma_j^2 \Delta\pi_{t-j}^p + \Sigma_{j=1}^k \lambda_j^2 \Delta\pi_{t-j}^w + \Sigma_{j=1}^k \delta_j^2 u_{t-j} + \varepsilon_t^2$$

$$u_t = \alpha^3(\pi_{t-1}^p - \pi_{t-1}^w) + \Sigma_{j=1}^k \gamma_j^3 \Delta\pi_{t-j}^p + \Sigma_{j=1}^k \lambda_j^3 \Delta\pi_{t-j}^w + \Sigma_{j=1}^k \delta_j^3 u_{t-j} + \varepsilon_t^3.$$

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The error term in the unemployment equation, ε_t^3, is identically and independently normally distributed over time. It is possibly correlated with ε_t^1 and ε_t^2.

Including unemployment as a short-run determinant of inflation alters the dichotomy found with the simpler bivariate model. Although wage inflation does not significantly enter the price equation, the unemployment rate does. On the other hand, including unemployment in the wage equation reduces the importance of price inflation. The unemployment rate significantly enters the wage equation, but lagged price inflation does not. This suggests that the unemployment rate plays a key short-run role in maintaining the long-run restriction on the price-wage inflation gap.

TABLE 3

***F*-tests, trivariate error corrections model**

Dependent variable	Excluded data	Test statistic	Degrees of freedom		Lags
$\Delta\pi^p$	π^w	2.49**	5	136	4
$\Delta\pi^p$	π^w	1.51	7	130	6
$\Delta\pi^p$	π^w	1.36	9	124	8
$\Delta\pi^w$	π^p	0.98	5	136	4
$\Delta\pi^w$	π^p	0.83	7	130	6
$\Delta\pi^w$	π^p	1.00	9	124	8

**$p < .05$

Table 3 presents the *F*-statistics that test the null hypotheses 8 and 9 using the trivariate error corrections model 10. Because unemployment can react to the price-wage gap, and price and wage inflation can react to unemployment, it is no longer necessary for either hypothesis 8 or 9 to be incorrect. The test fails to reject hypothesis 8 for all three lag specifications. When $k = 4$, the hypothesis that wage inflation does not help forecast price inflation is rejected at the .05 level. With the other two lag specifications, the test statistic falls below all conventional critical values. Adding unemployment to the analysis reduces the forecast power of price-inflation and the price-wage inflation gap.

If price and wage inflation do not help forecast one another, then at least one of them must be influenced in the short run by the unemployment rate. Table 4 reports *F*-tests of the hypotheses that the unemployment rate does not influence price or wage inflation in the short run. The null hypothesis for the first test is

$$(11)\quad H_0 \begin{cases} \delta_1^l = 0 \\ \vdots \\ \delta_k^l = 0. \end{cases}$$

When $l = 1$, this restriction omits the unemployment rate from the price equation. If $l = 2$, the unemployment rate is dropped from the wage equation. The test statistics indicate that the unemployment rate is an important short-run determinant of price and wage inflation. Unemployment enters the wage equation significantly with all three lag specifications. Unlike in the bivariate model, wage inflation does not respond directly to the gap. Rather, the unemployment rate first responds. Then wage inflation reacts to the change in unemployment via a Phillips curve type mechanism. Consideration of the unemployment rate also casts doubt on the proposition that the price level is independent of labor market phenomena. With four and six lags, the unemployment rate significantly enters the price equation.

Both the bivariate and trivariate systems of hypothesis 8 and model 10 can be used to generate forecasts of inflation. The results are shown in table 5. No exclusionary restrictions have been incorporated. The equations have been estimated over the period beginning in 1956:Q3 and ending in 1993:Q3 so that the Korean War period is excluded. In addition, the estimation was done using 4, 6, and 8 lags

TABLE 4

***F*-tests, trivariate error corrections model**

Dependent variable	Excluded data	Test statistic	Degrees of freedom		Lags
$\Delta\pi^p$	u	3.08**	5	136	4
$\Delta\pi^p$	u	1.98*	7	130	6
$\Delta\pi^p$	u	1.64	9	124	8
$\Delta\pi^w$	u	4.59***	5	136	4
$\Delta\pi^w$	u	3.73***	7	130	6
$\Delta\pi^w$	u	2.80***	9	124	8

* $p < .10$
** $p < .05$
*** $p < .01$

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TABLE 5

Inflation and wage growth forecasts, bivariate and trivariate models

		Bivariate model					
		4 lags		6 lags		8 lags	
Year	Quarter	$\Delta\pi^p$	$\Delta\pi^w$	$\Delta\pi^p$	$\Delta\pi^w$	$\Delta\pi^p$	$\Delta\pi^w$
1994	2	0.0044	0.0055	0.0132	0.0166	0.0168	0.0166
1994	4	0.0040	0.0045	0.0153	0.0193	0.0163	0.0140
1995	2	0.0035	0.0032	0.0156	0.0148	0.0142	0.0167
1995	4	0.0035	0.0035	0.0146	0.0144	0.0157	0.0169
1996	2	0.0036	0.0035	0.0145	0.0143	0.0154	0.0159
1996	4	0.0036	0.0036	0.0144	0.0140	0.0150	0.0163
		Trivariate model					
1994	2	0.0002	−0.0098	0.0071	0.0030	0.0166	0.0195
1994	4	−0.0030	−0.0057	0.0075	0.0146	0.0175	0.0103
1995	2	−0.0037	−0.0017	0.0115	0.0158	0.0150	0.0158
1995	4	−0.0033	−0.0030	0.0142	0.0164	0.0147	0.0152
1996	2	−0.0030	−0.0042	0.0143	0.0145	0.0137	0.0138
1996	4	−0.0031	−0.0046	0.0132	0.0103	0.0136	0.0123

of the data. The forecast period begins in 1993:Q4 and ends in 1996:Q4. No standard errors have been estimated so that care must be taken in interpreting the results.

To summarize the results, inflation forecasts are sensitive to the lag length used in the estimation as well as the model employed. Because the uncertainty surrounding these forecasts was not computed, these are only meant to be crude guideposts. Forecasts of price and wage growth increase with lag length in both the bivariate and trivariate models. Using only four lags of data, the inflation forecasts are unreasonably low. This reflects a great weight given to the wage deflation at the end of 1993. Forecasts constructed using 6 and 8 lags assign this deflation a smaller weight. Adding the unemployment rate to the system slightly changes the forecasts. In the case of six lags, wage growth and inflation are lower at the beginning of the forecast period when unemployment is incorporated in the analysis. The converse appears to be the case when eight lags of data are used in the estimation.

Conclusions

The short-run forecasting exercise illustrates an important point: It is dangerous to extrapolate short-run behavior from long-run restrictions. Although it is tempting to use information about nominal wage growth to infer the future path of prices, it is not valid to do so. The error corrections models estimated here are consistent with the long-run restriction that price and wage inflation equal each other. However, wage inflation is not a good short-run predictor of price inflation. In a simple bivariate analysis, price inflation appears to have a life of its own. Price and wage inflation move together in the long run because wages adjust to close the gap, and not because price inflation responds to wage inflation.

Including unemployment as a short-run determinant of inflation alters the results of the simpler bivariate model. The unemployment rate significantly enters both the price and wage equations. Price inflation no longer appears to have a life of its own, but is influenced by labor market phenomena. The empirical results cast doubt on the simple wage-price spiral view of inflation. Unlike the bivariate model, price inflation does not enter the wage equation once unemployment is incorporated. This suggests that the unemployment rate plays a key short-run role in maintaining the long-run restriction on the price-wage inflation gap. The exact nature of this role is not yet clear, but a Phillips curve type of relation seems to appear in the sense that lagged unemployment is an important predictor of nominal wage and price growth.

This finding implies lessons for policymakers. First, any argument that lower infla-

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tion is likely since wage growth is slow is not supported by the data. Rather, the bivariate model suggests that price growth does not respond to wage growth. Second, wage and price growth projections depend on the variables included in the model. If one wishes to forecast future wage and price growth, the unemployment rate is a useful guide.

FOOTNOTES

[1]See Okun (1981), p. 3.

[2]See Gordon (1982, 1985, 1988) and Stockton and Glassman (1987) for examples of the expectations-augmented Phillips curve.

[3]Several researchers, including Sachs (1980) and Neumark and Leonard (1991) have experimented with alternative expectations formulations and incorporated more complicated models of wage and price dynamics.

[4]For an assessment of cost-push versus demand-pull inflation, see Barth and Bennett (1975).

[5]The data used to construct the implicit price deflator for the nonfarm business sector come from the *National Income and Product Accounts* published by the U.S. Department of Commerce. Data on the unemployment rate can be found in the *Monthly Labor Review*, and unit labor costs can be found in *Employment and Earnings*, both published by the U. S. Department of Labor, Bureau of Labor Statistics.

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The 30th Annual Conference on Bank Structure and Competition

May 11-13, 1994

The Declining? Role of Banking

On May 11-13, 1994, the Federal Reserve Bank of Chicago will hold its 30th annual Conference on Bank Structure and Competition at the Westin Hotel in Chicago. The conference will evaluate questions related to the widely perceived decline in the role of commercial banks in the provision of financial services: Is commercial banking truly in decline or is the composition of its activities simply evolving? What are the causes of this decline or evolution? How should bank managers respond? Does the alleged decline create public policy problems?

The 1994 conference will feature discussions of these and related issues by some of the most prominent financial practitioners, regulators, and academics in the country, including Alan Greenspan, Chairman of the Board of Governors of the Federal Reserve System, and Eugene A. Ludwig, Comptroller of the Currency.

Undoubtedly, Chairman Greenspan's keynote address on Thursday morning will be carefully scrutinized by the financial press for clues regarding any subtle shifts in the position of the Federal Reserve on key issues facing the U.S. financial system. Thursday's special luncheon address by Eugene Ludwig marks the first appearance on the conference program by an incumbent Comptroller of the Currency. Mr. Ludwig's participation in the program takes on added significance in view of the ongoing debate over the Administration's proposals for bank regulatory reform and enhanced enforcement of the laws governing banks' responsibilities to their local communities.

This year's theme panel will offer candid and insightful analyses of the competitive realities facing banking today and how they might best be addressed. The panel features Carter H. Golembe, chairman emeritus of the Secura Group; Edward E. Furash, chairman of Furash & Company; Robert E. Litan, deputy assistant attorney general for antitrust, U.S. Department of Justice; and William E. Odom, chairman of Ford Motor Credit Company. Their greatly differing vantage points and expertise promise a lively and provocative session.

If banking is in fact in a state of decline, the consequences of that decline necessarily fall most heavily on the owners, managers, and employees of banks. The members of the conference's concluding panel on Friday, "Bank Strategies for Survival and Success," are chief executive officers of banking organizations that have not only survived, but thrived on the challenges of today's marketplace. They are Richard M. Kovacevich of Norwest Corporation, John B. McCoy of Banc One, and Thomas C. Theobald of Continental Bank. The diversity of their approaches is sure to offer something of value for every conference participant.

The first day of the conference is intended primarily for an academic audience and will emphasize technical research papers. Thursday's and Friday's sessions are addressed to a more general audience. Invitations to the conference will be mailed in March.

If you are not currently on our mailing list or have changed your address and would like to receive an invitation to the conference, please contact the Public Affairs Department of the Federal Reserve Bank of Chicago at 312-322-5114, or send your request to Public Affairs Department – 3rd Floor, Federal Reserve Bank of Chicago, P.O. Box 834, Chicago, Illinois 60690-0834.

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