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Clearing and Settlement of U.S. Dollar Payments: Back to the Future?

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The Federal Reserve System was formed in 1914. Wide dissatisfaction with routinely expensive and slow settlement of interregional payments, as well as occasional disruptions of the payments system caused by banking panics, are among the factors that led to its creation. Accordingly, an important purpose for creating the Federal Reserve to serve as the nation's central bank was to enhance the efficiency and improve the stability of the nation's payments system.

At the time of the formation of the Federal Reserve, the paper check was the principle means of making payment. The Federal Reserve attempted to fulfill its mandate for improving the check-collection system by providing banks with a national check-collection service.[1] Since it was the only institution with a nationwide network of banking offices and settlement accounts for banks, it had an advantage in interregional check collection. Over time, the Reserve Banks added new payment services to exploit the advantages of new technology: wire transfer of reserves, a book-entry service for safekeeping and electronically transferring ownership of government securities, and the automated clearinghouse, designed as an electronic alternative to checks.

The share of U.S. dollar payments processed through the Federal Reserve Banks began declining in 1980, when the Reserve Banks began charging for payment services, as required by the Monetary Control Act. This declining share, for both small- and large-dollar payments, appears to represent a major shift in the operation of the U.S. dollar payments system. Our paper examines the implications of this shift for the Federal Reserve's ability to fulfill its mandate to safeguard the stability and efficiency of the payments system. In particular, we examine whether the problems that existed in the payments system prior to 1914 will at some time reappear as the Fed's operational role declines. It is important to consider whether the nation's payments system has changed in ways that make Reserve Bank services less essential for dealing with the problems that have beset it in times past, and what the future role of the Federal Reserve Banks should be as payment processing systems continue to evolve.

The following section examines the operation of the payments system prior to the formation of the Federal Reserve, focusing on aspects of the system that were considered defects by advocates of a central bank. Subsequent sections establish a conceptual framework for our analysis and describe the payment services offered by the Reserve Banks and trends in their share of the total volume and value of U.S. dollar payments processed each year. The article then discusses reasons for the declining Reserve Bank share of payment processing and the implications of these trends for the payments system.

PROBLEMS WITH THE PAYMENTS SYSTEM PRIOR TO THE FORMATION OF THE FEDERAL RESERVE

An analysis of the importance of Reserve Bank payment services for the banking industry in the United States

[1] For convenience, depository institutions are called banks.

requires a review of some banking history.[2] By the mid-1850s, the dollar value of U.S. bank deposits exceeded that of banknotes, and the value of transactions settled by check exceeded the value of transactions settled by banknote. This growth in check transactions required a system for clearing a large number of checks among banks. Before the introduction of Federal Reserve services, commercial banks cleared checks drawn upon other local banks by channeling them through local clearinghouses or delivering them directly to the local banks for payment. Typically, local checks could be collected quickly and at par.

Collecting checks drawn on banks outside a given community involved more time and expense. When checks were presented directly to paying banks at their place of business, the banks were required by law to pay the face value of the checks. Banking law did, however, permit banks to pay less than the face amount of checks submitted for collection by indirect means, such as through the mail. The rationale for this deduction from the face amount, called an exchange charge, was that remitting payment could involve certain costs, including the cost of transporting coin or bank notes from the paying bank to the collecting bank. Delays were another expense to collecting banks, in addition to exchange charges. Under banking law, a bank that received checks through the mail became the collecting agent for the bank that had sent them and was therefore responsible for obtaining payment from itself. As a result, paying banks often remitted funds to collecting banks several days after receiving checks through the mail.

Despite the rationale for exchange charges, many bankers considered them a basic defect in the operation of the payments system. Prior to the formation of the Federal Reserve System, there were several major proposals and attempts by bankers to eliminate exchange charges. Opposition to exchange charges was most common among bankers in the larger cities, where banks generally paid for checks drawn on accounts of their depositors at par, through local clearinghouses. The banks that imposed exchange charges generally were relatively small and located in more isolated areas.

Collecting banks attempted to avoid these delays and exchange charges by using the services of correspondent banks. Often depository banks (the banks of first deposit) sent checks drawn on banks outside their communities to their correspondent banks. The correspondents would then send the checks to other banks with offices near the paying banks, which, in turn, would present the checks to the paying banks over the counter. In this system of collection through correspondents, depository banks might receive less than the face amount of the checks, but more than if the checks were sent directly to paying banks. The correspondents would split the collection fee (the difference between the face value of the checks and the amount credited to the demand accounts of the depository banks) with the other banks that had assisted them in getting the checks to the paying banks. In some arrangements, the correspondents would credit the demand accounts of depository banks for the full amount of the checks being collected but would require the depository banks to hold large demand balances as a form of compensation for this service. Under either arrangement, it was competition among correspondent banks that tended to reduce the costs of collecting interregional checks.

The process of collecting checks through correspondents as a means of avoiding exchange charges led to some notorious cases of checks passing through the offices of many banks and traveling over very long distances, relative to the actual distance between the depository bank and the paying bank. Many of the resulting delays and operating expenses could have been avoided through more direct collection channels. Competition among correspondent banks, however, led to substantially reduced levels of exchange charges over time (Spahr, 1926, pp. 102–3).

[2] The discussion of the check-collection system prior to 1914 and changes made by the Federal Reserve is based on Spahr (1926), chapters IV, VI, and VII; Watkins (1929), chapter VI; and White (1983), chapter 2.

Although exchange charges declined substantially over time, many bankers continued to view them as a fundamental defect in the operation of the nation's payments system. Congress responded to calls for reform by giving the Federal Reserve a mandate to improve the efficiency of the payments system, and the Federal Reserve responded by establishing a national network of offices for collecting checks. Because the Federal Reserve Act forbids the Reserve Banks from paying exchange charges to banks, the Reserve Banks established the practice of accepting for deposit only those checks drawn upon banks that had agreed to pay the Reserve Banks at par.[3] Although the Federal Reserve was not granted legal authority over the exchange charges set by individual banks, its dominant operational role in check collection eventually made collection at par (zero exchange charges) a national standard for the banking industry.

Another problem with the operation of the payments system prior to the formation of the Federal Reserve in 1914 was the occasional disruption of the payments system caused by banking panics. When events caused depositors to lose confidence in the safety of their deposits, they demanded payment in gold coin, banknotes or greenbacks.[4] Banks located outside the major financial centers maintained large shares of their cash assets in deposits with major banks in the financial centers, particularly New York City, and they tended to respond to depositors' substantial cash withdrawals by drawing down deposits with these banks. Sprague (1910), in his analysis of banking panics in the national banking era, emphasized that the concentration of bankers' deposits in a small number of banks in New York City made the banking system vulnerable to disruption.

Bankers attempted to cope with panics through cooperative arrangements implemented through their local clearinghouses. During normal times, activities of the clearinghouses were limited largely to check clearing and settlement: Banks deposited gold with the clearinghouses and received certificates that served as claims on the gold; they cleared checks through the clearinghouses and settled their net positions with clearinghouse certificates. At times of relatively high depositor demand for gold and currency (banknotes and greenbacks), the clearinghouses created additional certificates for interbank settlement, called loan certificates. Banks that borrowed these additional certificates from their clearinghouse pledged some of their commercial loans or other securities to the clearinghouse as collateral. This process of accepting bank loans as collateral and issuing loan certificates had the effect of increasing the monetary base. Members of the clearinghouse could use the gold and currency in their vaults to meet the demand of their depositors without concern that they would have insufficient cash assets to cover net debit positions at the clearinghouse.

On several occasions after clearinghouses had created loan certificates for their members, clearinghouse members also suspended currency payments to their depositors. While creation of loan certificates helped banks respond to unusually large demands for currency, the loan certificates were used primarily to settle interbank positions with the clearinghouse. Banks were obligated to pay their depositors gold or currency but did not always do so when their inventories were inadequate to meet the demand of their depositors.[5] Instead, during some general suspensions of currency payments to depositors, banks paid their depositors small-denomination loan certificates, issued by their clearinghouses, which served as substitutes for currency in emergency situations (Andrew, 1908).

Before the creation of the Fed, when banks in major financial centers suspended currency payments to depositors, major disruptions in the payments system resulted. There is evidence that these suspensions, each of which lasted only one or two months during the period from the Civil War through 1914, seriously disrupted economic activity, including

[3] Under the Federal Reserve's Regulation J, which governs the collection of checks and other items by Reserve Banks, an "item" does not include a check that cannot be collected at par. Further, the Reserve Banks are required to accept cash and other items at par.

[4] After passage of federal banking legislation in the 1860s, the paper currency in circulation comprised notes issued by national banks and greenbacks (fiat currency issued by the United States Treasury). Because national banks were required to back their notes with U.S. Treasury securities deposited with the Treasury Department, the public considered national bank notes as safe as gold coins, even during banking panics.

[5] Some have criticized the national banks in New York City for suspending currency payments when they still had large amounts of gold and currency in their vaults. These critics maintain that the banks were too concerned about meeting their legal reserve requirement—vault cash (gold and currency) that equalled or exceeded 25 percent of their deposits—rather than using all of the cash in their vaults to meet demands of their depositors (Dewald, 1972).

interregional and foreign trade, particularly in 1873 (Sprague, 1910, pp. 71–82) and in 1893 (pp. 119–210).

The Federal Reserve System, modeled after the clearinghouses of the period, was authorized to deal with panics by increasing bank reserves through discount window loans.[6] Its creators assumed that government sanction would lessen the impact of banking panics, and an experience in 1914, just before the Fed was created, may support this assumption. The outbreak of war in Europe triggered runs on U.S. banks. However, the Aldrich-Vreeland Act of 1908 had authorized clearinghouses to put into circulation emergency issues of national banknotes, which had been printed and stored for such an event. Roberds (1995), who finds that the real economic impact of the panic of 1914 was smaller than that of prior panics, argues that the difference can be attributed to government sanction for the emergency issuance of national banknotes.

CONCEPTUAL FRAMEWORK

This section describes some concepts that are fundamental to understanding the operation of the payments system and the role of the Reserve Banks.

Clearing and Settlement

In describing Reserve Bank services, it is useful to distinguish between two processes: the clearing of payments and interbank settlement of payment obligations. Most Reserve Bank services combine the clearing and settlement functions, although the Reserve Banks also offer interbank settlement services, with the clearing of payments among the banks performed through private channels. The implications for the payments system of declining Reserve Bank operations depend on which function of the Fed is affected more: clearing or settlement.

Clearing comprises three main steps: processing payment instruments, delivering them to paying banks, and calculating interbank payment obligations. Settlement involves discharging the payment obligations. To illustrate the distinction between these two functions, consider the clearing and settlement of checks among banks that are members of a clearinghouse. Banks rely on the clearinghouse to perform the clearing function when they exchange checks drawn on each other. Then the clearinghouse calculates the multilaterally netted payment obligations due to and due from each clearinghouse participant. Banks participating in the clearinghouse have various options for settling these obligations. Members of the clearinghouse can agree to settle using cash or more likely the deposit liabilities of a private bank, which might also be a member of the clearinghouse, or through another institution. Alternatively, settlement could be accomplished through the transfer of reserves maintained at the Reserve Banks. Using Federal Reserve Bank liabilities to achieve interbank settlement is important from a public policy perspective for at least two reasons: First, reliance on Reserve Bank liabilities contributes to the robustness of settlement arrangements and reduces the moral hazard that might result if all providers of payment services relied upon a small number of large commercial banks as settlement intermediaries. Second, it is by offering Fedwire and net settlement services to clearinghouses that the Federal Reserve is able to exert an indirect form of supervisory influence on the safety and soundness of private clearing arrangements, since the Federal Reserve lacks statutory authority over the operations of clearinghouses. (See Juncker, Summers, and Young, 1991.)

Network Effects

According to the literature on industrial organization, an industry has network effects if the value of a service to a customer depends on the number of other customers using the service. These network effects have important implications for industry structure and competitive behavior (see Economides and White, 1994; Katz and Shapiro, 1994).

Because the payments system has some of the characteristics of a network

[6] See Dwyer and Gilbert (1989) and Roberds (1995). During the 1930s, the Federal Reserve was not effective in dealing with banking panics. One view is that banks relied on the Federal Reserve to deal with the panics, and the Fed did not fulfill its role as the central bank in the face of bank runs.

industry, it is also important to consider the role of network effects in its operation. To illustrate, consider the value of membership in a check clearinghouse to banks with offices in a community where several banks conduct business. Initially, each bank sends payment instruments to each of the other banks demanding payment in currency for checks that are presented. Then, two of the banks in the community decide that they can reduce their operating costs—and the risk of having currency lost or stolen—by arranging for their messengers to meet at an intermediate point and exchange checks. The two banks agree to settle among themselves by debiting and crediting balances they hold with each other, rather than moving currency about the community.

This clearing and settlement arrangement would be even more efficient if these two banks were to get a third bank to join them, clearing checks among the three banks under rules they agree to adopt as a clearinghouse. In the same way, this clearinghouse would be even more valuable for its members if additional banks joined. If these network effects are strong enough, there will be one check clearinghouse in the community, and all banks with offices there will be members.

In an industry with network effects, the first entity to develop a network has an advantage over later entrants. To be successful in developing a rival network, the new entity must convince many participants to switch to its network simultaneously, since the value of a network to each participant depends on the number of other participants using the network. Many years ago, the Reserve Banks developed a dominant network for interregional check clearing, which gave the Federal Reserve leverage over the operation of the payments system. Even if some banks did not like the rules under which the Reserve Banks offered payment services or the process innovations favored by the Fed, those with a lot of interregional checks to clear found it advantageous to use the Fed's clearing and settlement network.

One alternative, of course, to using the Fed's network is to develop a private network for interregional check clearing. Developing such an alternative would have been especially difficult prior to 1980, however, when the Reserve Banks provided payment services to member banks only, free of explicit charge. Prior to passage of the Monetary Control Act of 1980, which required the Reserve Banks to charge for their services, almost all of the banks that cleared a high volume of interregional checks were members of the Federal Reserve System. A rival to the Fed for interregional check clearing would have had to convince banks to pay a positive charge per check (compared to a zero charge per item in the Fed's system) or withdraw from Fed membership and rely on the new private system. Once the Reserve Banks began assessing check-clearing charges and requiring all banks to maintain reserves, the private systems for check clearing became more viable alternatives to the clearinghouse services of the Reserve Banks.

Industries with strong network effects also tend to be highly concentrated. If private payments networks were to supplant the role of the Reserve Banks, this development would raise antitrust issues with respect to access to the payments system. Thus, the declining role of the Reserve Banks in processing payments and the development of private systems for check clearing compel us to examine the issues of competition and monopolies in the nation's payments system.

FEDERAL RESERVE BANK SERVICES

This section reviews the laws and Federal Reserve policies that govern the activities of Reserve Banks as providers of payment services. It also describes the principal payment and payment-related services provided by the Reserve Banks. The appendix describes the payment services of the Reserve Banks in more detail and discusses major changes in the services over the years.

MCA GUIDELINES FOR PRICING BANK SERVICES

The following section of the Monetary Control Act (MCA) specified guidelines for the pricing of Reserve Bank services:

"Over the long run, fees shall be established on the basis of all direct and indirect costs actually incurred in providing the Federal Reserve services priced, including interest on items credited prior to actual collection, overhead, and an allocation of imputed costs which takes into account the taxes that would have been paid and the return on capital that would have been provided had the services been furnished by a private business firm, except that the pricing principles shall give due regard to competitive factors and the provision of an adequate level of such services nationwide."

Thus, the basis for the Federal Reserve's setting the prices of its payment services below levels as specified in this section of the MCA is inadequate competition in markets for payment services or an inadequate level of services in at least some regions of the nation.

Background

The Reserve Banks function as bankers' banks: Banks that use the Fed's payment services maintain reserve balances at the Reserve Banks and have access to credit from the Fed. All transactions cleared through the Reserve Banks are settled on a gross basis; that is, the value of each transaction is settled through a debit or credit to a bank's reserve account. Occasionally, debits and credits resulting from use of the Fed's payment services can cause a bank to miss its target for reserves, or they can cause a negative reserve balance. Reserve Banks lend reserves to banks that are temporarily short of funds, including both intraday credit (daylight overdrafts) and overnight credit (discount window loans or overnight overdrafts). The Reserve Banks also serve as fiscal agents to the federal government by providing payment services to the United States Treasury and to various other government agencies.

Reserve Banks have special privileges and powers as suppliers of payment services. For example, they have legal authority to present checks for same-day settlement later in the day than do private banks. Further, Reserve Banks have access to privileged supervisory information concerning the condition of banks, which they may use to protect themselves from losses in providing payment services and related credit. In addition, they can create reserves to meet the liquidity needs of banks.

Law and Policy Governing Reserve Bank Services

The Reserve Banks provide payment services under the authority of the Federal Reserve Act, as amended over the years. The terms and conditions under which they provide services are governed by regulations of the Board of Governors and implemented through Reserve Bank operating circulars.[7]

The Monetary Control Act of 1980 (MCA) was a watershed for the Reserve Banks as providers of payment services. Prior to passage of the MCA, the member banks in the Federal Reserve shouldered a required reserve burden which they could satisfy through only two forms of nonearning assets: deposits held in accounts with the Reserve Banks and vault cash. Banks that were not members of the Fed system were not burdened by this requirement. Provision of "free" payment services by the Reserve Banks was viewed as an offset to the reserve requirement burden.[8] But the MCA changed all that:

1. It extended the reserve requirements of the Federal Reserve to all depository institutions.

2. It granted all depository institutions access to the discount window and to Reserve Bank services.

3. It required the Reserve Banks to charge explicit fees for their services.

Under the MCA, the Reserve Banks' revenue from fees on their payment services must, over the long run, equal or exceed the cost of providing the services plus a markup to reflect the tax rates and profit rates of private-sector firms (see shaded box on MCA guidelines). Thus, the MCA subjects the Reserve Banks to

[7] Operating circulars are detailed instructions concerning particular banking services, including account services, payment services, and the discount window. Some apply uniformly to all 12 Reserve Banks, while others apply to the services of individual Reserve Banks.

[8] For an analysis of the value of "free" Reserve Bank payment services to member banks relative to the opportunity cost of their required reserves, see Gilbert (1977).

market discipline similar to that faced by commercial firms: Reserve Banks must provide services efficiently, price them competitively, and meet the market's standards for quality services. Further, they must be careful to gauge the profitability of new service offerings.

Since passage of the MCA, the Federal Reserve Board has also issued guidelines that specify in more detail the conditions under which Reserve Banks may provide payment services. The guidelines issued in June 1981, state that "the System should be prepared to remove itself from the provision of those services that can be supplied more efficiently by the private sector, unless there are overriding public interest considerations for maintenance of an operational presence by the System" (Federal Reserve Regulatory Service 7–191). Further, the Board of Governors' May 1990 policy statement on the role of the Federal Reserve in the payments system sets additional conditions to be met before the Reserve Banks may offer new payment services: "the service should be one that other providers alone cannot be expected to provide with reasonable effectiveness, scope, and equity" (Federal Reserve Regulatory Service 7–145.1). Thus, the MCA, together with Federal Reserve Board policies, establishes market-oriented criteria for determining whether and how the Reserve Banks are to provide services.

While these formal and explicit conditions under which Reserve Banks may continue to offer existing services or enter new payment markets were developed after passage of the MCA, earlier decisions by the Board of Governors suggest something about the Federal Reserve's philosophy in providing services. In particular, there is evidence that, well before the MCA, the Board wished to proscribe Reserve Bank involvement in the processing of new types of payment instruments. In the second half of the 1960s, for example, the Federal Reserve came under some pressure from bankers to adapt its check-clearing services to handle the processing of credit card sales slips. For a variety of reasons, including concern over the public sector's shouldering significant new costs for handling a quasi-payment instrument, the Board decided to deny the credit card industry access to the check clearing infrastructure of the Reserve Banks (Brimmer, 1967). Accordingly, the Reserve Banks play no role in processing credit card transactions. Instead, a private-sector infrastructure has grown up to support this important component of the payments system.

In contrast to this decision on processing credit card slips, the Board agreed, at approximately the same time, to requests from bankers that the Reserve Banks provide operational support for the nascent automated clearinghouse (ACH) as a method of processing payments. The ACH represented a desirable alternative to checks that would require new automation systems and significant start-up costs. Because these start-up costs would have been difficult for the private sector to absorb, the Board permitted the Reserve Banks to take on this new operational responsibility.

Payment Services of the Reserve Banks

Cash Services. The Reserve Banks provide coin and currency to banks on demand and receive excess coin and currency from banks; the banks' reserve accounts are debited and credited for the value of these transactions. However, Reserve Banks do not charge banks for cash services, since the Board has determined that cash services are a central bank function.

Check Clearing. The offices of Reserve Banks throughout the nation receive checks from banks for collection, and the proceeds from the collection of these checks are credited to the reserve accounts of the depositing banks. The timing of credits reflects the length of time required for the Reserve Banks to present the checks to the banks on which they are drawn (paying banks) and to receive payment, which is made by debiting the reserve accounts of the paying banks. To facilitate this process, the Reserve Banks operate a national system for transporting checks to the paying banks. Reserve Bank check-collection services include both the clearing function (receiving

CALCULATING THE FED'S SHARE

The calculations in Tables 1–3 are based on three categories of checks processed by Federal Reserve Banks: those issued by the federal government, U.S. postal money orders, and all other checks (referred to as "commercial checks"). Commercial checks processed in the United States include "on-us" checks—checks drawn on the banks where they were first deposited. Since "on-us" checks do not have to be cleared between banks, in all three tables we have subtracted them from the totals for interbank checks processed in the United States.

For example, the figures for 1980 in Table 1 were calculated in this manner: Annual Reports of the Board of Governors include the numbers of checks processed by the Reserve Banks each year. The Annual Report for 1980 indicates that the Reserve Banks processed 15,721 million commercial checks, 705 million government checks, and 117 million postal money orders. The number for commercial checks, however, reflects double counting: Checks received by one Reserve Bank that were sent to another Reserve Bank for collection were counted as checks processed by each bank. Beginning in 1982, the Annual Reports eliminated this double counting of commercial checks. The numbers for 1982 are available with and without the double counting: The number of commercial checks processed without double counting is 94 percent of the number with double counting. Applying this 94 percent adjustment to the data for 1980 yields an estimate of 14,777.7 million commercial checks, and 15,599.7 million for total checks, including government checks and postal money orders.

The total number of commercial checks in the nation in 1980 is estimated as 42 percent of the number of commercial checks processed by the Reserve Banks. We divided the *number* of checks the Fed processed by the *percentage* of checks that it processed to arrive at the total number of commercial checks issued in the United States in 1980:

$$14{,}777.7\text{m}/.42 = 35{,}185 \text{ million.}$$

Of these 35,185 million checks, approximately 29.6 percent, or 10,414.8 million, were "on-us" checks. We subtracted the "on-us" checks from the commercial checks, then added the federal government checks and the U.S. Postal orders to arrive at the total number of interbank payment items processed in 1980:

$$35{,}185\text{m} - 10{,}414.8\text{m} + 705\text{m} + 117\text{m} = 25{,}592.2 \text{ million.}$$

In Table 2, the average estimated value of a check in 1980 was $792, and the average estimated value of an "on-us" check was $867. Average check values in these tables are based on the values in the 1979 Atlanta Fed Check Study, adjusted for inflation and other factors. The values for checks processed by the Federal Reserve are actual, except that 1980 data have been adjusted for the double counting that was used in Federal Reserve reporting systems at that time. We multiplied the number of commercial checks by the average value per check (35,185 million $\times$ $792) to arrive at a total value of $27.9 trillion for checks processed in the United States in 1980. We then subtracted the estimated value of "on-us" checks (10,414 million $\times$ $867 = $9.0 trillion) and added the value of federal government checks ($599 billion) and postal money orders ($6 billion) to arrive at a total value of $19.4 trillion.

In Table 3, we divided the number of payment items that the Federal Reserve Banks processed by the total number of interbank payment items processed in the United States (as calculated in paragraph 3, above) to arrive at the Federal Reserve's share of payment-items processing for 1980:

$$15{,}599.7 \text{ million} / 25{,}592.2 \text{ million} = .61, \text{ or } 61 \text{ percent.}$$

checks and presenting them to paying banks) and the settlement function (debiting and crediting reserve accounts).

Automated Clearinghouse. Banks that use the Federal Reserve's ACH service instruct Reserve Banks to pay other banks (ACH credit entries) or to receive payment from other banks (ACH debit entries). These entries are processed through the computer facilities of the Reserve Banks (clearing function), and entries are posted to the reserve accounts on the settlement dates designated by the banks (settlement function).

Safekeeping of Definitive Securities and Noncash Collection. Reserve Banks accept definitive securities (securities in paper form) for safekeeping. This service, however, is now largely limited to securities used to collateralize government deposits and discount window loans. The Reserve Banks collect interest coupons and matured securities and credit the proceeds to the reserve accounts of banks that own the securities.

Wire Transfer of Funds. Banks with reserve accounts at Reserve Banks may initiate transfers of their reserves to other banks through the Fedwire funds transfer service. Fedwire is a real-time gross settlement system. Fedwire funds transfers are processed electronically and are final when accepted for processing by the Reserve Banks. A final payment is one which is unconditional and irrevocable. Clearing and settlement is virtually simultaneous. Fedwire is described as a large-value funds transfer service because it is designed to facilitate interbank funds transfers (Horii and Summers, 1994).

Wire Transfers of Securities. Ownership of United States government securities and some agency securities is recorded in the securities accounts held by the Reserve Banks. Banks can transfer ownership of these securities via the Fedwire securities transfer service, and each transfer is final when accepted by the Reserve Banks for processing.

Fiscal Agency. The Reserve Banks provide account, custodial, and payment services to the U.S. Treasury and to a variety of other government agencies. These services include issuing and redeeming U.S. Treasury securities as well as securities of other U.S. agencies.

Net Settlement. Banks that are members of private clearing organizations may decide to settle their mutual obligations through multilateral netting. If a private clearing service uses the net settlement services of the Reserve Banks, the net debit and credit positions of the private banks are settled through entries to their reserve accounts at the Reserve Banks.

TRENDS IN CLEARING AND SETTLEMENT

The Reserve Banks' share of total interbank payments has declined since 1980 for at least three of the four principal types of payment instruments: checks, large-value funds transfers, and large-value securities transfers. Tables 1, 2 and 3 show the declining Reserve Bank components for both the volume and the value of interbank payment transactions. We have not been able to develop a time series on the share of the volume and value of ACH payments processed by the Reserve Banks.

Check Clearing

Table 3 indicates a significant decline in the Reserve Banks' share of interbank check clearing, in terms of both volume and value.[9] Between 1980 and 1994, the Reserve Bank's component of interbank check-clearing volume declined by about one-third, from an estimated 61.0 percent to 39.3 percent, while its check-value component declined from an estimated 48.5 percent to 24.9 percent. These declines are consistent with a conventional interpretation of major changes in the interbank check clearing market, including (1) the introduction of Reserve Bank pricing for services, mandated by the MCA, (2) a fairly rapid development of alternative private-sector channels for check clearing, and (3) adoption by the Board of Governors of same-day settlement amendments to Regulation CC.

These amendments to Regulation CC, effective January 1, 1994, changed the

[9] Interbank check clearings are so-called "transit items," for which the payor (check writer) and payee have accounts at different banks. These are in contrast to "on-us" checks, for which the payor and payee have accounts at the same bank.

Table 1

Volume of Interbank Non-Cash Transactions (in millions of transactions)

Type of Payment	1980 FR	1980 Total	1985 FR	1985 Total	1990 FR	1990 Total	1994 FR	1994 Total
Check[1]	15,599.7	25,592.2	16,687.0	33,489.8	19,304.0	39,670.0	17,149.0	43,637.4
ACH[2]	227.0	—	585.0	—	1,435.0	—	2,379.0	2,521.8
Large-Value Funds Transfer[3]	25.8	39.0	45.0	69.9	62.6	99.9	72.0	117.5
Securities Transfer[4]	—	—	7.7	7.7	10.9	12.9	12.6	19.1
Card	N/A	—	N/A	—	N/A	10,478.1	N/A	13,681.0

Sources: Annual Reports of the Board of Governors of the Federal Reserve System and the Bank for International Settlements.

1 See Shaded Box, page 10.

2 Total ACH volume represents Federal Reserve commercial and government items plus items processed exclusively by private-sector arrangements. The figures for Federal Reserve volumes are taken from actual, recorded data. The source of the estimate for the private-sector volume is the National Automated Clearing House Association. The private ACH processors active in 1994 included the Arizona ACH, Hawaii ACH, New York ACH, and Visa ACH. Data for private ACH processors for periods before 1994 are either not available or incomplete. Note that the majority of items handled by private ACH processors are also delivered to the Federal Reserve for processing, to gain access to endpoints serviced only by the Federal Reserve. In 1994, for example, the total number of items actually originated and received by private ACH operators was estimated to be 521 million; of these, only 143 million were also delivered exclusively within the private arrangements.

3 The total volume of large-value funds transfers is the sum of Fedwire funds transfers and Clearing House Interbank Payments System (CHIPS) transfers.

4 Total number of Fedwire securities transfers plus adjusted gross volume estimates for the securities transfers of the Government Securities Clearing Corporation (GSCC) and the Participants Trust Company (PTC). The GSCC estimates were adjusted downward by subtracting the number of end-of-cycle transfers made through Fedwire, to avoid double counting. All securities transfers of the Government National Mortgage Association (GNMA) were processed through PTC; they could, however, have been processed by Fedwire, had the Federal Reserve chosen to provide such services to GNMA.

rules under which banks pay each other for checks. Before implementation of the same-day settlement provisions, a bank presented with checks directly by another private bank could either pay the collecting bank the following business day or charge the bank a fee for payment the same day. Reserve Banks, in contrast, debited the reserve accounts of paying banks the same day they delivered the checks to the banks, and the Reserve Banks did not pay fees for this privilege. When private correspondents complained that these rules gave the Reserve Banks an unfair advantage, the Fed adopted the same-day settlement regulation, which says that if a collecting bank presents checks to the place of business of a paying bank before 8 a.m. local time, the paying bank must return the checks or pay the collecting bank through a Fedwire funds transfer by the close of business the same day. The paying bank is not allowed to charge the collecting bank a fee for same-day settlement. Banks may waive these rules for the timing of check presentment and means of payment if they wish (Fitzgerald and Macoy, 1993; Crockett, 1994b). Reserve Bank check collection volume through September 1994 was 12 percent below the volume for the same period in 1993. This decline is attributed largely to same-day settlement (Marjanovic, 1994b).

Automated Clearing House (ACH)

The Reserve Banks are the dominant processors of ACH payments. They handle all government-related transactions and a

Table 2

Value of Interbank Non-Cash Transactions (in trillions of dollars)

Type of Payment	1980 FR	1980 Total	1985 FR	1985 Total	1990 FR	1990 Total	1994 FR	1994 Total
Check[1]	9.4	19.4	10.1	31.9	13.2	43.5	12.6	50.6
ACH[2]	0.3	—	2.1	—	4.7	—	8.4	9.1
Large-Value Funds Transfer[3]	47.9	85.0	109.1	187.5	199.1	421.1	211.2	506.6
Securities Transfer[4]	—	—	74.2	74.5	99.9	108.1	144.7	170.0
Card	N/A	0.1	N/A	0.2	N/A	0.5	N/A	0.7

Sources: Annual Reports of the Board of Governors of the Federal Reserve System and the Bank for International Settlements.

1 See Shaded Box, p. 10.

2 The value of transactions handled by the Federal Reserve plus the value of transactions handled solely by private ACH processors (see Table 1, footnote 2). For 1994, the estimated value of ACH transactions processed solely by the private sector was about $700 billion.

3 The sum of the value of Fedwire funds transfers and Clearing House Interbank Payments System (CHIPS) transfers.

4 The sum of the value of Fedwire securities transfers, plus the value of the adjusted gross volume for the Government Securities Clearing Corporation (GSCC) plus the value of Participants Trust Company (PTC) adjusted gross volume. See Table 1, footnote 4, for more details.

Table 3

Federal Reserve Share of Interbank Non-Cash Transactions

Year	Check Volume (percent)	Check Value (percent)	ACH Volume (percent)	ACH Value (percent)	Large-Value Funds Transfers Volume (percent)	Large-Value Funds Transfers Value (percent)	Securities Transfers Volume (percent)	Securities Transfers Value (percent)
1980	61.0	48.5	—	—	66.2	56.4	—	—
1985	49.8	31.7	—	—	64.4	58.2	100	100
1990	48.7	30.3	—	—	62.7	47.3	84.5	92.4
1994	39.3	24.9	94.3	92.3	61.3	41.7	66.0	85.1

large share of commercial transactions. However, their present share of the volume and value of interbank ACH transactions, which exceeds 90 percent, does not appear to be sustainable. In addition to the Reserve Banks, three private organizations process ACH payments: the Arizona Clearing House Exchange, the New York Clearing House, and Visa USA. The financial press cites the share of ACH payments processed by the Reserve Banks at about 80 percent, with these three organizations processing the remaining 20 percent (Marjanovic, 1995a,b). This statistic is based on the fact that these private organizations receive 20 percent of total ACH entries. However, some of the ACH entries these private organizations receive are routed through the Reserve Banks for processing.

In this paper, the volume of ACH payments attributed to the Reserve Banks is that actually processed by the Reserve Banks, whether the originating institutions delivered the information on ACH entries to the Reserve Banks or to private processors. This method of calculating the component of *ACH payments* processed by the Reserve Banks is consistent with the

method of calculating the component of *checks* processed by the Reserve Banks. For instance, checks counted as processed by the Reserve Banks include those deposited by the banks of first deposit, and by banks that serve as intermediary correspondents for the banks of first deposit.

The high Reserve Bank share can be attributed to the unique circumstances surrounding the development of the ACH payment mechanism, which was initially subsidized by the Reserve Banks. Significant developments in the market for ACH services in the last five years, relating to changes in technology, banking structure and the entry of private providers, will almost surely combine to reduce the proportion of ACH payments processed by the Reserve Banks.

Large-Value Funds Transfer

The Reserve Banks guarantee finality of funds transfers among banks over Fedwire; private banks that receive funds transfers over Fedwire do not have to be concerned that the transfers will be reversed by the Reserve Banks because of the failure of the sending banks to fund their payments through the Reserve Banks. Casual observers of the market for large-value funds transfer might conclude that the Federal Reserve would have a virtual monopoly on this service. The information in Tables 1, 2, and 3, however, indicates that this conclusion would be incorrect. Large banks that are members of the Clearing House Interbank Payments System (CHIPS)—a wholesale wire-transfer network owned and operated by the New York Clearing House—use that system as an alternative to transfers over Fedwire for large-value funds transfers. Members of CHIPS net their interbank obligations multilaterally and settle these obligations as a group at the end of the day using Fedwire funds transfers. They use CHIPS largely for settling the dollar side of foreign exchange and for other international transactions.

The component of total large-value funds transfers (over Fedwire and CHIPS) handled by Fedwire declined from 1980 to 1994. The *volume* component fell from 66.2 percent to 61.3 percent, and the *value* component fell from 56.4 percent to 41.7 percent. While the reasons for the rise in the CHIPS component of large-value funds transfers are complex, they are related in part to the rapid growth of international payments. The Reserve Banks have not considered the settlement of foreign exchange and other international transactions to be part of the mission of Fedwire, and, therefore, they have not attempted to design the Fedwire service to meet the specific funds-transfer needs of that part of the market. They have, however, responded to the market for funds-transfer services, and to new record-keeping requirements resulting from anti-money-laundering legislation, by adopting a new format for funds transfers over Fedwire that is based on the standards of the Society of Worldwide Interbank Finance Telecommunications (SWIFT). Conversion to the new format will be completed by the end of 1997.

Another factor that may have reduced the Reserve Banks' share of large-value funds transfers is the Federal Reserve's payments system risk-reduction program, which in recent years has increased the appeal of multilateral netting for banks. The risk-reduction program, which has placed significant emphasis on containing the amount of intraday credit provided by the Reserve Banks, has probably stimulated use of alternatives to Fedwire for clearing large-value transactions.[10] On the other hand, the risk controls adopted by CHIPS, which have increased the cost of funds transfers over that system, have tended to offset the effects of the Reserve Bank's risk-reduction measures.

Securities Transfer

As with funds transfer, the casual observer might conclude that the Federal Reserve has a virtual lock on the market for securities transfers. In fact, however, the Federal Reserve has restricted the range of U.S. Treasury securities and agency securities for which the Reserve Banks serve as depositories and provide

[10] For a description of the policy of the Federal Reserve on daylight overdrafts and payments system risk, see Richards (1995).

transfer services. As a result, private systems for clearing and settling transactions involving these securities have developed. For example, the Participants Trust Company (PTC) now serves the entire market for clearing and settlement of Government National Mortgage Association (GNMA) securities.

Private-sector arrangements for netting securities transactions are also becoming more attractive to banks. The Government Securities Clearing Corporation (GSCC) has developed a multilateral netting service for future-dated U.S. government securities transactions, and it is in the process of testing an enhanced service that will support netting for same-day transactions. Introduction of this service by GSCC will likely trigger a significant further decline in the Reserve Banks' share of government and agency securities transfers. Table 3 indicates that Fedwire's share of the *volume* of securities transfers declined from 100 percent to 66.0 percent between 1985 and 1994. The Reserve Bank share of the *value* of securities transfers fell from 100 percent to 85.1 percent over the same period.

Card Transactions

As we noted earlier, the Reserve Banks do not clear payments made by cards. Table 1 shows that credit-card transactions have grown rapidly in recent years and by 1994 accounted for about 18 percent of the number of payments made by credit card, check and ACH. If payments based on other types of cards, such as debit cards and stored-value cards, grow rapidly relative to older types of payments instruments, the percentage of all retail payments processed by the Reserve Banks can be expected to continue declining.

In summary, the Reserve Banks' components of both the volume and the value of interbank payments have declined for small-value retail and large-value wholesale funds and securities transactions since about 1980. Prospective developments, including introduction by GSCC of multilateral netting for same-day government securities transfers, can be expected to cause significant further reductions in the Reserve Bank component of large-value securities transfers. In addition, continued increases in the use of new types of retail (small-value) payments instruments, in which the Reserve Banks are not active, could erode further their role in the processing of retail payments generally.

REASONS FOR THE RESERVE BANKS' DECLINING SHARE OF INTERBANK PAYMENTS

Tables 1, 2 and 3 indicate that the Reserve Banks' historically important role in providing clearing services has been declining, although it is still significant. Changes in technology and in banking structure have reduced the Reserve Banks' advantages in providing the dominant network for clearing and settlement of payments. In addition, the policies of the Board of Governors have stimulated a greater role for the private sector in clearing interbank payments.

Technology

New technology is perhaps the single most important force leading to new initiatives for processing payments in the private sector. Within the last decade or so, the costs of both computer processing and data communications have fallen dramatically. As a result, automated processing systems are now within the financial reach of individual institutions as well as private clearinghouses. At one time, ACH processing required large mainframe computer systems. Now, very powerful, small, and relatively inexpensive microprocessors are able to handle large volumes of transactions. Moreover, value-added networks offer a wealth of national and even international data communications pathways, including networks with sufficient control and security features to handle electronic payment transactions. Thus, dramatic reductions in costs have facilitated the development of alternative networks for payment processing func-

tions that were once the primary domain of the Reserve Banks.

Banking Structure

Regional interstate banking has also reduced the advantages of the Federal Reserve in interregional check clearing. Banking concentration resulting from the rise in interstate banking has increased the proportion of transactions handled by banks as "on-us" transactions, which bypass interbank clearing and settlement channels. Further, bank holding companies have been able to organize payments clearing among their affiliated banks on a regional basis, often by establishing regional processing centers. Today, the country is experiencing a major new interstate banking movement as a result of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. More and more, interstate banking extends network efficiencies to private institutions throughout the country, thus eroding the Fed's interregional check-clearing advantage.[11]

The last 10 or 15 years have seen the formation of national clearinghouses for both paper and electronic transactions. For example, in 1991, Visa USA began offering a national ACH processing service. Further, the New York Clearing House has expressed interest in expanding the geographic scope of its ACH service and connecting its processing network to other private sector providers, such as Visa (Marjanovic, 1995a,b). With respect to check clearing, the National Clearing House Association, formed in 1992, arranged the clearing of an estimated 2 million checks per day in 1994 (Marjanovic, 1994a). Similarly, the Electronic Check Clearing House Organization (ECCHO) which was introduced in 1990, was clearing an estimated 1 million checks per day by 1994, on the basis of electronic cash letters (Crockett, 1994a). Banks are also active in establishing consortia to exchange retail transactions in ATM and point-of-sale networks. Formation of these private networks for clearing payments reflects, to some extent, the increased concentration of banking in recent years. A few large banking organizations now can exchange large volumes of checks and other payment instruments directly, without relying on a processing intermediary.

Federal Reserve Policy

The Federal Reserve has strongly embraced market techniques that promote more efficient payment operations. Explicit pricing of Federal Reserve payment services, introduced by the MCA, has eliminated subsidies to banks that use Reserve Bank services. In addition, explicit pricing of intraday, reserve-account overdrafts has increased the costs of using Reserve Bank services for banks with relatively large intra-day overdrafts (Richards, 1995). Finally, the Federal Reserve Board's action in January 1994 requiring same-day check settlement helped to reduce the barriers to check clearing between private parties. Accordingly, within the last 15 years, the explicit cost of using Federal Reserve payment-processing services has been put on more comparable terms with private-sector alternatives, and artificial legal barriers to private clearing have been removed.

Federal Reserve Board policy has also limited the involvement of the Reserve Banks in the payments system by restricting the scope of their services. For instance, the Federal Reserve declined to provide services for clearing and settling credit card sales slips and book-entry transfers of GNMA securities. The limitations on the scope of Reserve Bank payment services have facilitated the development of private systems for clearing and settling payments.

Outlook for Fed Payment Services

Technology, banking structure, and Federal Reserve policy will likely continue to influence payments processing, certainly for the foreseeable future. The outcome is likely to be a continuation of the trends shown in Table 3—declines in the components of various types of interbank payments processed by the Reserve Banks. Indeed, because virtually all the factors discussed in this paper have emerged relatively recently, the trends in Table 3 could accelerate, at least for small-value payments such as checks and ACH.

[11] Berger and Humphrey (1988) conclude that nationwide interstate banking would reduce the resources used in check collection. In addition, they estimate that it would reduce the share of total checks processed by Reserve Banks by between 43 and 60 percent over a 10-year period.

SOME IMPLICATIONS OF REDUCTIONS IN RESERVE BANK SERVICES

Trends in the processing of payments by Reserve Banks have implications for the efficiency of the payments system and for the risk of disruptions in the operation of the payments system.

Implications for Efficiency

Subsidy for use of Reserve Bank Services. Prior to 1980, the Reserve Banks did not charge member banks explicit fees for use of their payment services. In the 1970s, the Reserve Banks may have compounded the inefficient use of resources in the payments system by subsidizing the collection of local checks through the establishment of Regional Check Processing Centers (RCPCs). Because RCPCs provided same-day check crediting to the reserve accounts of collecting banks for checks drawn upon banks located in the same area, many local check clearinghouses could not compete and closed down (Frodin, 1984). While the establishment of RCPCs may have accelerated the speed of collection, it created additional incentives for banks to use the Fed for check clearing rather than continuing direct exchanges of checks among nearby banks.[12] Recent declines in the use of Fed payment services reflect more efficient use of resources resulting from the elimination of the subsidy provided by "free" Reserve Bank services.

Implications of Interstate Banking. Inefficiency in the check-collection system prior to 1914 reflected, to a large extent, the lack of nationwide banking organizations. High exchange charges and lengthy delays in check collection that resulted from arrangements to avoid exchange charges would have been reduced or eliminated by nationwide banking.[13] The spread of nationwide interstate banking reduces the chances that the declining role of the Reserve Banks in payment processing will produce a return to the kind of payments system inefficiency that existed prior to the formation of the Federal Reserve. Interstate banking, however, might also lead to distortions in the pricing of payment services that would result from collusive behavior by a few large, nationwide branching organizations.

Federal Reserve as Payments System Rule Maker. The success of innovations in improving the efficiency of the payments system requires cooperation among providers of payment services. For instance, the Fed and the banking industry agreed many years ago to encode checks with magnetic characters (the MICR line) that make it possible for banks to sort checks by machine. This innovation would have been of little value if it had been adopted by only a few banks. Another example involves the truncation of checks in the collection process: To maximize the benefits of truncation (in which the actual paper check is taken out of circulation), the first bank that handles a check would convert the paper instrument into an electronic instrument and send the payment information on the check through the collection system electronically. Such an innovation would require the cooperation of virtually all banks.

Prior to 1914, the payments system of the United States functioned without a mechanism by which banks could cooperate in adopting innovations to make interregional check collection more efficient. Clearinghouses played such a role in their local communities. There was, however, no national clearinghouse to coordinate change for the national payments system. Banks collected checks drawn on banks located in distant cities through a correspondent banking system that often routed checks to paying banks indirectly, to avoid the exchange charges of paying banks. Indirect routing of checks increased the expense and length of time in check collection. Since its formation, the Federal Reserve has functioned as the de facto national coordinator of the payments system. The role of Reserve Banks as major providers of payment services has been important in facilitating a number of improvements in the efficiency

[12] For a description of RCPCs and analysis of their implications for the efficiency of the payments system, see Morris (1974, 1975a,b); White and Torgerson (1974); and Viswanathan and Mayo (1975).

[13] Jessup (1967) reports that nonpar banks (those imposing exchange charges) tended to be located in unit banking states. This observation supports the claim that nationwide branch banking would have reduced or eliminated exchange charges.

SAME-DAY SETTLEMENT: RISK REDUCTION FOR COLLECTING BANKS

Prior to the implementation of the Federal Reserve's same-day settlement regulation, banks that collected checks through correspondents generally received payment in the form of credits to their balances at correspondent banks. Under the new regulation respondent banks can send checks directly to paying banks and receive payment the same day via wire transfers of funds to their reserve accounts at Reserve Banks. Adoption of same-day settlement, therefore, gives respondent banks more options for limiting their exposure during periods of financial distress. For relatively small banks, however, the cost of collecting checks through direct presentment may exceed the risk of collecting through correspondents. The operating costs of collecting checks through direct presentment include the costs of sorting checks and arranging for couriers to present them directly to the paying banks. Even in times of financial stress in the banking industry, relatively small banks that rely on correspondents for check collection are more likely to continue using correspondent bank services than to switch their check-collection operations to direct presentment.

of the payments system, including the following:

1. Elimination of nonpar banking.[14]

2. Addition of the MICR line to checks, making them readable by check-sorting machines.

3. Creation of the automated clearinghouse.

4. Expedited processing of return items after passage of the Expedited Funds Availability Act.

5. General promotion of check imaging and electronic presentment (Marjanovic, 1996).

Will the benefits of this leadership and innovation be lost if the Reserve Banks have a substantially smaller role in the processing of payments in the future? Not necessarily. Even with a smaller operational role for the Reserve Banks, the Federal Reserve Board, with its broad regulatory power, can continue to promote payments system efficiency. An important example of the Board's use of this regulatory authority to promote efficiency in the check-collection system is its recent introduction of same-day settlement for checks, which took effect in January 1994. The Fed's same-day settlement regulation sets the rules under which collecting banks present checks and receive payment the same day without paying fees to paying banks. The authority for this action of the Board is derived from the Expedited Funds Availability Act of 1987, which granted the Board regulatory authority over interbank payment relationships for purposes of promoting efficiency of the payments system. Implementation of the change did not require a large operational role for the Reserve Banks; in fact, it has caused a decline in the check collection volumes of the Reserve Banks (Marjanovic, 1994b).

Increased concentration of the banking industry through interstate banking can facilitate innovation through cooperation among the banks themselves, independent of the Fed's efforts. The evidence suggests that, in the past, there were too many banks for effective cooperation. Associations of relatively small numbers of large banks, however, can work out agreements on innovations that benefit a majority of their members. For instance, the banks that formed ECCHO agreed to accept electronic transmission of information about checks as legal presentment. In March 1995, the New York Clearing House announced that its members had reached similar agreement (Marjanovic, 1995c). These examples illustrate innovation in the payments system through voluntary association.

Large numbers of banks are able to coordinate the clearing and settlement of payment instruments other than checks, and to adopt innovations. For example, Visa and Mastercard coordinate their payment operations for thousands of their member banks. The growth of regional ATM networks indicates that many

[14] Some authors challenge the idea that actions of the Reserve Banks to eliminate nonpar banking improved the operation of the payments system. See Baxter (1983). The literature on exhange charges provides conflicting views of this subject. See Frankel (1995); Gilbert (1991); and Salop (1990). For purposes of this section, it is sufficient to argue that, given the limited power Congress granted to the Reserve Banks over the operation of the payments system, the Federal Reserve was effective in establishing clearance of checks at par as the standard for the banking industry only because of the major role of the Reserve Banks in check clearing and settlement.

bankers can work together to provide ATM services for their customers. The National Automated Clearinghouse Association (NACHA) sets rules and standards for ACH, even though it does not itself process ACH payment items. Finally, there are well established institutional arrangements for setting standards for various aspects of the payments system. Thus, past experience with check collection in the United States may exaggerate somewhat the importance of the Reserve Banks as providers of payment services in facilitating innovation in the payments system.

Access to Payments Systems. When the Reserve Banks provided the dominant nationwide system for banks to clear and settle payments, access to the payments system was determined by legislation and the operating rules of the Reserve Banks. As private organizations emerge to rival the Reserve Bank's nationwide clearing and settlement arrangement, access will be determined at least in part by these private organizations. Various agencies of the government and the courts might become involved in settling disputes on the conditions under which private arrangements for clearing and settling payments may exclude some providers of payment services.[15]

Check Clearer of Last Resort. Issues raised by the role of the Reserve Banks as check clearer of last resort have implications for both efficiency and risk. The rise in Reserve Bank check clearing during the Texas banking crisis during the second half of the 1980s and early 1990s illustrates the role of Reserve Banks as check clearer of last resort (Clair, Kolson and Robinson, 1995). When major banks headquartered in the Southwest were in serious financial trouble, respondents turned to the Fed for check collection because they did not want to suffer disruptions and possible losses resulting from the failure of their correspondents (see shaded box, page 18). Given their major role in check processing, the Reserve Banks can absorb additional check volume when circumstances disrupt other check-collection channels.

If the Reserve Banks' check collection volumes fall substantially in the future, and their capacity to clear checks is reduced accordingly, they may no longer be able to fulfill the role of check clearer of last resort. In periods of financial stress, this situation could put an extra burden of responsibility on the banking industry for ensuring the safe operation of the payments system. Banks collecting checks would need to be vigilant in managing their risk when choosing correspondents and in agreeing to forms of settlement for checks presented directly to paying institutions. In this context, the Federal Reserve's Regulation F, "Limitations on Interbank Liabilities," mandates careful management of such interbank relationships.

Implications for Risk

Does the declining role of the Reserve Banks in processing payments increase the risk of payments system disruption? The answer depends on the nature of the shocks to the payments system.

Bank Runs. Prior to the formation of the Federal Reserve System, depositor runs were the most important source of risk to banks. The Fed can deal with threats originating from depositor runs by injecting reserves into the banking system through open-market operations and discount window loans. In addition, federal deposit insurance limits the vulnerability of banks to depositor runs.

Securities Transfers. Another possible shock to the payments system would be the disruption of arrangements for transferring ownership of securities. Is it important that the Reserve Banks retain a major role in processing securities transfers in order to minimize the effects of such shocks on the payments system? Alternatively, are private arrangements for securities transfers sufficiently sound to minimize the chances of such shocks?

Parties to securities transactions must be able to trust their agents to perform as contracted. For instance, individual investors in corporate stock must trust

[15] See Carlton and Frankel (1995) for analysis of a court case involving a dispute over access of a bank to Visa for issuing credit cards. Carlton and Salop (1996) discuss the issue of access by firms to joint ventures in a variety of cases.

their brokers to execute trades according to their orders. They must also trust that the organizations established to clear trades and settle obligations among brokers will be effective in settling trades. For investors in U.S. Treasury and agency securities, banks function as their agents by holding securities with the Reserve Banks and with private depositories. When the investors decide to sell, the banks use Fedwire or a private system to transfer ownership of the securities and settle the trades. For investors in securities transferred through privately operated systems, the risk of not receiving the securities they have paid for, and the risk of not receiving cash for securities they have sold, depends on the reliability of netting arrangements among members of the systems.

Securities transfers through private systems have not created problems for the operation of financial markets, because these systems are well designed. In addition, active oversight by authorities such as the Federal Reserve has ensured that such private arrangements have the controls and guarantees needed to make them reliable. In particular, the guidelines for operation of delivery vs. payment systems that were released by the Federal Reserve Board on June 15, 1989, refer to various controls, including liquidity safeguards, credit safeguards, and open-settlement accounting.

As long as the private systems for securities transfers are appropriately supervised and maintain adequate risk controls, the migration of securities transfers from the Reserve Banks to private systems would not appear to create problems for the operation of financial markets. The following sections indicate, however, why the Fedwire service for transferring funds and securities remains essential for the settlement of obligations among members of these private systems. These sections also discuss the limited authority of the Federal Reserve over the operations of private clearing organizations which is derived from the role of the Reserve Banks in providing settlement services.

Settlement Using Liabilities of Private Banks: Moral Hazard and Systemic Risk. Another source of shock to the U.S. payments system could result from the failure of a major bank used for settlement by a significant number of other banks. Prior to 1914, banks settled payment obligations among themselves by transferring ownership of deposit liabilities at private banks, and major disruptions occurred when customers lost confidence in the nation's money center banks. Given the declining role of the Reserve Banks in processing payments, the future might bring increased public reliance on a few large banks for settling payment obligations. If it does, the government might need to ensure the survival of those banks, to prevent disruption of the payments system. This reliance on a few large banks at the heart of the payments system could amplify any moral hazard in bank supervision and regulation. Since the failure of the bank would be too disruptive to the payments system, participants in the financial system could assume that there would be little risk in transactions with those banks, including the purchase of their short-term liabilities.

Multilateral Clearing Arrangements and Systemic Risk. Systems for clearing payments among banks can be designed to avoid the moral hazard outlined above. Consider, for instance, the design of CHIPS. Federal Reserve policies that apply to the operation of private large-dollar funds-transfer systems such as CHIPS include the requirement that such systems have means to ensure settlement in the event of a default by a major participant. Since these arrangements would prevent major disruptions in the payments system in the event of the failure of a particular bank, investors in bank equities and liabilities cannot assume that any one bank is essential to the operation of the payments system.

We argue that the Reserve Banks must continue to offer Fedwire services to facilitate access to reserve accounts and especially, to ensure the integrity of net settle-

ment arrangements. Banks that use the net settlement services of Reserve Banks in their transactions with private payments-clearing systems must have a mechanism like Fedwire for transferring reserves, to cover their net debit positions. At times, these banks must borrow reserves from each other to cover their net debits. Fedwire enables them to transfer securities electronically, both to provide collateral to lenders, and to post collateral with Reserve Banks for discount window borrowing.

Authority of the Federal Reserve over the operations of private clearing organizations rests principally on the role of the Reserve Banks as providers of settlement services, since the Fed has no statutory authority for central bank oversight of private clearing organizations. As a service provider, the Federal Reserve can make safe-and-sound operation of clearing organizations a condition to their using its interbank settlement services. The Board stated its standards for the operation of private clearing organizations in December 1994, in a policy statement titled "Privately-Operated Large-Dollar Multilateral Netting Systems." The threat of discontinuing its settlement support for such clearing organizations, however, is a very blunt supervisory instrument. For example, the Fed could disrupt clearinghouse operations, and therefore the payments system, by withdrawing its settlement services. The simple fact that the Fed could itself trigger an immediate operational crisis by withdrawing support for settlement calls into question the Federal Reserve's willingness ever to invoke such a harsh action.

The trends in the U.S. dollar payments system described in this paper indicate a major shift toward greater reliance on private arrangements for clearing both small-dollar and large-dollar payments. Increased privatization of the U.S. dollar payments system and a concomitant decline in the operational role of the Federal Reserve Banks raise questions about the adequacy of the Federal Reserve's supervisory authority to fulfill the original Congressional mandate for ensuring the stability of the nation's payments system. In fact, the Federal Reserve appears to be somewhat unusual among central banks in that it does not have explicit statutory powers related to the supervision of clearing organizations. Some of the private clearing organizations have implemented new risk controls to ensure settlement in the event of default by any of their members. These actions indicate some of the Fed's regulatory clout under current limitations on its statutory authority. It is unclear, however, whether the Fed's indirect influence on private clearing organizations through its role as provider of settlement services will be sufficient to ensure the safety and soundness of the payments system in the future.

CONCLUSIONS

The Federal Reserve Banks' role in processing payments—in terms of both volume and value—has declined since 1980, when Congress enacted legislation requiring the Reserve Banks to charge for their payment services. This decline can be expected to continue or even accelerate in the future. While the declines in the shares of payments processed by the Reserve Banks following pricing of the services represent a more efficient use of payments system resources, the declining role of the Federal Reserve Banks in payments processing has other important implications for the efficiency and stability of the payments system.

One of these implications relates to innovation. In the past, the actions of the Reserve Banks to foster innovation in the payments system relied on the status of the Reserve Banks as major providers of payment services. Will the Reserve Banks' declining role in payments processing eliminate the Fed's leadership in innovation? Not necessarily. The Federal Reserve Board has broad authority to promote safe and efficient payment methods undertaken bilaterally between depository institutions, especially in the check-collection system. This authority is independent of the Reserve Banks' operating role in the payments system. In addition, the growing concentration of the banking industry through interstate banking is facilitating

innovation by cooperating groups of banks that would have been more difficult when there were many more separate banking organizations.

At the same time, the growth of private payment networks raises some important new issues with respect to competition. In the past, access to the payments system was determined largely by law and by Federal Reserve policies; now some of the issues involving access to the new private payments arrangements will be settled in the courts.

Does the declining role of Reserve Banks in processing payments increase the risk of disruption in the operation of the payments system? The answer depends on how banks in bilateral and multilateral private clearing arrangements settle their obligations. Settlement through debits and credits to accounts at private banks would make the system vulnerable to disruption in the event of sudden failure by banks that provide settlement services. Fortunately, the settlement services of the Reserve Banks can limit this risk—to banks, and to the Federal Reserve in its role as lender of last resort. To facilitate the use of reserves for interbank settlement, whether net or gross, Reserve Banks should continue offering Fedwire funds and securities transfer services and net settlement services. The Federal Reserve System is able to influence the practices of clearinghouses primarily by setting conditions for their use of the settlement services of the Reserve Banks. The Fed does not have statutory authority to act as the supervisor of clearing organizations. It is not clear at this time whether the Fed's limited influence over clearing organizations will be adequate to maintain the safety and soundness of the payments system as the share of payments cleared through private channels continues to rise.

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Appendix

PAYMENT SERVICES OF THE FEDERAL RESERVE BANKS

Cash Services

The Reserve Banks have a government monopoly on issuing currency, which they process for banks. They also process coin issued by the United States Mint. Reserve Banks process cash deposits and shipments without charge to banks, at least for a certain basic level of service, since this is considered a government function. In accepting deposits of currency and meeting orders for currency, the Reserve Banks maintain the quality and the integrity of the currency stock. They employ sophisticated processing equipment that separates currency fit for circulation from unfit currency, which is destroyed. Reserve Banks also identify counterfeit notes, relying on the anti-counterfeiting features built into the design of the official currency.

Check Clearing

Since their formation, the Reserve Banks have provided a nationwide check clearing service. Check processing now takes place at 11 of the 12 Reserve Bank head offices, 24 of the 25 branches, 11 regional check-processing centers (RCPCs), and one additional facility. The Reserve Banks cooperate in managing this system in a highly-integrated manner and share some facilities and mechanisms, including a national transportation system for transporting checks.

Each Federal Reserve check-processing office serves an official territory, which is designated by routing numbers encoded at the bottom of checks. A territory may include a small but highly concentrated area, such as a city, or a larger area with banks dispersed across a large region. Routing numbers are the de facto national standard for check-clearing territories throughout the United States.

The Reserve Banks accept for collection checks (cash letters) drawn on banks located within the same territory, as well as checks drawn on banks located in other Federal Reserve territories.[16] The high degree of cooperation among the Reserve Banks in processing interterritory checks, and especially in debiting and crediting reserve accounts of banks located throughout the nation, facilitates an efficient nationwide check-clearing and settlement system.

The Reserve Banks accept shipments of checks in various degrees of sorting, including unsorted, sorted by Federal Reserve territory, or sorted by the banks on which the checks are drawn. Since sorting checks by territories or by the banks on which they are drawn is costly, the banks that send checks to the Reserve Banks already sorted are charged less than the banks that send checks unsorted and rely on the Federal Reserve Banks to sort them.

Like correspondent banks, Reserve Banks credit the accounts of the depositors of checks according to published availability schedules. That is, the depositors are able to count on receiving credit for checks drawn on banks located in different Federal Reserve territories according to a published time schedule, regardless of the Federal Reserve's ability to present the items within that schedule. Any float that results from mismatching the time of crediting the accounts of the depositing banks and the time of presentment to and debiting the accounts of paying banks is a cost of doing business for the Federal Reserve. Float is factored into the base costs recovered through explicit fees.[17]

In recent years, the Reserve Banks have provided a variety of value-added check-clearing services, particularly electronic information services demanded by check-clearing customers. Banks that receive cash letters (bundles of checks written by depositors) from the Reserve

[16] Cash letters are bundles of checks accompanied by registers that list the contents of the bundles and the total value of the items they contain. These bundles are called "cash letters" because settlement for the checks is in cash-equivalent funds, subject to the rules governing the return of checks.

[17] For a discussion of how float arises, is controlled, and what it costs, see Veale and Price (1994).

Banks can receive electronic transmissions that show the account numbers and dollar values of individual checks, information that normally would be physically presented later in the day. Timely availability of this information greatly aids banks in offering cash-management services to their large corporate customers.

In addition, the Reserve Banks are beginning to offer electronic check-deposit and presentment services, as well as truncation services, for banks that elect to settle checks in this manner. Reserve Banks recently have begun to offer image-processing services both to commercial banks and to the U.S. government. For example, images of government checks are captured and stored in archives, facilitating federal government investigations and claims settlements that involve payment by check. In addition, commercial image services are now being provided to banks, especially services designed to expedite check adjustments and returns.

Automated Clearinghouse

The automated clearinghouse (ACH) is an electronic alternative to check processing. In fact, the ACH was originally most attractive as a means of converting payroll disbursement and other recurring money transfers from check-based transactions to electronic transactions. The ACH is both a credit and a debit payment mechanism; that is, customer banks can make payments and withdrawals from accounts within the system. Use of ACH debit entries increases the efficiency and speed of transactions such as insurance premiums and mortgage payments, and they facilitate the concentration of cash by treasurers of businesses that maintain demand deposit accounts at large numbers of banks.

The Reserve Banks began providing ACH services to the United States Treasury and commercial banks in 1972. The federal government was a pioneer in converting its own paper-based check payments to ACH. At its inception, ACH processing required a very significant investment in computer technology. Only a large organization like the Federal Reserve System, with its established technical infrastructure and its extensive access to capital, was in a position to invest in a venture of this magnitude, for which the return was still uncertain. Moreover, the volume of payments at ACH's inception was not sufficient to justify the costs of the large initial investment for most companies. An exception was the New York Clearing House, which chose to handle the processing for ACH transactions in the Second Federal Reserve District. Over the years, the Arizona Clearing House and Visa USA, Inc. have also established successful ACH processing operations. The Chicago Clearing House also attempted to offer an ACH processing service but discontinued its service after a few years.

Safekeeping of Definitive Securities and Non-cash Collection

The Reserve Banks continue to provide definitive safekeeping and non-cash collection services to depository institutions, but on a significantly reduced scale in comparison to earlier years.[18] Definitive securities are paper instruments, such as bonds issued by state and local governments. Safekeeping for such securities includes accepting them under a trust agreement, collecting interest coupons, and redeeming matured securities. Today, only three Federal Reserve offices provide these services as priced services, although they do so for depository institutions located throughout the United States. Each Federal Reserve Bank does safekeep securities it accepts as collateral for discount window loans and/or in its role as fiscal agent. The demand for such services eventually will disappear completely as all securities are converted from paper to book-entry form, with ownership recorded and transferred electronically in the records of depositories.

Wire Transfer of Funds and Securities

Banks can transfer reserves among themselves electronically through the Fedwire funds transfer service. This is a

[18] Non-cash items are handled on a collection basis, meaning that principle and interest are credited to the accounts of banks with securities in safekeeping when collected, not on the basis of a published availability schedule.

real-time gross settlement service that provides final payment. Each transfer is processed separately without a netting of payment messages among banks (gross settlement), and the transfer of funds is final, which means that it cannot be reversed. If a bank sends a payment message over Fedwire and later fails while its reserve account is overdrawn, the Reserve Bank holding the overdrawn reserve account cannot recover funds from the receiver of the payment message. The finality of Fedwire funds transfers make them a unique type of payment, quite distinct from other payment services provided by the Reserve Banks. For instance, the Reserve Banks do not guarantee that credits to reserve accounts resulting from check collection are "good funds." If a Reserve Bank cannot collect from a bank on which the checks have been drawn, it has the right to reverse the credits to the reserve account of the depositing bank. Fedwire funds transfer is a natural monopoly, in that only the Federal Reserve can provide final settlement of reserves transfers.

Reserve Banks began providing the Fedwire funds transfer service in 1918 via telegraph. Today the Reserve Banks operate a highly-sophisticated computer network with more than 8,000 on-line connections to the Fedwire funds transfer system. The Fedwire securities transfer service dates to 1967, when the Reserve Banks agreed with the United States Treasury to begin converting U.S. Government securities to book-entry form. The computer system of the Reserve Banks became the depository for ownership of the government securities. The Fedwire securities transfer service is also a real-time gross settlement service, providing for the simultaneous delivery of securities and payment in final funds on the books of the Reserve Banks.[19] This delivery-versus-payment feature of securities transfers over Fedwire limits the risk to participants in the market for government securities, because a seller of securities can transfer ownership to a counterparty in a transaction without concern about whether the counterparty will pay for the securities.

Since the Reserve Banks assume any risk from the transfer of reserves over Fedwire, the Fedwire funds transfer service is, together with federal deposit insurance and the discount window, part of the federal safety net for the banking system. It's important to note that, given the high volume, value, and velocity of wire transfers, the Fedwire service is able to operate efficiently as a real-time gross settlement system only because the banks that use Fedwire have access to significant amounts of intraday credit from the Reserve Banks. When the Reserve Banks agree to process Fedwire funds transfers on behalf of financially troubled institutions, they essentially guarantee payments by these institutions, thereby providing confidence to counterparties receiving the payments and contributing to the stability of the payments system. The Reserve Banks manage the risk in providing this guarantee through a combination of operational and financial controls.

An important milestone in the Fedwire funds and securities transfer services was the introduction of explicit pricing of Federal Reserve intraday overdrafts on April 14, 1993, to provide banks an incentive to limit their use of intraday credit (Richards, 1995; Summers, 1995).

Fiscal Agency

One of the roles of the Federal Reserve Banks is to serve as a fiscal agent for the U.S. government. The Reserve Banks provide services to the United States Treasury and to a variety of other government agencies, as requested by the Treasury Department. For example, they collect checks, process ACH transactions, and make wire transfers on behalf of the fiscal principals. They provide a variety of cash management services for government agencies, including collection, cash concentration, and letters of credit. In addition, they service the public debt and, through the Fedwire securities transfer service, provide operational support for the secondary market in U.S. government and agency securities. Approximately 12

[19] The Reserve Banks maintain book-entry securities accounts for banks just as they maintain funds accounts in which banks hold reserves.

percent of the annual operating expense of the twelve Reserve Banks is attributable directly to their role as fiscal agents (Federal Reserve Planning and Control System).

Net Settlement

Net settlement is a service provided by the Federal Reserve Banks to a group of banks that clear payments among themselves, net their interbank positions, and settle their net debit and credit positions through entries to their reserve accounts. These arrangements can be classified as "final" or "provisional." Net settlement entries classified as final are not reversible by the Reserve Banks, whereas provisional entries are reversible.

In December of 1994, the Board of Governors of the Federal Reserve System issued a policy statement governing large-value arrangements, which establishes the conditions that such arrangements must meet to operate and to gain access to Federal Reserve net settlement services.[20] Large-value settlement arrangements include electronic funds transfers (for example, the Clearing House Interbank Payments System or CHIPS) and electronic securities clearing and settlement (for example, the Government Securities Clearing Corporation or GSCC). To minimize the systemic risk associated with large-value netting arrangements, the new policy statement requires that these arrangements be designed to achieve final settlement. Members use Fedwire to settle their net debit obligations resulting from net settlement. Also, one private ACH service and one check-clearing arrangement use Fedwire for net settlement.

The Reserve Banks also provide settlement services for small-value payments to approximately 160 local and regional clearinghouses throughout the country. The small-dollar settlements are for a variety of netting arrangements, predominantly check clearinghouses, but also for credit card systems and ATM and POS networks. Settlements for these netting arrangements are provisional. The Federal Reserve does not guarantee that credits to reserve accounts resulting from use of its provisional net settlement service represent "good funds." If a Reserve Bank is not able to collect the net debits from members of a group, it may reverse the entries made to the reserve accounts for the net settlement.

One reason depository institutions have a strong interest in using the Federal Reserve for interbank settlement is that virtually all depository institutions in the United States hold reserve accounts at the Reserve Banks (Blommestein and Summers, 1994). They are uniquely positioned to meet the needs of clearinghouses with a diverse membership, since virtually all the clearinghouse members would hold accounts with the Reserve Banks. In addition, the Reserve Banks are able to offer their natural monopoly advantage of providing final settlement in central bank money, rather than in terms of the liabilities of another private bank.

[20] Federal Reserve Press Release, December 21, 1994, Docket No. R-0842.

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The FOMC in 1995: A Step Closer to Inflation Targeting?

William T. Gavin

In the course of the Committee's discussion of its monetary growth ranges, members commented on the failure of the monetary aggregates to provide a reliable nominal anchor for the conduct of monetary policy in recent years. Moreover, the restoration of historic relationships, or the emergence of new but stable relationships, between money growth and measures of progress toward broad economic objectives could not be predicted with any degree of confidence. Some members expressed the view that in these circumstances the Committee needed to continue to look at potential alternative approaches to guide the formulation of policy and to communicate its intentions to the public, especially with respect to the Committee's objective of promoting price stability over time.

Minutes of the FOMC meeting, July 5–6, 1995, pp. 19–20.

The FOMC has long had a price stability goal, but it has not accepted suggestions to choose an index and set a timetable that would make this goal an operational target. The FOMC took up the issue of inflation targeting at its first meeting in 1995, discussing the advantages and disadvantages of setting explicit inflation targets. The issue also came up at the Committee's September 1995 meeting when it discussed the Economic Growth and Price Stability Act of 1995, a bill proposed in the Senate. The shaded box on page 30—"FOMC Discussion of Inflation Targets"—summarizes these two discussions.

Those who advocate inflation targeting argue that the FOMC would better communicate its intentions and thereby enhance the credibility of its policy. Nevertheless, some members are opposed to inflation targeting, stating that such targets might hinder the pursuit of effective countercyclical policies. In addition, some economists have argued that targeting the aggregate price level directly would cause instability in the economy and, possibly, in the price level. This view is based on the notion that prices adjust sluggishly to all shocks. It gives little credence to a rational expectations view of the monetary transmission mechanism. The rational expectations revolution in macroeconomic theory, as well as the practical experience of the United States and other countries in setting monetary targets and attempting to control inflation, has led many economists (including this one) to favor using the price level, rather than the money supply, as a guide for policy.

Rational Expectations

Sargent (1986) explains how the rational expectations revolution in macroeconomics changed the way economists think about the monetary transmission mechanism. Economists believe price level is determined by expected future policies rather than by past monetary policies. The intuition behind rational expectations is simply that people will use information about the policy process when they form expectations of inflation. This is an important insight because it suggests that the long and variable lag from money to prices is partly caused by changes in expectations about future inflation that occur because the policymakers and circumstances that determine monetary policy change.[1]

News about monetary policy actions is transmitted through all markets almost

[1] See Bryan and Gavin (1994) for details of this argument. Gavin and Kydland (1995) present evidence of instability in U.S. data, which, they argue, can be explained by changes in the monetary policy process.

FOMC DISCUSSION OF INFLATION TARGETS

Setting Specific Inflation Targets

"The Committee also considered the potential advantages and disadvantages of setting specific targets for bringing inflation down and achieving price stability over time. Such targets might provide an alternative or supplemental approach to the monetary growth ranges, which had been found to be unreliable guides for monetary policy over the past several years. The members discussed a number of aspects of inflation targeting. On the one hand, such targeting would help to anchor the conduct of monetary policy and progress in meeting these objectives could enhance the credibility of the Federal Reserve and perhaps reduce the overall cost of attaining price stability. On the other hand, close adherence to preset inflation targets could unduly constrain the Federal Reserve in its efforts to counteract the effects of cyclical shortfalls in the performance of the economy."

Minutes of the FOMC Meeting, January 31–February 1, 1995, p. 18.

The Goal of Price Stability

"At this meeting, the Committee discussed a bill, titled the "Economic Growth and Price Stability Act of 1995," that recently had been introduced in the United States Senate. The bill would make price stability the primary long-run policy goal of the Federal Reserve and require the Federal Reserve to establish a numerical definition of price stability and to implement a policy that would effectively promote such stability over time. It would repeal the Full Employment and Balanced Growth Act of 1978 (the "Humphrey-Hawkins Act") and certain related provisions in the Employment Act of 1946 and the Congressional Budget Act of 1974. The Federal Reserve had not yet been asked its views of the bill, but testimony was likely at some point and a preliminary discussion would help to identify important issues.

"The members had not had time to review the bill in detail or to consider fully all its implications. Nonetheless, their initial reaction was favorable in regard to the overall thrust of the bill's monetary policy provisions. These would make clear that price stability was the primary long-run objective of monetary policy and would restructure the monetary policy reporting requirements to permit the Congress to carry out its oversight responsibilities more effectively. Many members felt that in the context of seeking and maintaining price stability, monetary policy should have the flexibility to react to short-run fluctuations in output and employment, and they believed the bill would be improved if its intent in this regard were clarified. A few members expressed strong reservations about the part of the bill that would delete the employment objectives set forth in the Employment Act of 1946."

Minutes of the FOMC Meeting, September 26, 1995, pp. 17-18.

simultaneously because changes in expected monetary policy affect pricing behavior in all markets. In markets where contracts prevail, or where markets do not meet and clear frequently, such monetary policy changes will affect the distribution of wealth even though the price changes may not be recorded in transactions until much later. With forward-looking expectations, the important channels through which monetary policy affects real outcomes are changes in the expected inflation trend and deviations of the actual inflation rate from the rate that was expected.[2]

The rational expectations revolution implies that policies should be transparent. Everything else equal, the policy process should be structured to help people form accurate expectations. For example, a credible multiyear price-level objective would help concentrate expectations about

[2] See Litterman and Weiss (1985) for an econometric analysis of this view of the monetary transmission mechanism.

inflation. This, in turn, would cause people to make decisions in a way that would make the multiyear targets easier to achieve.

Experience with Monetary Targets

Our understanding of monetary phenomena has also been advanced through two decades of experience with monetary targeting in the United States. The Monetary Control Act of 1980 was structured under the assumption that M1—the sum of currency in circulation, traveler's checks, and checkable deposits—would be the key monetary target. This decision reflected the relatively constant growth rate of M1 velocity, the ratio of aggregate income to the money stock. As Figure 1 shows, M1 velocity appeared to experience a steady 3 percent growth during the 1960s and 1970s. The average inflation rate was approximately equal to the average M1 growth rate because the real economy grew at the same average rate as M1 velocity. The simplicity of the long-run relationship of M1 to inflation implied that policymakers could center the M1 growth range on the desired inflation trend.

Unfortunately, the simple relationship did not hold after 1980. The introduction of interest-bearing checkable accounts and the implementation of disinflation policy caused a dramatic change in the behavior of M1 velocity. Rather than continuing to grow at 3 percent per year, M1 velocity has actually fallen during the past 15 years. From 1981 through 1995, M1's average annual growth was just under 7 percent. Under the simple rule of thumb that worked before 1980, the average consumer price index (CPI) inflation rate would have been expected to be about 7 percent, rather than the 4 percent average that was actually observed. By 1987 the FOMC stopped targeting M1 and emphasized the broader aggregates.

Hallman, Porter, and Small (1991) suggested that a long-run relationship existed between M2 and the aggregate price level. This relationship was reflected in a relatively flat trend in M2 velocity.

Figure 1

M1 Velocity

Quarterly Data, Seasonally Adjusted

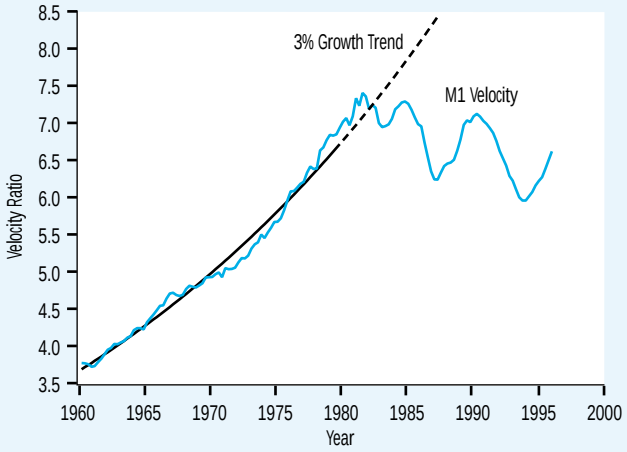


Figure 2

M2 Velocity

Quarterly Data, Seasonally Adjusted

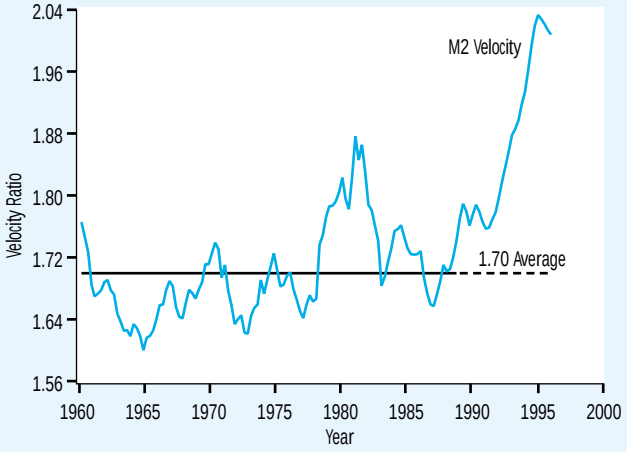
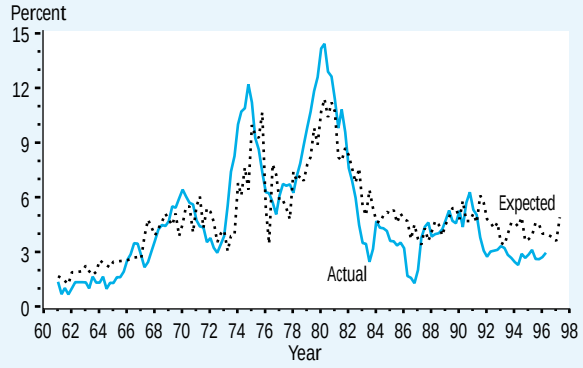


Figure 2 shows M2 velocity with a trend line calculated as the average from 1959 to 1989. M2 velocity displayed considerable cyclical variability and interest-rate sensitivity, but Carlson (1989) and Moore, Porter, and Small (1990) showed that these fluctuations appeared to be transitory and reasonably well explained by standard money demand theory. The apparent lack of trend in M2 velocity suggests that targets for M2 could be useful in communicating the long-run inflation objective. Here, the simple long-run relationship suggests that nominal gross

Figure 3

Michigan Mean Expectations and Actual CPI Inflation (Year-over-Year CPI)



Note: The expected inflation in May 1997 is the forecast from May 1996.

domestic product (GDP) growth would be equal to M2 growth. To achieve price stability, all the Fed would need to do is set the M2 growth target equal to the trend in real GDP growth.

From 1991 through 1995, M2 grew at an average annual rate of 2.1 percent, a little more than the average real GDP growth rate of 1.9 percent. Ex ante, such an outcome should have been expected to have resulted in a stable price level—an average inflation rate very near zero. However, the relatively constant long-term trend in M2 velocity also disappeared as the economy recovered from the 1990–1991 recession. There was a substantial increase in M2 velocity, a surprisingly stable 3 percent inflation trend, and a continuing de-emphasis of M2 in discussions about the short-run stance of monetary policy. This experience with M1 and M2 gives us less reason to agree that "the long way around seems the surer way to our objective" (Friedman, 1968, p. 15).

Controlling Inflation

The desirability of targeting inflation has been affected by the FOMC's success in getting control over inflation in the past 15 years. In a study of errors in private forecasts from 1976 through 1987, McNees (1988) reported that uncertainty about inflation went up, not just with the length of the forecast horizon, but also with the length of the period during which inflation was forecast: Forecasters could predict the next quarter better than they could forecast the average of the next two years. Although inflation was relatively predictable in the short run, the trend in the inflation rate appeared to be highly variable. Since 1990, it appears that this longer-term uncertainty may be substantially reduced. Figure 3 depicts the actual change in the CPI and the mean forecast of inflation from the Survey of Consumer Attitudes conducted monthly by the University of Michigan Survey Research Center. The mean value from this survey is aligned so that the forecast matches the period of actual inflation. Both the actual and the expected inflation rate display high year-to-year variability in the 1976–1987 time frame McNees studied. Figure 3 also shows declining variability with the decline in the average inflation rate after 1982.

Table 1 includes detail about the level and variability of inflation for various subperiods and alternative inflation measures. The average inflation level so far in the 1990s is about the same as it was in the 1960s, well below levels recorded in the 1970s and somewhat below those of the 1980s. In general, inflation volatility rose with the average level of inflation, so we should not be surprised to see volatility in the 1990s below that observed in the 1980s. Nevertheless, it is difficult to compare inflation variability of the recent period with the 1980s because the United States has not had a recession or a major oil price shock since the 1990–91 recession. Even with an optimal policy process, we would expect inflation to become more variable in response to such disturbances.

As we might expect, inflation rate stabilization has been associated with a reduction in the uncertainty about inflation. Table 2 reports statistics from two surveys of inflation expectations. The first is the Michigan survey, also shown in Figure 3; the second is the semi-annual Livingston survey of economists that is maintained by the Research Department at

Table 1

Inflation Statistics

Period	CPI*	CPI(LFE)	PPI†	PPI(LFE)	PGDP‡
1961-70	3.0	3.2	1.8	Not	2.9
	(2.7)	(2.9)	(3.9)	Available	(1.8)
1971-80	8.2	7.4	9.0	9.2	7.3
	(4.5)	(4.2)	(8.5)	(5.7)	(2.3)
1981-90	4.6	5.1	3.0	3.6	4.3
	(3.3)	(2.7)	(5.7)	(3.1)	(1.8)
1991-96	2.9	3.3	1.4	1.9	2.6
	(1.3)	(1.2)	(3.3)	(2.7)	(0.8)

Note: Each cell contains the average inflation for the period and the standard deviation of the inflation rate in parentheses. All figures are seasonally adjusted and expressed as compound annual growth rates.

* The CPI, the Consumer Price Index for all urban consumers, and the CPI less food and energy (LFE) are monthly.
† The PPI, the Producer Price Index for finished goods, and the PPI less food and energy (LFE) are monthly.
‡ PGDP, the Gross Domestic Product chain-type price index (1992=100), is quarterly.

Table 2

Inflation Forecast Errors
(Forecast Minus Actual)

	Michigan Survey		Livingston Survey	
Period	MAE*	Bias†	MAE	Bias
1961-70	0.78	0.30	1.08	−1.07
1971-80	1.95	−1.05	2.63	−2.33
1981-90	1.27	0.70	1.35	0.92
1991-96	1.38	1.32	0.61	0.49

Note:

* MAE = Mean Absolute Error
† Bias = Mean Error

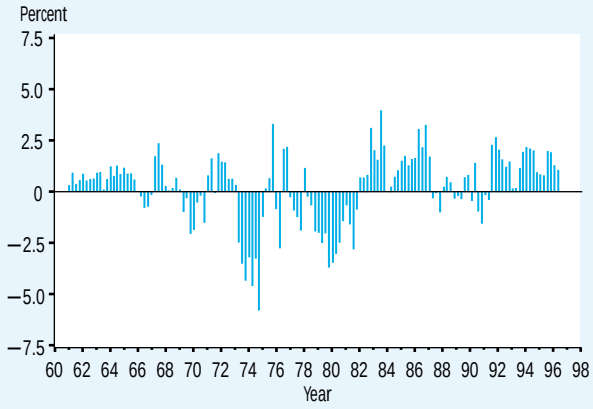
the Federal Reserve Bank of Philadelphia. Except for the case of the Michigan survey in the most recent period, the surveys show a positive correlation between the average level and predictability of inflation. In this case, the larger error is associated with lower inflation, but this is almost entirely a result of bias in the forecast.

Figure 4 shows the error in the mean forecast by respondents to the Michigan survey. The mean forecast has consistently been either too high or too low. When inflation was accelerating in the 1970s, survey respondents were slow to catch on to the policy process and thus tended to underestimate the inflation rate. In the early 1980s, when inflation was averaging around 4 percent, it appears that people in the Michigan survey did not really believe inflation would remain at that low level. Inflation forecasts were accurate from 1987 through 1990, a period of accelerating inflation. The bias in the errors is quite pronounced over short periods. This bias exists even today, when inflation is at its lowest level since the early 1960s. The inflation rate has stabilized at around 3 percent since 1990, but it does not appear

Figure 4

Forecast Error in the Michigan Survey

Deviation of Expected from Actual Inflation



that people who have responded to this survey have had much confidence that the trend would continue. The question is whether the Federal Reserve could enhance its credibility and reduce these expectational errors by adopting explicit inflation targets.

An interesting statement of the Federal Reserve's current long-term inflation objective can be found in the 1996 Monetary Policy Objectives:

> Most on the Committee anticipate consumer price inflation at or somewhat below 3 percent in 1996. ... the Committee recognized that its expectations for inflation do not imply that price stability has yet been reached. Nonetheless, keeping inflation from rising significantly during economic expansions will permit a gradual ratcheting down of inflation over the course of successive business cycles that will eventually result in the achievement of price stability (p. 5).

This statement suggests that the objective is to keep inflation from rising above the recent 3 percent trend through the end of the current expansion. On page 20 of the minutes from its January 31 – February 1, 1995, meeting, the FOMC explained its decision to raise the fed funds rate target from 5.5 percent to 6.0 percent on February 1, 1995: "In terms of balancing the policy risks that were involved, a prompt move would provide some insurance against what these members viewed as the principal risk in current circumstances—that of rising inflation." The FOMC issued an asymmetric directive at its March 28, 1995, meeting to "provide a clear signal of the Committee's intention to resist higher inflation" (minutes of FOMC meeting, p. 23).

The statement of an inflation objective also suggests that policy would become less restrictive if there were no signs of accelerating inflation. The FOMC lowered the fed funds rate to 5.75 percent in July 1995, explaining, "The members agreed that under present economic conditions a slight easing of the stance of policy would incur little risk of stimulating increased inflation and would be entirely consistent with their commitment to continued progress toward price stability over time" (minutes of July 5–6, 1995, FOMC meeting, p. 20).

In December 1995 the Committee explained its vote to lower the fed funds target to 5.5 percent: "In any case, the recent slowing of the economic expansion, combined with the wage and price restraint evident at current levels of resource utilization and continuing business efforts to expand capacity, suggested that there was little risk of a pickup in inflation" (minutes of December 19, 1995, FOMC meeting, p. 14).

This description of the policy objective resembles the "opportunistic" view of policy outlined by Orphanides and Wilcox (1996) and by Orphanides, Small, Wieland et al. (1996). This view is that the FOMC should stabilize the inflation rate at the recent trend (currently, about 3 percent in the CPI) until some outside event such as a favorable supply shock or an unavoidable recession causes a reduction in the inflation rate. Then the FOMC would take such an opportunity to lock in that lower rate as its new objective. One attraction of this approach is that the FOMC would never intentionally engineer disinflation that might cause a recession.

This opportunistic approach to policy arises naturally in a committee setting where the decision-making process requires a compromise between members whose views lie on a continuum.

Table 3

1995 and 1996 Projections

	Variable	FOMC Central Tendency Projections July 1994	FOMC Central Tendency Projections Feb 1995	FOMC Central Tendency Projections July 1995	Blue Chip Consensus Forecasts Feb 1995	Blue Chip Consensus Forecasts July 1995
Projections for 1995	Nominal GDP	5-5½	5-6	4¾-4¾	5.5	4.8
	Real GDP	2½-2¾	2-3	1½-2	2.5	2.0
	CPI	2¾-3½	3-3½	3⅜-3⅜	3.4	3.4
	Unemployment Rate	6-6¼	5½	5¾-6⅛	5.5	5.7
Projections for 1996	Nominal GDP			4¾-5⅜	5.4	5.6
	Real GDP			2¼-2¾	2.2	2.4
	CPI			2⅞-3¼	3.7	3.6
	Unemployment Rate			5¾-6⅛	5.7	5.8

At one end of the continuum are members who want to focus policy actions on the short-run real economy and who will be willing to resist signs of rising inflation pressures because such signs are associated with high levels of aggregate demand. Furthermore, this group may be persuaded to adopt preemptive policies to prevent the acceleration of inflation because they believe inflation is so costly to eradicate. On the other hand, they will resist attempts to lower the inflation trend intentionally if they believe that doing so would require higher unemployment and slower growth.

At the other end of the continuum are members who want a deliberate policy with multi-year targets to eliminate inflation. They argue that announcing targets in advance and implementing the policy gradually will reduce any costs associated with disinflation.

When inflation appears to be on the rise, there is no need for compromise: Everyone votes for monetary restraint. But in times of steady inflation, the key to compromise is members in the middle of the continuum. They want price stability but will wait for more favorable circumstances.

1995 Economic Outlook: Turmoil and Tranquility

FOMC members' and nonvoting presidents' forecasts are summarized in projections reported to Congress in February and July, pursuant to the Humphrey-Hawkins Act. The central tendency of these forecasts is shown in Table 3.[3] Blue Chip forecasts show the corresponding forecasts of private-sector economists.

Both output and employment grew more than expected in the second half of 1994. By the beginning of 1995, forecasters had therefore nudged up inflation forecasts and reduced unemployment forecasts for the year. In February, the central tendency of the FOMC's forecast for output was almost perfectly centered on the Blue Chip Consensus forecasts. The Fed policymakers were predicting 3.0 percent to 3.5 percent inflation in the CPI, while the Blue Chip Consensus fell in the upper part of that range.

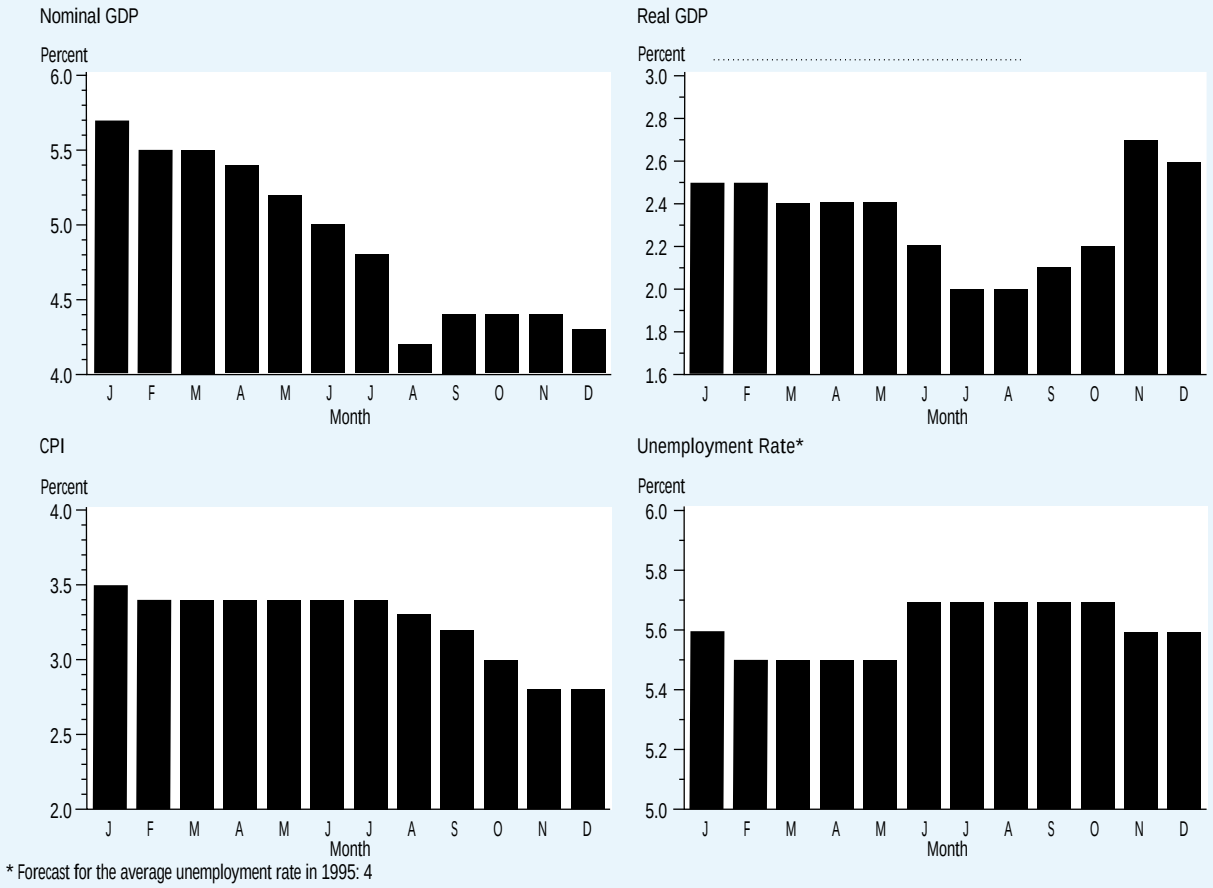
As 1995 unfolded, recurring reports of weakness in industrial production, the leading indicators, retail sales, and employment growth led both the FOMC and the private forecasters to revise their projections downward for real growth. By July 1995, the FOMC and nonvoting Federal Reserve Bank presidents were a little more pessimistic about real growth than were the Blue Chip forecasters. On the inflation side, both the Fed and Blue Chip had essentially the same forecasts in July as they had reported early in the year. The Fed reported a smaller range, centered on the same 3.25 percent midpoint. The Blue

[3] Pakko (1995) provides a detailed description of earlier forecasts and policy actions in 1993–1994.

Figure 5

Blue Chip Forecasts for 1995

(Fourth Quarter/Fourth Quarter)



* Forecast for the average unemployment rate in 1995: 4

Chip reported the same 3.4 percent consensus figure as in February.

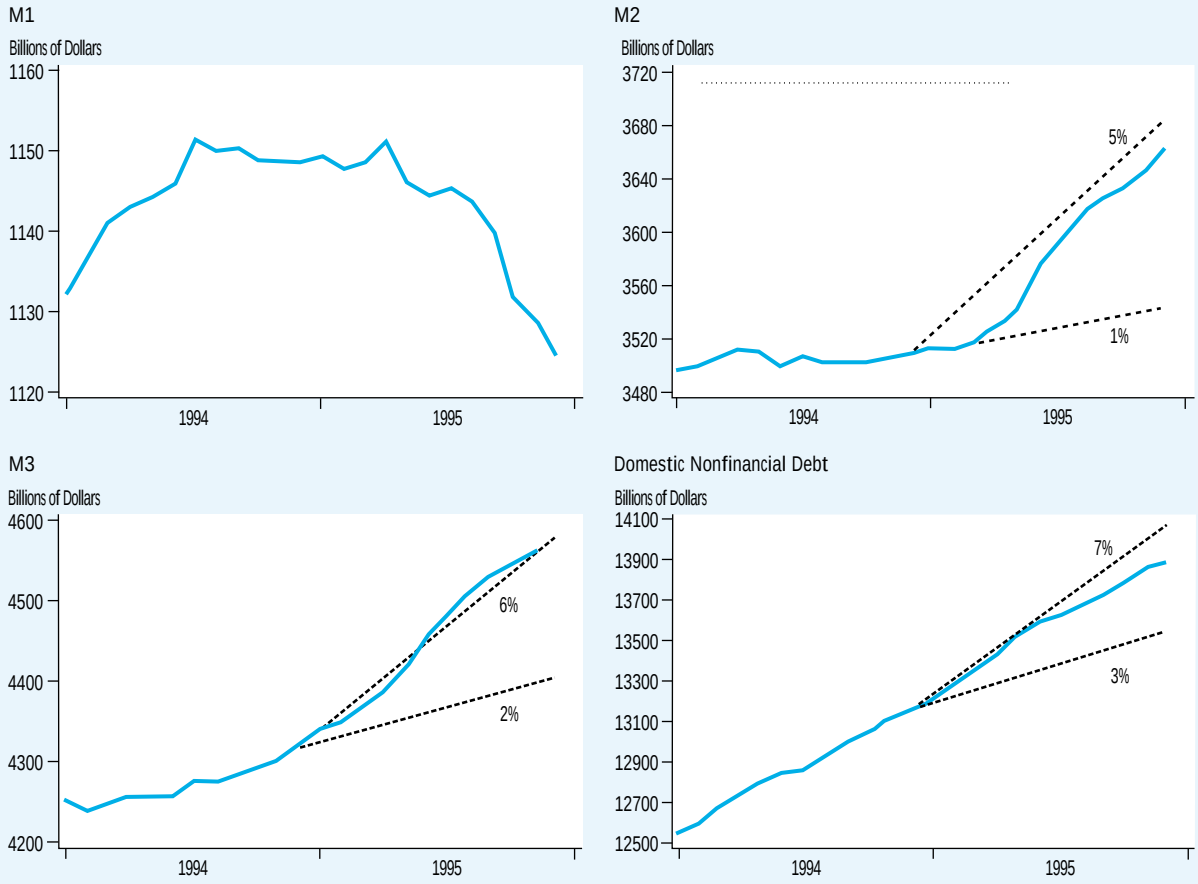
The monthly evolution of the Blue Chip forecasts for growth in nominal GDP, real GDP, and the CPI are shown in Figure 5. Also included are the monthly updates to the forecast for the fourth quarter average unemployment rate. Two important trends appeared in the evolving outlook for 1995—the general decline in inflation expectations that occurred during the second half of the year and the U-shaped pattern in the outlook for growth in the real economy. By midyear many economists were asserting that a recession had begun. Yet the second half of 1995 turned out to be surprisingly robust, with output bouncing back so strongly that the year actually finished above the initial forecasts (when measured by the 1987 fixed-weight output measure that was the basis for many beginning-of-the-year projections).

The monetary aggregates are shown in Figure 6. The introduction of sweep accounts caused M1 to decline throughout most of 1995. New software made it easy for depository institutions to sweep funds automatically out of checkable accounts into savings accounts to avoid the reserve requirement on checkable deposits. Funds would be moved back into the checkable accounts when needed to make payments. Since these funds were swept into accounts included in M2, this broad aggregate was not directly affected by

Figure 6

Monetary Aggregates with Targets

(Monthly Data, Seasonally Adjusted)



Note: The M3 target was set at 0 percent to 4 percent and was changed to 2 percent to 6 percent after the July 5-6, 1995, FOMC meeting.

Table 4

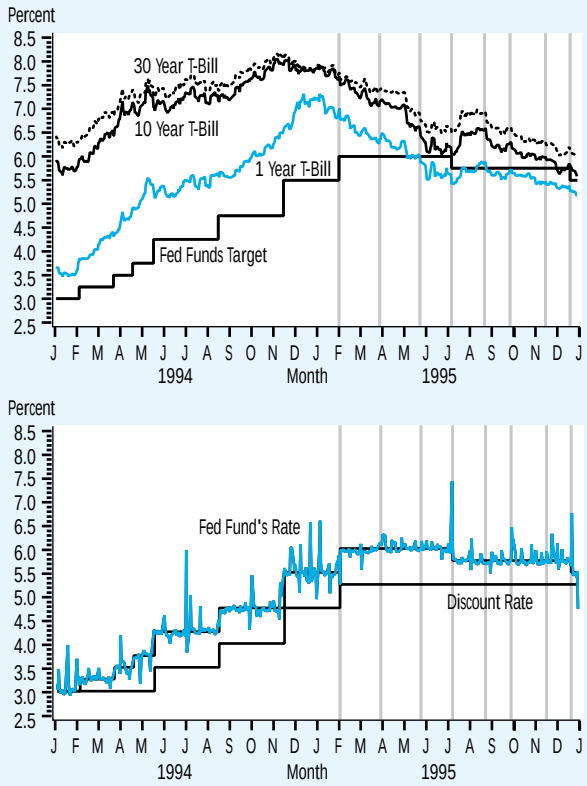
Monetary Policy Objectives

Meeting	Target Period	Percentage Growth Rates		
		M2	M3	Debt
January 31-February 1, 1995	1994:Q4-1995:Q4	1 - 5	0 - 4	3 - 7
July 5-6, 1995	1994:Q4-1995:Q4	1 - 5	2 - 6	3 - 7
	1995:Q4-1996:Q4	1 - 5	2 - 6	3 - 7

sweep activity. The targets for the broad monetary aggregates are shown in Table 4, as well as in Figure 6. M2 grew in the upper part of its 1 percent to 5 percent growth range. From early in the year, M3 grew above its initial 0 percent to 4 percent target range. In July, the FOMC raised this target range to 2 percent to 6 percent. The monitoring range for nonfinancial debt was set at 3 percent to 7 percent for 1995. This measure of debt grew in the upper part of the range throughout the year.

Figure 7

Selected Interest Rates
(Daily Data, Annual Percentage Rates)



The top panel of Figure 7 depicts the federal funds rate target and the evolution of three interest rates: yields on 1-year, 10-year, and 30-year, constant-maturity Treasury securities. Aggressive 1994 policy actions and a 50 basis-point increase in the fed funds target at the first FOMC meeting of 1995 quelled expectations of rising inflation and led to a year-long bond rally as surveys and market measures of inflation expectations inched downward throughout the year. An interruption in the trend occured in July 1995, after the FOMC lowered the fed funds rate on the day before the Bureau of Labor Statistics announced a large increase in jobs for June and a major upward revision of employment statistics for May. Subsequent economic reports showed that inflation pressures were easing even as the economy appeared to be strengthening. With the exception of this temporary increase in July, 1995 was a year in which the level of rates fell and the term structure flattened.

The bottom panel of Figure 7 shows the target level for the fed funds rate, again accompanied by the actual fed funds rate and the discount rate. The variability of the actual fed funds rate demonstrates that the Fed does not control the fed funds rate directly but, rather, supplies reserves in a way that keeps the average trading range very close to the target rate. The upward move to 6 percent in February, followed five months later by a decline to 5.75 percent, is shown in the figure. On December 19, 1995, the rate was lowered again to 5.5 percent. The discount rate had been raised to 5.25 percent in February and held at that level through the end of the year.

FOMC DISCUSSIONS AND DECISIONS

Several common themes emerged in discussions on the outlook for the economy at all the FOMC meetings:

•The deceleration in the growth of nominal hourly compensation. This slowing in nominal labor costs spanned most major occupations and industries and was believed to reflect a fundamental lowering of inflation expectations.

•The view that inventories were above desired levels in many sectors and that, on average, 1995 would be a year in which attempts to reduce inventory accumulation would lead to cuts in production and slower real GDP growth.

•The notion that business fixed investment would stop growing so rapidly and slow down to a more sustainable rate.

•The view that, by the end of 1994, the economy had fully recovered from the last recession and that pent-up demand for housing, autos, and other durable goods was exhausted.

The Committee's decisions are summarized in Table 5. The directive to the Manager of the Open Market Desk contains language indicating the FOMC's intentions about a possible policy change within the intermeeting period, depending on developments in that period. Table 5

Table 5

FOMC Directives and Measures of Monetary Policy Stance

1995 Meetings	Directive for Pressure	Intermeeting Stance toward		Result from Change in Reserve Pressure		
		Lesser Restraint	Greater Restraint	Date of Change	Fed Funds Target*	Discount Rate
Jan. 31-Feb. 1	Increase somewhat	Would	Would	Feb. 1	6.00	5.25
Mar. 28	Maintain (+)	Might	Would	N/A†	6.00	5.25
May 23	Maintain	Would	Would	N/A	6.00	5.25
Jul. 5-6	Decrease slightly (−)	Would	Might	Jul. 6	5.75	5.25
Aug. 22	Maintain	Would	Would	N/A	5.75	5.25
Sep. 26	Maintain	Would	Would	N/A	5.75	5.25
Nov. 15	Maintain	Would	Would	N/A	5.75	5.25
Dec. 19	Decrease slightly	Would	Would	Dec. 19	5.50	5.25

* Federal funds rate expected to be consistent with desired reserve restraint. The rate expected to be consistent with policy before the Jan. 31-Feb. 1 meeting was 5.5 percent. The discount rate was raised from 4.75 percent to 5.25 percent on Feb. 1. An asymmetric policy setting is indicated by a (+) or (−) in the second column.

† N/A indicates that there was no change in the discount rate or the fed funds target.

shows that, at the first meeting of 1995, the Committee used the same word, "would," indicating that either greater or lesser restraint would be acceptable within the intermeeting period. An example of an asymmetric directive was the one written after the March 28, 1995, meeting, in which the Committee used the weaker word "might" to indicate that an easier policy was less likely to be acceptable than a tighter policy.

The FOMC began the year concerned about the inflationary pressures implied by the relatively high demand observed in 1994, and those pressures began to show through in reports of consumer and producer prices. Incoming data showed that the economy was weaker than had been expected in early 1995. In May the FOMC adopted a symmetric directive, switching from a position of prospective tightening to a more neutral posture. Negative economic reports continued, leading the FOMC to reduce the target for the fed funds rate to 5.75 percent on July 6.

Indicators of a slowing real expansion appeared to turn around with a surprisingly robust labor market report on July 7 and subsequent positive reports on economic activity. The switch in beliefs about real growth caused bond prices to decrease temporarily. Throughout the summer and fall, news continued to show a robust economy and declining inflation. The bond market turned around again with the news of lower inflation and the rally dating from the final months of 1994 continued through 1995. Falling long-term interest rates and inflation expectations, combined with some year-end slowing in the economy, led the FOMC to lower the fed funds target to 5.50 percent at the December 19th meeting. I present details about the decisions and discussions in the following accounts of each meeting.

January 31–February 1 Meeting

The year began with the federal funds rate trading at 5.5 percent. The Open Market Desk operated under an asymmetric directive that called for a bias toward a firming of reserve conditions during the intermeeting period. The most important economic news that had been

released since the December 20, 1994, FOMC meeting was a report showing a surge in the fourth quarter GDP to an annual rate of 4.7 percent. Although rapid accumulation of inventories had been a big part of the growth, analysts were divided about whether this accumulation had resulted from falling demand or from anticipation of future sales. News reviewed at the meeting suggested that retail sales were mixed but that consumer confidence was high, and strength in the housing sector was expected to support moderate growth in 1995, even in the face of a probable inventory correction. Reports about the economy in the closing months of 1994 indicated that both industrial production and payroll employment continued to grow above their longer-term trends.

Financial markets were embroiled in concerns about debt quality in the wake of the Orange County, California, default and the crisis in Mexico. Neither the FOMC nor the markets were giving much weight to monetary aggregates' sluggish 1994 growth. Although M3 had picked up with the rising demand for bank loans at the end of 1994, M2 had grown along the bottom of the 1 percent to 5 percent target range. Total non-financial debt was increasing slightly below the trend growth in nominal spending. Although rising money market interest rates in 1994 had brought a halt to growth in M1, the Committee saw little indication that credit conditions were tight.

Household and economic forecaster surveys all predicted an acceleration of inflation in 1995. To reduce the probability and extent of such an acceleration, the FOMC unanimously voted to increase reserve market pressures so that the fed funds rate would trade around 6 percent. In conjunction with this decision, the Board of Governors voted to raise the discount rate from 4.75 percent to 5.25 percent. The action was explained in a press release:

> Despite tentative signs of some moderation in growth, economic activity has continued to advance at a substantial pace, while resource utilization has risen further. In these circumstances, the Federal Reserve views these actions as necessary to keep inflation contained, and thereby foster sustainable economic growth. (Feb. 1, 1995.)

This 50–basis point increase in the fed funds rate was followed by lower interest rates in the bond market during the intermeeting period, as shown in Figure 7.

Crisis in Mexico

At the Committee's first meeting of 1995, members also voted to expand the swap arrangement with the Bank of Mexico:

> On December 30, 1994, the Committee approved a temporary increase from $3 billion to $4.5 billion in the system's reciprocal currency (swap) agreement with the Bank of Mexico and it also approved the activation of that agreement. The Committee approved a further temporary increase of $1.5 billion and activation of that amount at this meeting, thereby raising the swap arrangement with the Bank of Mexico to a level of $6 billion, consisting of the regular $3 billion line and a special $3 billion line. (Minutes of FOMC meeting, p. 24.)

In addition, the Committee voted to facilitate U.S. participation in the Multilateral Program to Restore Financial Stability in Mexico, with an increase in the agreement to "warehouse" foreign currencies for the U.S. Treasury:

> The Committee also approved at this meeting an increase from $5 billion to $20 billion in the amount of eligible foreign currencies that the System is prepared to 'warehouse' for the Treasury and the Exchange Stabilization Fund (ESF)" (Minutes of FOMC meeting, p. 25).

The majority of members voted to approve these measures because they "were persuaded that the nature and severity of Mexico's financial problems could not be contained without making available substantial financial assistance to the Government of Mexico" (minutes of FOMC meeting, p. 26). Two members dissented:

Messrs. Lindsey and Melzer dissented with respect to increases in both the swap line and the warehousing arrangement with the Exchange Stabilization Fund. They did not believe that the Committee had been provided sufficient information to assess whether developments in Mexico threatened U.S. financial stability, a possible justification for increased central bank lending on a short-term basis. Furthermore, they considered it inappropriate for the Federal Reserve to participate, directly or indirectly, in intermediate to long-term financing to facilitate debt restructuring. They were concerned that such participation in a fiscal policy matter might compromise, or appear to compromise, the independence of the monetary policy process. Mr. Lindsey added that the latter risks were significantly enhanced given the absence of Congressional authorization or more general public support for these measures. (Minutes of FOMC meeting, pp. 26–27.)

March 28 Meeting

Given the rapid economic growth in 1994, policymakers anticipated a relative slowdown in 1995. Early reports on economic activity were mixed. Industrial production continued to grow, and new jobs were created at a rate that exceeded the underlying trend in labor force growth. The expected inventory correction was not yet evident; available information showed that inventories had continued to accumulate in January. On a weaker note, reports of spending in the first two months of 1995 showed a decline in auto sales and a slowdown in the housing market. Lower demand for autos led to cutbacks in production schedules and this, combined with a bleak houing market, led Blue Chip economists to nudge GDP forecasts down slightly in 1995.

Expectations for a slight pickup in inflation were reinforced as reports for the first two months showed both consumer and producer prices rising at rates above their 1994 averages. Although private forecasters were lowering predictions of inflation slightly, there was no sign that anyone expected the FOMC to make further progress toward price stability. Few indications of monetary restraint surfaced as bank credit continued to advance and the broad monetary aggregates appeared to be growing within the prescribed ranges.

In sum, there was a consensus among Committee members that the economy was slowing from the torrid pace of 1994 but was already operating at a high level, and the extent of the slowdown was in question. The Committee voted unanimously to maintain the degree of the reserve restraint (fed funds trading at about 6 percent), but concern about the risk of accelerating inflation and a desire to move gradually toward price stability led them to adopt an asymmetric directive biased in the direction of more restraint.

May 23 Meeting

By the time of the May meeting, the Committee was picking up signs of weakness in the year's first half, particularly in the demand for autos and housing. This perception was reinforced by reports that indicated slower job growth, a jump in the unemployment rate to 5.8 percent in April, a slowdown in the manufacturing sector, a decline in retail sales, and a weakness in export demand associated with problems in Mexico. These indicators of weakness were offset by expectations that the economy, especially the interest-sensitive sectors, would benefit from the ongoing rally in bond markets and the surge in stock prices. The rising stock market was reducing the cost of capital to businesses and enhancing the wealth of many households.

Declining long-term interest rates were accompanied by declines in survey measures of inflation expectations despite the above-average growth in the CPI and the producer price index (PPI) in the first four months of the year. Monetary aggregates grew little, and the market seemed to believe the increase in inflation would be transitory—the Blue Chip consensus remained at 3.4 percent.

Overall, the perceptions of weakness in demand led the Committee to revise its view that the next move in interest rates

would be upward. It unanimously set aside the asymmetric directive of the previous meeting and voted in favor of a symmetric policy that would maintain the existing degree of pressure on reserve markets.

July 5–6 Meeting

Committee members' differing perceptions had a strong influence at this midyear policy meeting. Some members believed the economy would be substantially weaker than expected. On June 2, the Bureau of Labor Statistics reported a 101,000 decline in the number of nonfarm payroll jobs in May. This was after a slight decline in April. The household surveys, although thought to be less reliable, showed even greater declines in April and May. This unexpected weakness in the labor market led Blue Chip forecasters to revise their estimate of GDP growth for 1995 substantially downward. The consensus forecast fell from 2.4 percent in the May release to 2.2 percent in the June 10th report. In July, Blue Chip forecasters again lowered the 1995 outlook for GDP, this time from 2.2 percent to 2.0 percent. Although these figures were not released until after the July FOMC meeting, most of the individual forecasts would have been made with the same information available to the FOMC members who had reduced their forecasts from February. The central tendency in the outlook for real GDP growth in 1995 fell from a range of 2 percent to 3 percent in February to 1.5 percent to 2.0 percent in early July. Pessimism brought on by the dramatic decline in jobs was reinforced by the string of negative reports on retail sales, industrial production, and the leading indicators.

M2 rebounded strongly after April and approached the upper 5 percent limit of the target range by midyear. In choosing to keep the 1 percent to 5 percent range for M2, a majority of the members reasoned that they did not have enough confidence in the relationship between measures of economic performance and M2 to justify making a change in the target:

> Moreover, if the more normal behavior of velocity over the past several quarters were to continue, a 1 to 5 percent range for growth of M2 likely would prove consistent with the Committee's ultimate objectives of sustained economic expansion and reasonable price stability (Minutes of FOMC meeting, p. 16).

Not all the members agreed that the 1 percent to 5 percent growth range was appropriate for M2:

> Mr. Blinder and Ms. Yellen dissented on a technical judgment, not a policy difference. They noted that if growth in the demand for M2 were close to historic norms in 1995 or 1996, as indeed it had been for some time, then the Committee members' projections for nominal GDP would likely imply M2 growth near the top of, or even above, the current range. While the relationship between the growth of M2 and that of nominal GDP remained subject to a great deal of uncertainty, they were persuaded that the range—in fact, the midpoint of the range—should normally be consistent with members' forecasts of nominal GDP growth. (Minutes of FOMC meeting, p. 18.)

Strong growth in loans stimulated bank demand for M3 liabilities and caused M3 to grow above the upper 4 percent limit. Projections of continued growth in M3 led the FOMC to raise the target for this broad aggregate by 2 percentage points. The Committee voted unanimously to raise the M3 target to 2 percent to 6 percent and to reestablish the monitoring range for domestic nonfinancial credit at 3 percent to 7 percent. The Committee also voted unanimously to adopt tentative targets for 1996 that were the same as the targets agreed to for 1995.

In spite of reports of higher inflation early in the year, the Committee left its inflation outlook centered on 3.25 percent. Blue Chip forecasters ignored these reports as well, upholding their January inflation outlook of 3.4 percent. The May CPI report showed some slowing from the early data. The flat PPI for finished goods in May suggested some reduction of infla-

tion pressures in the second half of the year. At this meeting, members expressed some differences of opinion about the definition of price stability. Some members believed the weakening economy would prevent an acceleration of inflation—and therefore policy should be eased substantially. Other members stated that there was no indication of progress toward price stability—and therefore policy should be held at a 6 percent fed funds rate. The Committee compromised by slightly easing reserve pressures. In the press release issued at the end of the meeting, on July 6th, the Fed explained:

> As a result of the monetary tightening initiated in early 1994, inflationary pressures have receded enough to accommodate a modest adjustment in monetary conditions.
>
> Today's action will be reflected in a 25 basis point decline in the federal funds rate from about 6 percent to about 5.75 percent.

There was one dissent on the short-run policy decision:

> Mr. Hoenig dissented because he believed the stance of monetary policy should remain unchanged at this time. With the pace of economic activity likely to return to trend growth later this year and inflation expected to be higher this year and next than in 1994, he felt an unchanged policy in the near term would enhance the prospects of achieving the Committee's long-run objectives of sustainable economic growth and price stability. (Minutes of FOMC meeting, p. 24.)

August 22 Meeting

The news leading up to the July meeting had been almost entirely negative. But one day after the July meeting ended, the monthly labor report showed an unexpected 215,000 increase in nonfarm payroll jobs during the month of June; it also revised the earlier report of a 101,000 jobs decline for May to show a decline of only 46,000 jobs. Incoming information suggested that the economy, after a weak first half, was on track for continued moderate expansion. Revised data showed that retail sales had not been as weak as reported earlier. The housing market picked up considerably in response to falling long-term interest rates. Business investment, led by spending on computing equipment and construction, continued to post solid gains. Although the state of the economy remained uncertain, the news was more balanced than it had been earlier in the year. The good news about the economy caused a temporary backup in interest rates as market participants realized that aggregate demand was stronger than previously thought.

CPI inflation, after rising at a 3.25 percent rate through the first five months of the year, rose at more subdued rates in June and July—the two months averaged 1.2 percent at an annual rate. Increases in producer prices at the earlier stages of production appeared to be decelerating, suggesting some further reduction of inflation later in the year. An ongoing slowdown in the growth of benefit costs supported continued moderate growth in labor costs. By early August, Blue Chip economists were beginning to mark down their forecasts for CPI inflation in 1995.

The wedge between growth in the narrow and broad monetary aggregates increased. The narrow aggregates, from currency to M1, were dramatically below expected trends. The slowdown in currency was attributed to an unexplained decline in the net foreign demand for U.S. currency. The slowdown in the deposit component of M1 was attributed to the introduction of sweep accounts that substantially reduced banks' required reserves.

The broad aggregates grew well above the trend that had been established in recent years. Some observers noted that, following a period of rising velocity, M2 velocity appeared to be stabilizing around a new higher level. M3 growth was also rapid, reflecting the continued growth in managed liabilities needed to fund strong growth in bank loans.

This good news about the economy led the Committee to vote unanimously to

maintain the existing degree of pressure in the reserve market—a fed funds rate trading around 5.75 percent—and to abandon the bias in favor of an easier policy that had been adopted at the previous meeting.

September 26 Meeting

Good news of lower inflation and the real economy's continued expansion filled most reports during the intermeeting period. In September, the Blue Chip consensus forecast slightly higher spending in 1995, with a bit more real output growth and a bit less inflation. Indicators that had caused concern about economic weakness early in the year turned around during the summer:

- Consumer spending continued at a relatively high level.
- Housing markets strengthened in the presence of lower mortgage rates.
- The manufacturing sector surged in August, led by a sharp increase in auto production.
- Growth in employment rebounded strongly from slower growth in July.
- Business spending on equipment and structures remained surprisingly robust.

News about consumer and producer price inflation suggested that acceleration in the first six months was likely to be reversed in the second six months. On a year-over-year basis, inflation was moderate in 1995, approximately equal to or below that of the previous year and the previous five years. The broad monetary aggregates continued to grow in the top part of the range (M2) or well above the target range (M3). The term structure of interest rates, while still above the low level reached at midyear, had declined slightly across the maturity spectrum from the levels at the time of the August meeting.

Overall, information available to the Committee at this meeting indicated continued strength in aggregate demand and a moderating inflation trend, suggesting little reason to adjust the degree of pressure in reserve markets. Members voted unanimously to maintain the existing degree of pressure in reserve markets, with no bias for a change before the next meeting. Some members were concerned about downside risks to the economy and believed the 5.75 percent fed funds target was slightly restrictive.

> However, the current performance of the economy suggested that the timing of an easing action was not an immediate concern. Other members who preferred an unchanged policy placed more emphasis on current forecasts of little or no progress in reducing inflation from recent levels. They thought it would be premature to ease policy without greater assurance that inflation had been contained in the current cyclical expansion and that prospects for significant further progress toward the long-run objective of price level stability had improved. (Minutes of FOMC meeting, p. 14.)

November 15 Meeting

Information released before this meeting revealed a surge of economic growth in the third quarter that caused forecasters to revise the GDP outlook for 1995 substantially upward. The Blue Chip consensus for real GDP growth in 1995 was 2.7 percent in the November report, up from 2.2 percent a month earlier. As often occurs in the face of a surprisingly good report for the previous period, the GDP outlook for the current quarter was revised downward. Falling retail sales in October, slower employment growth in September and October, falling industrial output with a labor strike in the aircraft industry, and uncertainty about the duration of the government shutdown led some members to question whether aggregate demand would be sustained, given the current policy setting. Other members believed there was sufficient evidence of continued expansion to delay any policy easing. Anecdotal evidence suggested that retail sales were beginning to rebound in early November; a strong housing market earlier in the year was expected to fuel the demand for household appliances and other durable goods; and growth in

business investment, although slowing somewhat, remained on an upward trend.

On the price side, reports of lower inflation caused analysts to revise expectations downward. Long-term bond rates fell with inflation expectations, and the Blue Chip forecasters continued the march downward in their outlook for CPI inflation for both 1995 and 1996. On the short end of the market, the yield curve became U-shaped as the one-year rate fell below both the three-month and the three-year rates. Growth in the broad monetary aggregates, at or above the upper limits of their respective target ranges, slowed in October as the demand for bank loans slowed. All these factors pointed toward lower inflation pressures. As reported in the minutes of the meeting, "With regard to inflation, members noted that despite generally high levels of resource use, including tight labor markets in many parts of the country, inflation had been more subdued than many had expected over the past several months." Although inflation expectations were lowered, they still remained at or above the actual inflation trend in the economy.

Deliberations at the November meeting reflected both differences in views about the outlook and differences about the strategy that might be taken to achieve price stability. The majority of the Committee agreed that aggregate demand was sufficiently high to justify leaving the trading range for the fed funds rate at 5.75 percent despite considerable sympathy with the view reflected in the term structure—that is, during the next year, short-term interest rates would move lower. Most members who would have preferred to cut rates at this meeting were willing to wait for further information about the state of the economy and the associated demands for credit. The meeting's minutes explicitly state that monetary policy should not be conditioned directly on the budget negotiations, but rather, monetary policy should deal directly with any change in the net demand for credit that resulted from a budget deal.

The Committee voted to maintain the existing degree of pressure on reserve markets. Even those who might have preferred a bias toward a lower interest rate agreed that there was not likely to be enough new information available to justify an intermeeting policy adjustment. Only Governor Lawrence B. Lindsey dissented from the majority opinion:

> Mr. Lindsey dissented because he believed that monetary policy should be eased. The evidence suggested to him that in the absence of an easing move the underlying rate of nominal GDP growth was likely to be lower than needed to maintain real GDP at or near its potential. The intermediate forecast was subject to a number of significant risks: household balance sheets seemed unlikely to sustain the current rate of durables expenditure for any extended period; government expenditures were certain to be cut substantially; and with fiscal contractions underway in Europe and Canada and severe financial stresses present in Japan and Mexico, he did not see much likelihood of a substantial expansion of exports. In keeping with his views, the financial markets were signaling the likelihood that a weaker pace of nominal GDP growth would materialize. The yield curve was virtually flat, with government securities up through relatively long maturities trading at yields below the current average federal funds rate. Thus, markets would be unlikely to find some easing inappropriate and over the intermediate horizon would view the current level of short-term rates as unsustainable. (Minutes of FOMC meeting, p. 18.)

December 19 Meeting

As FOMC members prepared for their final meeting of the year, financial markets were reflecting a continuing decline in inflation expectations, and Committee members were somewhat concerned that fourth-quarter aggregate demand was slightly weaker than had been anticipated

at the November meeting. The Blue Chip consensus released in December forecast a slight modification in the 1995 real GDP growth rate to 2.6 percent, down 0.1 from November's report. This lower forecast for the year was based on a view that the fourth quarter would see little increase in manufacturing, the tangled budget process would result in a temporary reduction in federal outlays, and both consumer and business demand for current output would moderate from earlier expectations. The economy was expected to grow closer to its perceived trend rate—around 2.5 percent in the unchained measure, down from the rapid growth in the third quarter. Consumer demand was thought to be restrained by job insecurity associated with widespread reports of business restructuring; higher debt service burdens; and the satisfaction of pent-up demands for housing, autos, and other durable goods. Growth in business fixed investment was expected to slow just because few economists believed it could continue growing as rapidly as it had done since 1992.

The reports on inflation reinforced a widespread impression that 1995 would be another year in which the CPI would increase less than 3 percent. These lower inflation expectations were evident in surveys, as well as in financial markets, where interest rates continued to fall across the entire term structure. The growth in the broad aggregates remained subdued in November after experiencing sluggish growth in October. Nevertheless, robust growth earlier in the year meant that M2 finished the year in the upper portion of its targeted 1 percent to 5 percent range, and M3 finished the year above the upper end of its targeted 2 percent to 6 percent range.

Falling inflation and, more important, expectations for lower inflation in the future, as well as some indications of slowing in the expansion, led the Committee to vote unanimously for a slight decrease in reserve pressure, lowering the target for the fed funds rate from 5.75 percent to 5.5 percent. The discount rate, which had been raised to 5.25 percent at the first meeting of the year, was left unchanged. In a press release dated December 19, 1995, Fed Chairman Alan Greenspan announced that the easing was made possible because "inflation has been somewhat more favorable than anticipated, and this result along with an associated moderation in inflation expectations warrants a modest easing in monetary conditions."

BETTER CONTROL THROUGH AN EXPLICIT OBJECTIVE

Long-term bond yields decreased as the FOMC's federal funds rate target increased in late 1994 and early 1995. In July, long-term yields rose after the fed funds rate target was lowered. Although politically unpopular, increases in the fed funds rate target may be needed to lower inflation expectations, and thus, long-term bond yields. The focus on long-term interest rates highlights expectations in the monetary transmission mechanism. The FOMC's practice in 1995 was directed toward the control of inflation and was generally explained in terms of the expectations for and outcomes of the various price indexes. Modern theories in macroeconomics and finance suggest that the Fed could improve control over inflation by committing to an explicit long-term inflation (price level) objective.

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MEMBERS OF THE FOMC IN 1995

At any given time, the Federal Open Market Committee consists of 12 voting members. The Committee includes all seven members of the Board of Governors of the Federal Reserve System, as well as five of the 12 presidents of the regional Federal Reserve banks. Reflecting the importance of the Federal Reserve Bank of New York in policy implementation, the president of that Reserve Bank is always a voting member and is, in fact, elected as Vice Chairman of the Committee (the Chairman of the Board of Governors is elected as Chairman of the FOMC). The remaining four positions rotate among the presidents of the other 11 Federal Reserve banks. Although only a limited number of Federal Reserve Bank presidents are voting members of the Committee, all 12 attend the meetings and participate in the discussions. John P. LaWare attended the first meeting of 1995, later resigning from the Board, and was not replaced until 1996, so there were only 11 voting members for the last seven meetings of 1995.

Listed below are the voting members of the FOMC in 1995.

Alan Greenspan, Chairman, FOMC
Chairman, Board of Governors

William J. McDonough, Vice Chairman, FOMC
President, Federal Reserve Bank of New York

Alan S. Blinder
Member, Board of Governors

Thomas M. Hoenig
President, Federal Reserve Bank of Kansas City

Edward W. Kelley, Jr.
Member, Board of Governors

John P. LaWare*
Member, Board of Governors

*Resigned effective April 30, 1995

Lawrence B. Lindsey
Member, Board of Governors

Thomas C. Melzer
President, Federal Reserve Bank of St. Louis

Cathy E. Minehan
President, Federal Reserve Bank of Boston

Michael M. Moskow
President, Federal Reserve Bank of Chicago

Susan M. Phillips
Member, Board of Governors

Janet L. Yellen
Member, Board of Governors

William R. Emmons is a research economist at the Federal Reserve Bank of St. Louis. Kent A. Koch provided research assistance.

Price Stability and the Efficiency of the Retail Payments System

William R. Emmons

Two of the Federal Reserve's most important policy mandates are to foster price stability and to oversee the integrity and efficiency of the payments system. Effective price stability is usually defined as annual rates of inflation or deflation close to zero. The integrity and efficiency of the payments system, on the other hand, are related to the reliability and cost effectiveness of the institutions and practices that individuals, businesses, and government entities use to transfer funds to one another. Although these policy goals are seldom discussed together, this article illustrates how price stability could enhance the efficiency of the payments system. The argument is reminiscent of and extends Friedman's (1969) analysis of the optimum quantity of money.

To simplify the discussion, I focus only on the efficiency-enhancing effects of price stability on the retail payments system, which consists of all those transfers of funds that involve individuals, nonbank firms, and government entities.[1] It is quite likely that the integrity (that is, reliability) of the payments system would be increased as a result of the greater financial stability that would accompany stable prices, but I do not consider that issue here.

The key link between price stability and the efficiency of the retail payments system is the level of nominal short-term interest rates. This is because the benefit of float to the user of a payment instrument—that is, the interest that can be earned while a payment order is in the process of clearing but has not yet been settled—is proportional to the prevailing interest rate as follows:

User Float Benefit = (Payment Amount) × (Days Spent in Clearing) × (Daily Interest Rate on Investable Funds)

Price stability would almost certainly result in relatively low nominal short-term interest rates because nominal interest rates and inflation have historically moved up and down together (see Figure 1). Thus float benefits would be relatively small with stable prices.

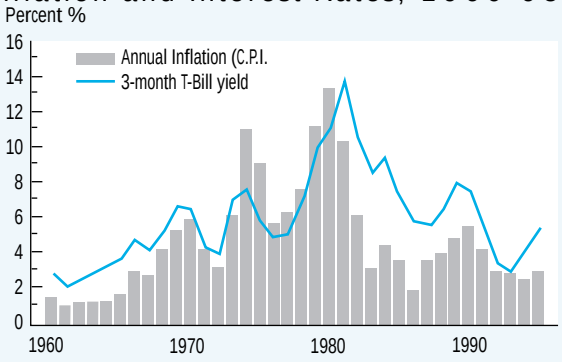
Why does float reduce the efficiency of the payments system? A policymaker might be tempted to ignore float because it causes a pure transfer to occur. That is, the interest earnings gained by one party correspond to losses of interest income by the payment counterparty (or counterparties). The parties to any transaction involving float could in principle negotiate a contract that compensates the loser(s) so that no intervention would be necessary.

The actual net result of float is far from benign, however, because it encourages the use of float-intensive payment instruments instead of other instruments that generate less float. Negotiation to allocate the costs and benefits of various payment methods and instruments is difficult because there are typically more than two parties to every transaction, involving not just the parties making and receiving payment, but also the primary payment provider and potentially several other intermediaries in the payment-clearance and payment-settlement chains. Although payment providers and other intermediaries (primarily banks) or receivers (such as merchants) could levy fees or penalties to discourage the use of particular payment instruments, this practice is not widespread. Instead, originators of payments in

[1] Funds transfers that occur strictly among banks are termed *wholesale payments*. I do not discuss the wholesale payments system in this article.

Figure 1

Inflation and Interest Rates, 1960-95



the United States generally retain some control over the choice of payment method and do not usually face an explicit price penalty when choosing riskier or costlier payment methods. Therefore, the net user costs of alternative payment instruments, including float benefits, are potentially important in determining actual payment practices.[2]

Float-influenced choice of payment instruments is inefficient for at least two reasons. First, float is an imperfectly priced loan (sometimes unpriced), and it therefore increases the riskiness of the payments system. For example, a merchant who accepts a check in payment is actually extending credit to the customer. The merchant's loan is repaid not when the merchant deposits the customer's check, but (typically) a few days later when the merchant's bank makes the funds available for withdrawal. Bad checks (those written against insufficient funds in the customer's account) represent less than nine-tenths of one percent of all checks written, but a typical merchant is ill-suited to judging the credit risks presented by any given customer.[3] Thus although accurate pricing of credit is essential to prevent concentrations of risk and potential disruptions to the payments system, checks in fact generate a substantial volume of mispriced credit in the form of float.

This article focuses on a second reason why float is harmful. Available empirical evidence on the relative cost efficiency of the various retail payment methods in use today reveals that the most float-intensive payment methods are also typically the most costly to produce and process in terms of economic resources used—namely capital, labor, and land.[4] The most important examples in the United States of float-intensive and cost-inefficient retail payment instruments are checks and credit cards, which are the most frequently used retail payment methods after cash. Thus a systematic preference for float-intensive payment instruments by originators of payments and an unwillingness or inability of other parties to discourage it reduce overall payments-system efficiency.

The correlation between user float benefits and real-resource costs is not surprising when one considers that both are a reflection of a relatively long and often complex sequence of processing stages, many of them labor intensive. Checks, in particular, may require several rounds of processing because several banks may be involved and virtually every check is physically returned to the bank whose customer wrote it, wherever that may be.

Clearly, float is not the only impetus for excessive use of costly retail payment instruments in the United States. In addition to the forementioned fact that actual costs are often not fully passed through to the party controlling the choice of instrument, thus encouraging overuse, checks and credit cards provide users with purchasing flexibility in the form of ready access to short-term credit, as well as a familiar and trusted system for keeping records of transactions. These practices and features reflect the outcome of a competitive market for financial services, so there is little basis for direct policy intervention to change retail payment practices, even though they do not seem to be the most efficient use of economic resources. Hence a monetary policy geared toward price stability and the reduction of float incentives to choose particular payment instruments is a potentially important way for the Federal Reserve to fulfill its mandate of enhancing the efficiency of the payments system.

[2] Float benefits have declined in recent years due to generally lower nominal interest rates and faster collection of checks. Recent survey evidence indicates that float still plays a role in payment-instrument choice for at least some consumers and businesses, however. For example, 8 percent of credit-card users cite "30 days to pay" as their primary reason for using their cards (University of Michigan, 1995). Fifteen percent of surveyed businesses cited concerns about the loss of float as the reason that their companies had chosen not to use financial electronic data interchange (E.D.I.) as a means of payment, even though E.D.I. may generate significant cost savings in other ways (Knudson, Walton, and Young, 1994, p. 275).

[3] See Humphrey and Berger (1990), Table 2-A2, p. 82, note f, or the Appendix to this article, note c.

[4] Humphrey and Berger (1990, p.49) define *total social or real resource costs* of payment instruments as the sum of (1) production costs, which include costs of fabricating and distributing the physical payment instruments, and (2) processing costs, including the costs of accepting, safeguarding, and

This article begins with a description of the current U.S. retail payments system, paying particular attention to the float intensity and cost efficiency of the various payment instruments (section 1). Section 2 explores the role of float in the retail payments system. A series of examples illustrates that price stability and low nominal interest rates could in some circumstances improve the cost efficiency of the U.S. retail payments system by reducing users' incentives to choose float-intensive payment instruments. The third section considers whether float incentives are large enough to be considered economically significant. Section 4 concludes.

THE U.S. RETAIL PAYMENTS SYSTEM

The most recent comprehensive empirical examination of the U.S. retail payments system was carried out by David B. Humphrey and Allen N. Berger (1990), using data for 1987. According to Humphrey and Berger, American consumers, businesses, and government entities made about 334 billion payments for goods, services, and financial transactions in 1987, representing a total transfer of funds of about $342 trillion. Since gross domestic product (GDP) in 1987 was $4.69 trillion, it follows that the annual volume of payments was about 73 times as large as GDP. If that same ratio prevailed in 1995, the total value of payments in the U.S. economy would have been $528 trillion, or about $2 million per U.S. resident. Although much of this turnover occurs in the wholesale payments system in association with financial markets, the basic economic fact remains that large amounts of payments are associated with producing output and earning income in an advanced economy.

The retail share of total payment activity—that is, all transactions except those strictly between banks—is about 99 percent when measured by number of transactions and about 18 percent when measured by the dollar volume of transfers. The precise breakdown of retail payments activity by instrument is very difficult to estimate. Humphrey and Berger concluded that, for 1987, approximately 279 billion transactions, or 83.5 percent of retail payments, were made in cash (that is, currency or coin). Another 52 billion, or 15.7 percent, were check or credit card transactions.[5] The remaining eight-tenths of one percent of retail payments were completed with a variety of instruments, including debit cards, traveler's checks, money orders, automated clearinghouse (ACH) transfers, wire transfers, point-of-sale (POS) electronic transfers, financial electronic data interchange (EDI), electronic benefit transfers (EBTs), automated teller machines (ATMs), home banking by telephone or computer, Internet-based cybercash, and stored-value cards. Wholesale (interbank) payment transactions, which account for the bulk of the dollar volume in the U.S. payments system, are carried out using wire transfers, ACHs and, to a limited extent, the exchange of paper-based instruments such as checks and credit card receivables.

A recent survey of consumers found a much smaller role for cash in retail payments and correspondingly larger roles for noncash payment instruments (University of Michigan, 1995). The survey, conducted on behalf of the Federal Reserve System, found that cash accounted for only 60 percent of consumer transactions, whereas checks accounted for 30 percent, credit cards for 8 percent, and debit cards for 2 percent in mid-1995. All other forms of payment accounted for less than 1 percent of transactions.

Although retail payment practices may indeed have changed substantially since 1987, the extent of the decline in cash's importance, estimated in this survey, may be overstated. Most important, undersampling of certain groups in the population is likely to exert a downward bias on the estimated share of cash in total transactions. Participants in the underground economy are likely to be underrepresented in the sample, as are individuals who do not maintain banking relationships. Members of these groups rely to a great degree (or exclusively) on cash for making payments

transmitting payment instruments for purposes of collecting good funds from the payor. Both production and processing costs ultimately entail outlays for capital, labor, and land or buildings.

[5] See Humphrey and Berger (1990, p. 77). Virtually all transactions made by cash, check, or credit card are retail payments as defined here. Checks and credit cards accounted for 14.2 percent and 1.5 percent of retail payments, respectively.

and are notoriously difficult to reach and to interview. The estimates in Humphrey and Berger may be more reliable because they do not rely solely on consumer survey data. Instead, they construct estimates of cash usage by combining consumer, retail, and financial-institution data. The Appendix contains details on Humphrey and Berger's methodology.

Traditional Retail Payment Methods: Cash, Checks, and Credit Cards

Float benefits run into the tens of billions of dollars in the United States each year and have been equivalent to about 1 percent of GDP in recent years.[6] The real-resource cost to society of making payments is also quite large, accounting for between 2 percent and 3 percent of national product annually.[7] The Appendix to this article reproduces Humphrey and Berger's (1990) Table 2-A2 in slightly abridged form, providing details concerning the resource costs and float benefits associated with various payment instruments.

The three most commonly used retail payment instruments—cash, checks, and credit cards—generated essentially all of the float and consumed 93 percent of all the real resources devoted to making payments in the United States in 1987. These same instruments accounted for 99 percent of transactions and 18 percent of the funds transferred in that year.[8] Thus efforts to reduce the market share of these traditional instruments, to increase the efficiency of these instruments, or both—especially with regard to checks and credit cards—could produce significant economic benefits.

Cash is currently the predominant and most efficient instrument for making payments in the vast majority of face-to-face retail transactions. Cash provides simplicity, anonymity, and finality to both buyer and seller at very low cost.[9] The average social cost of using cash in retail payments amounted to approximately $0.04 per transaction as of 1987.[10] In addition to the risk of loss or theft, one major disadvantage of cash from the user's point of view is that it entails a float cost (corresponding to interest earned by cash's issuer, the government) because cash balances in one's wallet or purse earn no interest. Milton Friedman (1969) stressed that positive float costs borne by users of cash drive a wedge between individual and social optimality because individuals and firms will hold smaller cash balances than otherwise and will expend real resources to compensate for their inefficiently reduced holdings of money.

Despite the attractive combination of attributes provided by cash for many retail transactions, consumers have, over the years, adopted alternative payment methods to varying degrees for specific purposes, such as payment by mail or over the telephone. The most familiar substitute for cash in retail payments in the United States is the paper check, which represents a consumer's IOU backed by the funds in his or her bank deposit account. Checks are sometimes preferred to cash because they are more secure (requiring endorsement by the writer and the receiver), because they are more flexible (just as easily written for $1 or $999.99, given sufficient deposit funds), and because they provide a convenient written record of transactions (summarized in the monthly account statement prepared by the consumer's bank, as well as in the form of the cancelled and returned checks themselves).

Checks also provide the writer a float benefit that varies with the prevailing interest rate, the check amount, and the time a given check spends in the mail, in the recipient's cash box, and in the interbank collection and clearing process. Estimates for 1987 indicated that consumer checks were outstanding (that is, generating float) for an average of three days, whereas checks written by businesses or government entities remained outstanding for five days. Average float benefits for all types of checks combined were $0.83 per check.[11] Businesses captured the largest float benefits—$35 billion in 1987—because they tend to write larger checks that remain outstanding for more days. Consumer float benefits from checks were small—$2 billion—with government float benefits falling near the average for all

[6] Humphrey and Berger (1990, pp. 80–5. See also the Appendix.) estimated that total (gross) float benefits were about $55 billion in the U.S. payments system in 1987, whereas GDP was $4.69 trillion. To arrive at this estimate for float benefits, Humphrey and Berger estimated the amount of all payments made and the length of time each type of payment spent in clearing, then multiplied these amounts by the average yield on three-month T-bills during 1987, which was 5.775 percent.

[7] See Humphrey, Pulley, and Vesala (1996, p. 915). For the United States in 1995, this implies a cost of between $147 billion and $221 billion.

[8] See Humphrey and Berger (1990, pp. 77–9, 80–5). Also see the Appendix.

[9] Payment finality refers to completion of an economic exchange with no recourse by either party, except in case of fraud. Finality contrasts with provisionality, as when a check is presented in payment. When payment is provisional, the transaction may still be reversed within a certain period if, for example, the check-writer has insufficient funds in the deposit account to cover the payment.

[10] See Humphrey and Berger (1990, pp. 80–5). Also see the Appendix.

[11] See Humphrey and Berger (1990, pp. 53–4, 80–5, and 86).

[12] See Humphrey and Berger (1990, p. 54).

checks, about $2 billion.[12] Checks and their associated processing infrastructure are quite costly, consuming approximately $0.79 of economic resources for every check written in 1987.[13]

Another substitute for cash (and checks) is the credit card. Bank-issued credit cards are sometimes *co-branded*, an arrangement that allows nonbank firms to participate in the marketing of the card and to deliver special benefits or promotions to cardholders. Credit cards, like checks, provide the accepting merchant with an IOU that can be redeemed for cash or deposits at the merchant's bank. In practice, credit cards provide consumers with most of the advantages of checks, along with greater on-the-spot purchasing power. This advantage derives primarily from the assumption of nonpayment risk by the card-issuing bank. The acceptance of liability differs from the case of a check, in which the merchant bears the risk that the check cannot be redeemed for cash or deposits. Banks are willing to absolve merchants of this risk when credit cards are used because banks specialize in screening and monitoring retail customers' creditworthiness and because merchants effectively pay a fee for each credit card transaction they accept.[14]

The risks to banks involved in credit card transactions are minimized by screening the creditworthiness of consumers both before they receive cards and at the time of a purchase. Credit checks before a card is issued allow issuing banks to exclude likely defaulters from using their card at all. On-line data bases maintained by the major credit card associations allow merchants to obtain an update on a consumer's credit status at the time of purchase. Merchants receive an authorization number from the issuing bank at the time of purchase to verify the credit check and thereby transfer nonpayment risk to the bank.

Credit cards provide a significant amount of float if they are used exclusively as payment instruments. This is true of so-called convenience users of credit cards, those cardholders who pay off all charges within the grace period granted by the issuer. Use of the card as an instrument for taking out preapproved consumer loans, on the other hand (that is, running a balance), redirects the float benefit from the consumer to the issuing bank. Float benefits averaged about $0.44 per credit card transaction in 1987, considerably more than the estimated $0.07 of float benefit per check written by consumers or the $0.05 of float *cost* per cash transaction.[15] Credit card payments are, like checks, relatively costly to process because they require a complex supporting infrastructure and multiple rounds of processing by the parties seeking to collect the ultimate payment in bank funds. Humphrey and Berger estimate that the average credit card payment consumes about $0.88 in economic resources.[16]

Non-traditional Retail Payment Methods: ACH, Debit Cards, and Stored-Value Cards

Although the majority of U.S. consumers and businesses express satisfaction with their traditional payment options (cash, checks, and credit cards), significant efforts are currently being made by many nonfinancial firms, banks, trade associations, and government agencies such as the Federal Reserve to expand the use of newer retail payment methods. In many instances, the technology underlying the newer payment methods has existed for some time, although it has not been in common use. In other cases, advances in information technology and communications have accelerated the development of these substitutes for cash, checks, and credit cards.

New methods of making consumer payments include ACHs, debit cards, ATM cards, stored-value cards, and cybercash, a payment instrument that exists on, and is used solely to make purchases over, computer networks. New methods for making business and government payments include ACH, financial EDI, purchasing cards, and EBT.

Among the most important of the newer retail-payment methods is the use of automated clearinghouses. ACH transfers are used to effect direct deposit of pay-

[13] See Humphrey and Berger (1990, pp. 80–5). See the Appendix.

[14] The credit card fee is collected by the merchant's bank by discounting the merchant's credit card receipts. For example, the merchant trades a credit card charge receipt of $100 for a $97 credit in its account at the bank. The merchant's bank then collects the receivable from the card-issuing bank through established interbank clearing channels, receiving perhaps $98 for the item. Finally, the issuing bank bills the cardholder periodically, for payment of the full $100 and the accumulated balance of other charges.

[15] See Humphrey and Berger (1990, pp. 50, 54, and 80–5). See the Appendix.

[16] See Humphrey and Berger (1990, pp. 80–5). See the Appendix.

checks, Social Security checks, or other benefits into recipients' bank accounts; to carry out routine repetitive payments by consumers, such as mortgage payments, insurance premiums or utility bills; or to execute cash-management operations for far-flung businesses. Tiny amounts of float are created in ACH debit transfers (requests for payment), whereas ACH credit transfers (sending payments) create no float. Funds transfers made by ACH are currently very efficient because they exploit economies of scale in information processing. A large employer can pay its employees, for example, simply by encoding all of the pertinent payroll information (including the employee's name, the amount of the payment, and the employee's bank account number) and sending this information to the ACH through its bank (typically on magnetic tape or through EDI). The funds transfers from the employer's account to those of all its employees are then carried out electronically among banks at a precisely specified time. Humphrey and Berger (1990) estimate that the average social cost of an ACH transfer was only $0.29 as of 1987. As more and more transactions occur through the ACH, the cost per transaction falls, an indication that unexploited economies of scale remain in ACH payments.[17]

Another fast-growing form of retail payment is the debit card, sometimes also called a POS card. To consumers, a debit card functions much like a credit card at the point of purchase, with one important exception. Rather than providing the consumer with float, as with convenience use of a credit card, a debit card transaction transfers funds directly from the consumer's bank account to the retailer's bank account. Hence consumers receive no float benefits.[18] The lack of float associated with debit cards is almost certainly one of the reasons why consumers have not adopted debit cards even more rapidly than they have. Debit card payment systems are developing rapidly, so it is difficult to know how cost-efficient they are currently. Estimates from the late 1980s put debit card transaction costs at about $0.47 per transaction, considerably less than the transaction costs of credit cards and checks, but greater than those for cash and ACH.[19]

A new form of retail payment that has captured the attention of many merchants, bankers, and computer experts is the stored-value card, also referred to as the electronic purse or electronic cash. Stored-value cards promise greater convenience in certain retail-purchase situations, including those in which coins are normally used. For example, stored-value cards would be quite convenient for making purchases from vending machines, at newspaper kiosks, or in laundromats. Stored-value cards can be thought of as small-dollar traveler's checks. The consumer purchases a card from a financial institution with monetary value encoded on the card and then uses it anywhere merchants are willing to accept its stored value in payment. The merchant, in turn, trades the stored value for monetary value in the merchant's bank account. Finally, the bank must collect funds from the card-issuing institution. Stored-value cards will likely suffer in consumers' eyes because they incur a float cost: Consumers must pay out funds in advance of any retail purchases, so the funds do not earn interest.

Given the recent arrival of stored-value cards on the retail payment scene, it is impossible to gauge their cost effectiveness with any certainty. One relevant comparison might be the resource costs associated with traveler's checks, which were estimated by Humphrey and Berger (1990) to be about $1.18 per transaction. The purely electronic nature of stored-value cards should reduce the per-unit costs to a great extent relative to traveler's checks, but the necessary investments by merchants, banks, and consumers to support the cards means that the economics of stored-value cards will not be favorable until a substantial volume of payment activity is ensured.

In sum, there has been moderate progress in converting U.S. retail payments from a paper-based system to a more predominantly electronic system. The Appendix summarizes the resource costs and user float benefits associated with the major retail payment instruments as of

[17] See Bauer and Ferrier (1996, p. 1025).

[18] This statement applies strictly to debit card networks that operate on-line, with merchants maintaining real-time electronic connections with banks so that funds can be transferred as purchases are made. There are also some debit card networks that operate off-line, with merchants cumulating a record of transactions during the day, which are then transmitted at the end of the day in a batch to the merchant's bank for processing and collection, perhaps through ACH. In this case, the consumer enjoys some float, although the amount is generally less than with a check or credit-card purchase.

[19] See Humphrey and Berger (1990). Recall that the estimated average social cost per transaction using cash was $0.04; for ACH $0.29; for checks $0.79; and for credit cards $0.88. See the Appendix.

Table 1

Use of Non-Cash Retail Payment Instruments (in Billions*)

	1988	1989	1990	1991	1992	1993	1994
Checks	50.99	52.90	55.44	57.47	58.40	60.30	61.67
Credit Cards	8.81	8.90	10.75	11.24	11.70	12.52	13.68
ACH	1.01	1.18	1.43	1.63	1.84	2.09	2.37
Debit Cards	0.17	0.22	0.28	0.30	0.51	N.A.	1.05
Total (including instruments not shown)	61.08	63.30	67.96	70.75	72.56	75.01	78.89

* From: Bank for International Settlements (1993, p. 472; 1994, p. 110; and 1995, p. 110)

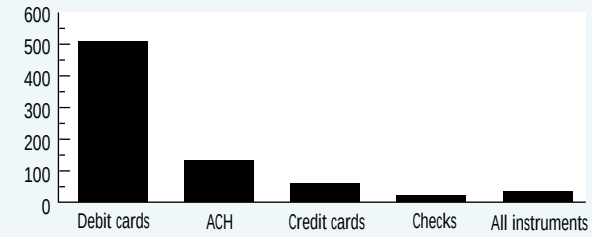
1987. Cash, check, and credit card processing have become more automated since 1987, thereby reducing unit costs associated with these instruments. At the same time, newer payment instruments have achieved ever-larger transaction volumes, reducing their unit costs.

Purely electronic payment methods, such as debit cards, ACHs, cybercash, and home banking, are among the fastest growing sectors of the payments market and may have accounted for well over 3 billion transactions in 1995.[20] Table 1 shows the relative importance of several leading noncash retail payment instruments in recent years. Figure 2 illustrates the relatively high growth rates of debit cards and ACH in particular.

Despite rapid growth of nontraditional retail payment instruments, it is still much too early to describe the changes in U.S. consumers', businesses', and government entities' payment habits to date as a true revolution. After all, it is likely that 60 percent to 80 percent of retail payments are still made in cash and that 15 percent to 30 percent are made with checks or credit cards.[21] All other payment instruments together probably account for 10 percent of all transactions or less. Hence the retail payments revolution has just begun.

Figure 2

Total Growth in Use of Non-Cash Payment Instruments 1988-1994



THE ROLE OF FLOAT ON CONSUMER INCENTIVES IN RETAIL PAYMENTS

This article's theme is that a movement away from today's environment of moderate inflation to one characterized by effective price stability could make the retail payments system more efficient. The reason is that, with no sustained inflation and thus consistently low short-term nominal interest rates (averaging perhaps 2 percent to 3 percent), the benefits of float that create incentives for payment originators to choose float-intensive instruments would be much less than they are today. Modest inducements from retailers and payment providers to use the more efficient retail payment instruments, such as merchant surcharges on checks and credit cards or discounts for cash and debit cards, might then be effective in changing payment practices. Although payment-instrument choice would be most efficient if each instrument's actual resource cost were passed through to the party choosing the instrument—typically the party making payment—even partial pass-through of costs would be more effective in an environment of price stability. Thus this article extends Friedman's (1969) analysis of the welfare costs of in-

[20] See Bank for International Settlements (1993, p. 472; 1994, p. 110; 1995, p. 110).

[21] See note 20, Humphrey and Berger (1990, pp. 77–9), and University of Michigan (1995).

Table 2

Payment Instrument	Days in Clearing	Float Benefit at[22] 5 Percent	Float Benefit at[22] 2 Percent
Cash	0	0	0
Check	3	$0.01	$0.004

Table 3

Payment Instrument	Average Social Cost (in 1995 Prices)
Cash	$0.05
Check	$1.06

Table 4

Payment Instrument	Days in Clearing	Float Benefit at[24] 5 Percent	Float Benefit at[24] 2 Percent
Debit Card	0	0	0
Credit Card	15	$1.23	$0.49

Table 5

Payment Instrument	Average Social Cost (in 1995 Prices)
Debit Card	$0.63
Credit Card	$1.18

flation to the full range of retail payment instruments in use today.

To illustrate the role of float and the potential importance of price stability in the retail payments system, I consider three examples. The examples are designed to capture the roles played by float and explicit transactions costs in a small-value personal payment transaction, in a large-value personal transaction, and in a large-value business transaction, respectively, in determining which payment instrument a rational decision maker would be likely to choose. First, I determine the incentives the decision maker would face as a result of float. Then I compare the privately optimal choice of payment instrument with the most efficient choice from the standpoint of total social costs. Finally, I examine the potential of different levels of nominal interest rates and float benefits to affect decision makers' behavior when they bear some or all of the social costs resulting from their decisions.

Example 1: Small-Value Personal Payment Transaction. A consumer purchases a restaurant meal for $25. She may pay with cash or check. Assume first that the only relevant cost to the customer is float; in other words, there are no per-check fees and the customer has at least $25 in her wallet (hence no need to pay any ATM withdrawal fees). The customer receives no float if she pays with cash, whereas she expects three days of float if paying by check. Which retail payment instrument would she choose if the short-term interest rate were 5 percent? What if it were 2 percent?

Float benefits associated with each instrument are shown in Table 2. The rational decision maker prefers to write a check whatever the interest rate, although the float benefit is trivial.

Adjusting Humphrey and Berger's (1990) estimates for 1987 to account for general inflation through 1995, social costs associated with each of the retail payment instruments considered here are shown in Table 3.[23] As the table indicates, the customer's choice of a check, though modestly beneficial to herself, is quite costly from the standpoint of overall efficiency of the payments system. In this case, the consumer might switch her payment preference to cash in response to even a small incentive, such as a 1 percent cash discount offered by the restaurant (that is, 25 cents off the bill).

In this example, the potential interest earnings created by float would obviously play a very minor role in a typical decision maker's choice of payment instrument. In fact, this is true of most consumer payments. A more important reason why a consumer might use a check instead of cash is the flexibility it affords. Suppose, for example, that the restaurant diner had no cash in her pocket and no money in her bank deposit account. Suppose further that the customer knew that her pay-

[22] Float benefit is the amount of the payment, $25, multiplied by the number of days the payment takes to clear, multiplied by the daily interest rates—5 percent or 2 percent divided by 365.

[23] These are average rather than marginal social costs, which one would normally prefer when analyzing a given consumer payment decision. The illustrations here are intended to point out the full-cost implications of various payment practices over time, however, so average costs are the relevant measure.

[24] Float benefit is the amount of the payment, $600, multiplied by the number of days the payment takes to clear, multiplied by the daily interest rates—5 percent or 2 percent divided by 365.

Table 6

Payment Instrument	Float Benefit at 5 Percent	Float Benefit at 2 Percent	Average Social Cost and User Price (1995 Prices)	Total User Benefit at[25] 5 Percent	Total User Benefit at[25] 2 Percent
Debit Card	0	0	$0.63	−$0.63	−$0.63
Credit Card	$1.23	$0.49	$1.18	$0.05	−$0.69

check would be deposited in her bank account the next day through ACH. Being able to write a check that will not clear for three days can thus be very valuable in some situations. Taking into account the value of flexibility, one can see that the short-term rate may actually understate the true economic value of float.

Example 2: Large-Value Personal Payment Transaction. Suppose a new homeowner purchases a home appliance, such as a refrigerator, for $600. The consumer may pay with a debit to his deposit account using a debit card or with a credit card, both of which the appliance store accepts without surcharge or discount. Assume first that the only relevant cost to the purchaser is float. In other words, there are no transaction fees for either type of payment. The customer receives no float if he pays with his debit card, though he expects 15 days of float if he pays with a credit card. Which payment instrument would a rational decision maker choose if the short-term interest rate were 5 percent? What if it were 2 percent?

Float benefits associated with each instrument are illustrated in Table 4. In this case, it is likely that the consumer would be aware of the benefit of using a credit card to capture float and that he might do so.

Is the customer's choice of payment instrument efficient from the standpoint of the economy's use of resources? Again adjusting Humphrey and Berger's (1990) estimates for 1987 to account for general inflation through 1995, Table 5 shows average social costs associated with the use of debit and credit cards. Comparing the user float benefits to average social costs, one can see that the consumer's personal preferences are again the reverse of the socially efficient choice, which would be to use a debit card.

Would full pass-through of the average social cost of the payment instrument change this rational consumer's choice of instrument? It turns out that the answer depends on how much float is available. In an environment such as the one that exists today with a moderate level of inflation and short-term interest rates around 5 percent, the consumer's choice would be unaffected. The situation would be quite different in an environment of price stability and a low interest rate of 2 percent, however. The calculations that a rational decision maker would make if he were forced to pay the full social cost of the payment instrument are shown in Table 6.

One conclusion from the table is striking: *Even if a rational consumer were forced to bear the full cost of his choice of payment instrument, he would still choose a credit card if the nominal interest rate were 5 percent, but he would choose a debit card if the interest rate were 2 percent.* This example points out that, for at least some retail payment transactions, even the implementation of full pass-through of costs to the purchaser would not eliminate incentives for inefficient payment-instrument choice when float benefits remain substantial. Even with only partial pass-through of costs to payment users, lower interest rates can shift a consumer's incentives in the direction of more efficient payment instruments. The next example illustrates a clear-cut case in which price stability would be likely to have a big effect.

Example 3: Large-Value Business Payment Transaction. Suppose a small-business owner is preparing the firm's monthly payroll covering 10 employees with an average wage payment of $2,000 each (that is, a total payroll of

[25] Total user benefit is the user's float benefit at the given interest rate minus the social cost of each payment, which is also the user's price.

Table 7

Payment Instrument	Days in Clearing	Float Benefit[26] at 5 Percent	Float Benefit[26] at 2 Percent
ACH	0	0	0
Check	3	$0.82	$0.32

Table 8

Payment Instrument	Average Social Cost (in 1995 Prices)
ACH	$0.39
Check	$1.06

$20,000). The owner may pay her employees using ACH or checks. First, the owner examines the float implications of the two payment methods. She receives no float if she pays by ACH, whereas she expects three days of float on average if she pays by check. Which method would this rational business owner choose if the short-term interest rate were 5 percent? What if it were 2 percent?

Float opportunity costs per employee are shown in Table 7. Now consider the bank fees associated with each instrument. Assume that the pricing schedule from the owner's bank reflects average social costs exactly. Adjusting Humphrey and Berger's (1990) estimates for 1987 to account for general inflation through 1995, the total bank fees assessed for using each method would be as shown in Table 8. The small-business owner's total costs are therefore shown in Table 9. The net cost of paying her employees is $0.15 less per person by check than by ACH if the interest rate is 5 percent, though the small-business owner saves $0.35 per employee by using ACH under the low–interest rate scenario. This example illustrates that, even if full social costs are passed through to the decision maker, moderate levels of inflation and interest rates—such as we currently have in the United States—may be sufficient to distort incentives toward socially wasteful payment instruments.

To summarize the point made in these examples, the lower the short-term interest rate, the less valuable is a float-intensive payment instrument to the user. With little float benefit available from any payment instrument, originators of payments might shift their payment preferences away from float-intensive instruments, given even a modest inducement to do so. Because the per-item social costs are roughly the same no matter how large the dollar amount of the payment involved, this general benefit arising from price stability would be particularly important in changing payment patterns for items involving only a few dollars.

ARE FLOAT INCENTIVES ECONOMICALLY SIGNIFICANT?

How important is the choice of retail payment instrument? Consider the following thought experiment: If all 1987 household payments by check (totalling 25.8 billion) and by credit card (5.1 billion) had instead been carried out by debit card, and if all business and government check payments (21.2 billion) in that year had been executed via ACH, those who made the payments would have lost about $41 billion in float benefits. These "losses" would have been exactly balanced by $41 billion of reduced float costs incurred by payment recipients, however, so there would have been no net gain or loss for society from this source. At the same time, the total resource cost of making retail payments in the United States would have been about $21 billion lower.[27]

This estimate must be interpreted as an upper bound, since some of the social costs allocated to each payment instrument were already sunk as of 1987, and therefore would have been incurred even if the payment instruments weren't used. The best interpretation of this $21 billion estimate is that it represents the efficiency gain that might have resulted if the retail payments system had developed differently than it actually did: namely, without checks and credit cards being used in retail payments at all.

Could it be that checks and credit cards appear to be "resource guzzlers" but

[26] Float benefit is the amount of the payment, $2,000, multiplied by the number of days the payment takes to clear, multiplied by the daily interest rates—5 percent or 2 percent divided by 365.

[27] Humphrey and Berger (1990, pp. 54, 77, 80). This figure is the sum of social costs accounted for by all checks and credit-card transactions ($41.85 billion) less the total cost of making 30.9 billion payments with debit cards at 47 cents per transaction ($14.52 billion) and 21.2 billion payments via ACH at 29 cents each ($6.15 billion). If some check and credit-card transactions were instead replaced by cash payments, the cost savings would be even greater.

Table 9

Payment Instrument	Float Benefit at 5 Percent	Float Benefit at 2 Percent	Average Social Cost and User Prices (1995 Prices)	Total User Benefit at[28] 5 Percent	Total User Benefit at[28] 2 Percent
ACH	0	0	$0.39	−$0.39	−$0.39
Check	$0.82	$0.32	$1.06	−$0.24	−$0.74

in fact deliver correspondingly higher satisfaction to their users and recipients? In other words, could they be the "Cadillac of payment instruments," simply items on an economically efficient menu of options? If the genuine economic benefits provided by float-creating retail payment instruments exceed the social costs even when the zero-sum nature of float is netted out, then there is really no efficiency problem in the U.S. retail payments system.

A recent study concludes that checks may be popular in the U.S. not because they provide significant float benefits to check-writers but, rather, because they provide a uniquely desirable bundle of payment services not available from other payment instruments (Wells, 1996). This conclusion is based on new evidence from 1993 suggesting that checks are, in fact, even more costly than Humphrey and Berger (1990) had estimated, while float benefits from checks may have been virtually eliminated.[29] Wells reasons that tiny float benefits could not possibly explain why 60 billion checks are written each year in the United States. Hence, Humphrey and Berger's emphasis on float as an incentive to use checks is "a mistaken view" (Wells, 1996, p. 3).

The implication of Wells' conclusion, if correct, is that float-intensive payment instruments such as checks may not be "over-used" in the U.S. at all. The higher resource costs associated with checks and other float-creating instruments such as credit cards should not be labelled wasteful, since genuine value is being delivered. In short, float does not reduce economic efficiency, because float is essentially irrelevant for check use.

It is probably unwise to become complacent about the efficiency of the U.S. retail payments system on the basis of this (or any other) individual study, however. First, the Wells (1996) and Humphrey and Berger (1990) studies are not directly comparable, so conclusions drawn from one study cannot be overturned by the other. For example, Wells uses different data sources to calculate some key components of social costs associated with checks and ACH (the only two payment methods examined in her study). The fact that Wells finds much higher social costs than do Humphrey and Berger may be attributable to underlying trends, or it may be due simply to differences in data-collection methods. Similarly, Wells finds much lower float benefits than do Humphrey and Berger, but the former study assumes a short-term interest rate of 3 percent (as it was during 1993), while the latter study assumes a rate of 5.775 percent, which is much closer to the average rate that has prevailed over the last ten years (and which exists today).

Even more importantly, Wells uses different definitions of social costs and float benefits than do Humphrey and Berger. For example, Wells includes payee costs (representing over 40 percent of her estimate of the social cost of checks), while Humphrey and Berger exclude them altogether. Wells excludes mail float and recipient float, while Humphrey and Berger include both (representing 37 percent and 24 percent of their estimate of float benefit, respectively). Finally, Wells assumes all checks require only one round of clearing through a financial institution, while Humphrey and Berger allow for two stages (the second stage representing 20 percent of their estimate of float benefit). It is important to note that each of these methodological differences has the effect

[28] Total user benefit is the float benefit at the given interest rate minus bank fees.

[29] Wells (1996, p. 5) estimates that the average social cost of a payment by check in 1993 was $2.93 (midpoint of estimated range) while Humphrey and Berger (1990, p. 80, and Appendix of this article) conclude that a check payment cost society $0.79 in 1987 (or $1.00 in 1993 dollars). Wells estimates 1993 float benefits for checkwriters of only $0.09, versus Humphrey and Berger's estimate of $0.83 ($1.04 in 1993 dollars).

of increasing Wells' estimate of social costs or decreasing her estimate of the float benefits of checks. Thus, even if both studies used identical data, Wells would find a significantly higher social cost and lower float benefit for checks than do Humphrey and Berger.

Apart from these differences in data collection and methodology that prohibit direct comparisons between the Wells and Humphrey and Berger studies, there are more obvious reasons to doubt that float incentives are irrelevant for retail payment-instrument choice. As noted above, at least some consumers and businesses are aware that checks and credit cards create float, even if they do not calculate the (often trivial) benefit float confers. Surveys indicate that float incentives can and do influence payment-instrument choice for some payors at least some of the time (University of Michigan, 1995; Knudson, Walton, and Young, 1994).

The Wells study assumes that total social costs are fully internalized (taken into account) by all the relevant parties in a retail payment decision. Consequently, actual instrument choices reflect genuine benefits received.[30] In practice, of course, negotiation over the form of payment is the exception, rather than the rule. Repeated negotiation among all involved parties in the retail payment clearing and settlement chain would be extremely costly. Thus, in general, the payor exercises some choice of instrument from among a menu of alternatives provided by the payee. Since costs are incurred by others in processing the chosen payment instrument, the decision maker does not fully internalize the social costs of the payment instrument. In sum, it is not appropriate to assume, as Wells does, that all social costs associated with a particular payment instrument are fully considered—and matched by real benefits—in the choice of instrument.

Finally, the fact that consumers and businesses like certain features of a given payment instrument does not imply that all facets of that instrument contribute to (or are neutral with respect to) social welfare. For example, surveys reveal that consumers and businesses clearly appreciate certain features of checks and credit cards, such as convenience in record-keeping and ease of use in making payments through the mail (checks) or over the phone (credit cards). However, there is no inherent reason why float must be associated with payment instruments that provide these or other features. Humphrey, Pulley, and Vesala (1996. p. 926) point out that most retail payments in European countries and Japan are made without creating float for the payor. This does not prevent consumers and businesses in those countries from keeping records or making payments through various communication channels.

CONCLUSION

Price stability and the efficiency of the payments system are two of the Federal Reserve's most important policy goals. This article suggests that price stability could enhance the efficiency of the U.S. retail payments system because lower nominal interest rates would reduce float benefits, which affect payment users' incentives to choose particular payment instruments. Friedman (1969) pointed out the real-resource costs incurred by economic agents holding inefficiently small real money balances, by which he apparently meant cash. This article extends the argument to the full range of retail payment instruments. Instrument choice matters for economic efficiency because the most float-intensive payment instruments are typically also the most costly to produce and process, reflecting relatively long, labor-intensive clearing and settlement cycles.

Incomplete pass-through of retail payment costs to the decision makers who control instrument choice is a widespread practice that may well continue. Because this practice is the outcome of a competitive retail payments marketplace, there is little that policymakers can or should do to change it. A monetary policy geared toward price stability may therefore be an

[30] In other words, efficient instrument choice by all consumers and businesses is assumed rather than being demonstrated. Wells (1996, p. 4) appeals to the Coase Theorem and relatively inexpensive bargaining among concerned parties.

important practical way in which the Federal Reserve can make progress toward its goal of increasing the efficiency of the payments system.

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Appendix

Resource Costs and User Float Benefits of Retail Payment Instruments, 1987*

Type of Payment Instrument	Total Social or Real Resource Cost per Transaction	User Float Benefit (+ for Benefit, – for Cost)
Cash	$0.04[a]	−$0.05[b]
Checks	0.79[c]	0.83[d]
Credit cards	0.88[e]	0.44[f]
ACH	0.29[g]	0.00[h]
POS (Debit Cards)	0.47[i]	−0.00[j]
Traveler's Checks	1.18[k]	−0.00[l]
Money Orders	1.79[m]	−0.00[n]
Wire transfers	7.33[o]	0.02[p]

* Slightly abridged version of Table 2-A2 in Humphrey and Berger, 1990, pp. 80-5.

THE FOLLOWING IS A DETAILED EXPLANATION OF THE ITEMS IN THE TABLE ABOVE:

[a]Cash

Production costs were estimated by multiplying the number of currency notes outstanding (11,776 million) times an average production cost of $26 per 1,000 notes produced at the Bureau of Engraving and Printing (giving $306 million). The weighted average cost of coin issue is $0.0107 per coin at the U.S. Mint for approximately 154 billion coins outstanding (giving $1,648 million). This production cost for all currency and coin outstanding is transformed into a yearly cost as follows: Since the average $1 bill (37 percent of currency notes outstanding) is replaced every 1.5 years, with other denominations replaced at more infrequent intervals, all currency was assumed to be replaced every two years. Coin has a very long lifetime but requires replacement over time as individual coins are lost. For our purposes, coin was assumed to be replaced every 15 years. To these replacement costs are added the cost of producing new currency and coin because of yearly growth in demand, a function of inflation and population growth. The yearly growth of cash was 8 percent between 1985 and 1987. In sum, the yearly production cost of cash is $419 million {$306 million/2 + $1,648 million/15 + [($306 million + $1,648 million) × 0.08] = $419 million a year}.

In accepting cash for retail sales, the payee may incur costs for all of the following: POS and accounting, theft and loss of cash, safekeeping and security, and deposit charges and fees paid to financial institutions. (See Curtin, Richard T. *Payment Method Costs: Assessments by Retailers.* Survey Research Center, University of Michigan, 1983). These costs, expressed as a percentage of the average cash retail transaction amount, were 2 percent (and 2.5 percent for checks). Studies have suggested that the share of retail sales paid for with cash is around 30 percent. Applying this 30 percent share and the 2 percent cost percentage to all retail sales in 1987 of $1,505 billion yields a total payee cost of cash of $9,030 million (0.02 × 0.30 × $1,505 billion). This payee cost estimate covers payee bank cash costs as well. Payor costs of using cash cannot be reliably estimated but would include the costs of lost cash and theft along with the cost of obtaining cash from a bank. The bank costs of giving cash over the counter when checks are cashed are estimated at $1,674 million. This estimate is derived primarily from the 1986 *Functional Cost Analysis* data for the 76 banks with over $200 million in deposits. (See Board of Governors of the Federal Reserve System. *Functional Cost Analysis,* 1986). The smaller banks were discarded to offset the bias toward smaller banks in the Functional Cost Analysis (FCA) sample, although the difference would be negligible. The per-transaction cost of giving cash is estimated at $0.314. The number of checks cashed per

personal account was estimated by taking the total on-us plus transit checks cashed by the average bank per year and dividing by the average number of personal accounts per bank (for those banks reporting a separate breakout by type of account), giving 48.55 cashings per account per year. The aggregate number of personal accounts was estimated at 109.8 million [See Avery, Robert, Gregory Elliehausen, Arthur Kennickell, and Paul Spindt. "Changes in the Use of Transaction Accounts and Cash from 1984 to 1986," *Federal Reserve Bulletin* (March 1987), pp. 179–96. This article was a special unpublished computer run.] Total check-cashing costs were therefore estimated at $0.314 × 48.55 × 109.8 million = $1,674 million. Federal Reserve costs in transporting and processing currency and coin, including the cost of retiring old and counterfeit currency, were $154 million [See Board of Governors of the Federal Reserve System. *Planning and Control System Expense Report* (PACS), 1987.] Thus the payee ($9,030 million), payor and bank ($1,674 million), and Federal Reserve ($154 million) processing cost of cash is $10,858 million.

This figure excludes the government production cost of $364 million and the portion of processing costs borne by the Federal Reserve, $154 million, both of which are provided free. The remaining private-sector costs are assumed passed on to cash customers through higher prices.

[b]Cash

The opportunity cost of holding idle coin and currency was derived from evaluating the $230 billion in coin and currency in circulation in 1987, which is less than the $271 billion outstanding, at the average 90-day T-bill rate in 1987 (5.775 percent), giving $13,283 million. This figure excludes coin and currency held by the U.S. Treasury and Reserve Banks but includes idle cash balances at depository institutions. That vault cash at banks can be used to satisfy reserve requirements reflects the fact that effective reserve requirements were lowered in 1959, not the possibility that the seigniorage benefits to the government were reduced and that vault cash costs are now part of reserve requirements.

[c]Checks

Check production costs were estimated by taking the actual production costs per standard consumer-type check ($0.025 cents per item) and business-type check ($0.05 cents per item) for a large East Coast check-printing firm and multiplying these average production costs by the volume of the types of checks written. The numbers of consumer, business, and government checks to be written are estimated, respectively, at 25.8 billion, 18.8 billion, and 2.4 billion. [See Humphrey and Berger (1990), Table 2-2, pp. 54–5.] Government checks are more like business checks and are included there. Thus the total check production cost is estimated at ($0.025 × 25.8 billion consumer checks) + [$0.05 × (18.8 billion business checks + 2.4 billion government checks)] = $1,705 million.

Check-processing costs comprised accounting and disbursement costs of business and government payors, postage ($0.22) and envelope costs ($0.02) for all payors (business, government, and consumers), and bank costs. The opportunity cost of consumer payers' time to write and mail checks was not included because few consumer payors actually have the opportunity of getting paid for the time saved if they do not write checks. Accounting and disbursing costs for business and government payors is estimated at $0.24 per check or payment transaction, based on the $0.239 per payment transaction cost for the U.S. Treasury's direct deposit program. (See Dudley, William C. A *Comparison of Direct Deposit and Check Payment Costs*, ed. 2, Board of Governors of the Federal Reserve System, 1983.) This excludes all postage, commercial bank, and Federal Reserve check-processing and collection expenses. Thus $0.24 multiplied by the sum of business and government checks [21.2 billion items, according to Humphrey and Berger (1990) Table 2-2, pp. 54–5] gives $5,088 million in business

and government payor costs. According to U.S. Postal Service sources, there were 153.9 billion pieces of mail handled in fiscal 1987. Earlier analyses by the University of Michigan's Survey Research Center (*Household Mail Stream Study,* Prepared for the Mail Classification Research Division, Rates and Classification Department, U.S. Postal Service, 1978; and *Nonhousehold Mail Stream Study,* Prepared for the Mail Classification Research Division, Rates and Classification Department, U.S. Postal Service, 1980) indicated that 82.5 percent of all mail originated in the nonhousehold sector, whereas 17.5 percent originated from households. Of nonhousehold-originated mail, 35 percent was bill related and typically included checks sent to pay for bills received. In contrast, 75 percent of all household-originated mail was bill related. Overall, some 42 percent ($0.75 \times 0.175 + 0.35 \times 0.825 = 0.42$) of all mail (153.9 billion items) is estimated to be payment related—bills sent for collection and checks sent for payment. At $0.24 each, the 64,638 million in payment-related items generates $15,513 million in consumer, small business, and corporate payor stamp and envelope costs. Because almost all of these mailed items are likely to be first class mail and the number of first class items was 78.9 million in 1987, bill payment–related mail comprises 82 percent of all first class mail in this estimate.

Bank processing and transportation costs per check were estimated at $0.32, which includes (1) costs of crediting a deposit account of $0.057 per credit, (2) costs of processing and transporting transit items (either by the payee bank or its intermediaries) of $0.049 per item, (3) costs of an on-us debit of $0.177 per debt, (4) costs of handling return items of $0.012 per item, and (5) the cost of returning canceled checks to account holders of $0.029 per check. These estimates were based primarily on data from the 1986 *Functional Cost Analysis* data for the 76 banks with more than $200 million in deposits. (See Board of Governors of the Federal Reserve System. *Functional Cost Analysis,* 1986.) The smaller banks were discarded to offset the bias toward smaller banks in the FCA sample, although the estimates would not be substantially different if these smaller banks were included. The estimate in (1) was determined by dividing the cost of handling a deposit ($0.3627) by the number of checks per average deposit (6.386). The estimate in (2) was determined by multiplying the cost of a transit check deposited ($0.0975) by the proportion of total handlings accounted for by transit items (0.507). (Note that this proportion is less than the proportion of transit checks overall, because all transit checks are also handled as on-us items by other banks.) The estimate in (3) is simply the FCA's estimate of the cost of an on-us debit. The estimate in (4) was determined by using data from a return item study by J. D. Carreker and Associates. (See Carreker, J. D., and Associates, Inc. *Return Item Study: Final Report.* Prepared for the Bank Administration Institute, 1985.) It was estimated that 350 million out of about 40 billion items in 1985 were returned—a ratio of 0.00875. The estimated costs to reject the item are $0.71, and the estimated cost to send the item each step backward through the endorsement chain is $0.43. We assume that the $0.43 also applies to returning the item to the payee. The average return-item cost of $0.012 was therefore determined to be $(0.00875) \times \{\$0.71 + \$0.43 + [\$0.43 \times 0.507]\}$, where 0.507 is the transit-handling proportion discussed previously. The estimate in (5) was determined by taking the check safekeeping savings of $7 per account per year (that is, the savings from not returning canceled checks to payors) reported by Valley National Bank. (See *Wall Street Journal.* "Canceled Checks Are Destroyed at Some Banks, Producing Savings." February 21, 1985 p. 1.) and dividing by the number of checks written per account per year (237.28). Thus bank processing costs are $\$0.32 \times 47$ billion checks = $15,040 million. Together, the business and government payor accounting and disbursing costs ($5,088 million), the mailing costs for all payors ($15,513 million), and the bank costs just derived total $35,641 mil-

lion in check-processing costs. Bank costs will include Federal Reserve check-processing and transportation costs.

[d]Check

The total value of check float in 1987 is estimated at $39.1 billion. [See Humphrey and Berger (1990) Table 2-2, pp. 54–5, note c]. Dividing by 47 billion checks written gives a per-item float benefit of $0.83. The cost of holding funds earning little or no interest in a checking account is assumed to be a soft-dollar payment for services and is therefore implicitly included under production and processing costs rather than float costs.

[e]Credit Cards

Credit card production costs—which include the costs of issuing the cards, maintaining accounts, and paying merchants—on average equaled the cost of float. (See Bank Administration Institute. *Banking Issues and Innovations,* 1985. This was referenced in *American Banker*, April 9, 1985, p. 16.) Production costs are presumed equal to the cost of float today as well ($2,257 million). Retail or merchant processing costs were $0.44 per credit card transaction, giving a total processing cost of $2,249 million [from 5,111 million card transactions in Humphrey and Berger (1990) Table 2-A1, pp. 77–9, multiplied by $0.44, from Board of Governors of the Federal Reserve System. *Credit Cards in the U.S. Economy,* 1983, p. 43]. Thus the total social (user) costs of credit card transactions are estimated at $4,506 million ($2,249 million) with a unit cost estimate of $0.88 ($0.44) per transaction.

[f]Credit Cards

According to a Bank Administration Institute study (*Banking Issues and Innovations,* 1985), bank credit card transactions are outstanding an average of 45 days. Thus total credit card float costs are estimated at $2,257 million. [This estimate is based on a figure of $317 billion in yearly charge volume in Humphrey and Berger (1990) Table 2-A1, pp. 77–9, divided by 365 days, multiplied by the 45 days a transaction is outstanding, multiplied by the 90-day Treasury bill rate of 0.05775.]

[g]ACH

Payor ACH costs are estimated to be $0.18 per ACH item, based on the government's direct deposit ACH costs. (See Dudley, William C. *A Comparison of Direct Deposit and Check Payment Costs,* ed. 2. Board of Governors of the Federal Reserve System, 1983.) Applying this origination cost to the total volume of ACH items originated [936 million items in Humphrey and Berger (1990) Table 2-A1, pp. 77–9] gives $168 million as an estimate of government and business payor costs. Payee and bank ACH costs were derived by multiplying the 1987 weighted average per item commercial bank price for ACH ($0.089, from Trans Data Corporation. *1988 Bank Pricing Program,* 1988, p. 42) by 1987 ACH item volume (936 million), giving $83 million. This includes per-item fees, tape-handling costs, and other ACH charges. The commercial bank prices used included all Federal Reserve costs [$71 million, from Board of Governors of the Federal Reserve System. *Planning and Control System Expense Report* (PACS), 1987, including a 16 percent PSAF]. Last, some bills paid through an ACH are first mailed to payors as a notification before debiting a customer's account. These costs ($0.22 for postage plus $0.02 for an envelope) are assumed to apply to 20 percent of ACH commercial volume, which is around one-half of total ACH volume of 936 million. Thus mail costs of $22 million ($22 million = $\$0.24 \times 0.10 \times 936$ million) are added to ACH costs of $251 million, giving total ACH processing costs of $273 million.

[h]ACH

ACH debits do create some float, like checks, but there is no float associated with ACH credits, which are like European giro payments. ACH debit float, evaluated at the 90-day Treasury bill rate cited previously, gives less than $1 million in float value in

1987. Wire transfer also can create some float and fluctuates between debit and credit float [none for Clearinghouse Interbank Payments System (CHIPS)]. Over 1987, wire transfer debit float valued at less than $2 million was created. Debit float is a user benefit; credit float is a user cost.

[i]POS (Debit cards)

Some POS networks use a direct debit to an account (like an ATM withdrawal or bill payment with a unit cost of $0.66). Other networks are configured to work more slowly through an ACH, which has a unit cost of $0.27. Lacking strong evidence on the real cost of POS, we assumed that it is likely to fall between that for an ATM direct debit and an ACH transfer. The simple average of these two unit costs was $0.47, which was used to approximate the cost of a POS transaction.

[j]POS (Debit cards).

There is no float associated with POS transactions (except for those functioned through an ACH, but the value of this float is small), so the user costs and the social costs ($0.47 × 55 million POS transactions = $26 million) are the same.

[k]Traveler's Checks

Production, processing, and operating costs for traveler's checks are proprietary. Thus it was assumed that revenues associated with issuing traveler's checks equaled the costs involved. Generally, an issuing fee of 1 percent of the face value of the traveler's check is assessed, yielding a revenue flow of $470 million [from 0.01 multiplied by $47 billion, in Humphrey and Berger (1990) Table 2-A1, pp. 77–9]. More revenue for the issuer is obtained from float because it is estimated that the average traveler's check is outstanding for 70 days. (See Penzer, Michael L. "The Nature and Size of Money Order and Traveler's Check Markets in California and the Nation." Economic and Financial Information Division, California State Banking Department, 1978, p. 32. Penzer estimated that a traveler's check was outstanding for an average of 57 days in 1976.) Float revenues to the issuer are $525 million [from 0.05775—the 90-day Treasury bill rate in 1987—multiplied by $7.0 billion and divided by (l - 0.23)], which was the average daily value of outstanding nonbank traveler's checks. [See Humphrey and Berger (1990) Table 2-A1, pp. 77–9, note *d*, adjusted upwards to account for bank traveler's checks.] Thus the costs of issuing and paying traveler's checks, which would also cover the expense of funding lost checks, is $525 million plus $470 million for a total of $995 million. The retail cost of handling and processing traveler's checks is assumed to be equal to that for cash of $0.45 per transaction (Board of Governors of the Federal Reserve System, 1983, *Credit Cards in the U.S. Economy,* Washington, D.C., p. 43), which yields a cost of $0.45 times 1,345 million transactions (Humphrey and Berger, 1990, Table 2-A1, pp. 77–9) = $609 million.

[l]Traveler's Checks

Though there is float associated with traveler's checks ($525 million in float divided by 1,345 million transactions = $0.39 in float cost per traveler's check), we have assumed that all float revenues in fact cover operating costs, so float in the same sense as check float, or the opportunity cost of holding idle funds, in the same sense as applied to the issuance of cash by the government, does not exist. Put differently, traveler's check float is not the same thing as a redistribution of income between payor and payee but rather an alternative method of covering operating expenses for the issuer of the traveler's check. Because this is a reasonably competitive industry, we have assumed that there is no monopoly power on the part of the issuer to obtain above-normal profits (such a situation does not apply to the issuance of currency by the government). In sum, the user and social unit costs of a traveler's check are the same at $1.18 per transaction [($995 million plus $609 million) divided by 1,345 million transactions].

[m]Money Orders

Federal Reserve cost in processing 146 million postal money orders in 1987 was $2.8 million [direct and allocated costs plus overhead (39 percent of total activity costs), from Board of Governors of the Federal Reserve System. *Planning and Control System Expense Report* (PACS), 1987], or $0.019 per money order. This unit cost figure was applied to the 811 million money orders estimated to have been used in 1987 [Humphrey and Berger (1990) Table 2-A1, pp. 77–9], giving $15 million. Merchant or receiver processing costs were assumed to equal those reported for checks at a sample of retail stores: of $0.50 per item for a total merchant processing cost of (811 million money orders) × ($0.50) = $406 million. (See Board of Governors of the Federal Reserve System. *Credit Cards in the U.S. Economy,* 1983, p. 43.) It was assumed that one-half of all money orders are mailed by the user, giving an extra user cost of $97 million [from per-item postage cost ($0.22) plus per-envelope cost ($0.02) multiplied by 0.5 and then multiplied by 811 million items = $97 million]. This assumption is supported in a survey of money order users in California by Pierce, who found that the payment of utility and other monthly bills plus sending money to relatives or friends accounts for almost two-thirds of the responses as to why money orders were used. (See Pierce, James L. "The Users of Money Orders," University of California–Berkeley, 1977. Appendix Table A-3, p. 8.) Total money order processing costs are thus estimated at $518 million. Money order production costs, including all costs of distributing them to users plus the costs of redemption, are taken from postal money order fiscal year data for 1984 (and thus will not match exactly with the volume and value figures for postal money orders processed by the Federal Reserve in calendar year 1987). The directly allocated production costs for postal money orders were $0.79 per item ($112 million in directly allocated cost divided by 142 million items in fiscal year 1987 from U.S. Postal Service, *Costs and Revenue Analysis Report,* 1987*).* Revenues, however, were $1.15 per item ($148 million from fees plus $16 million from float, giving $164 million total, divided by 142 million items). Revenues from money orders ($164 million) in excess of directly allocated costs ($112 million) are allocated to Postal Service overhead for all services offered. These overhead costs are viewed as joint costs and are reallocated back to the individual services according to certain criteria, one of which is the value of the service to the user (Ramsey pricing). Thus it is impossible to determine whether postal money order revenues cover all costs or if excess profits (or losses) are being incurred and cross-subsidization exists. Penzer has noted that use of postal money orders peaked in 1952 and subsequently lost market share to bank-issued money orders and private firms. (See Penzer, Michael L. "The Nature and Size of Money Order and Traveler's Check Markets in California and the Nation." Economic and Financial Information Division, California State Banking Department, 1978, p. 6.) This implies that postal money orders face a competitive market and, if anything, may be cross-subsidized rather than be used to cross-subsidize other postal services. As a result, we assume here that all postal money order revenues are used to cover all costs, even though it is likely that costs may exceed total revenues by some unknown amount. This implies that the fully allocated cost of a postal money order is at least $1.15 per item, and this figure is used to approximate the unknown production cost of all money orders. Thus total production costs of all money orders is estimated at $1.15 × (811 million items) = $933 million, for a total social cost of $1,451 million. Total user costs are the same because total money order float costs of $89 million (from $0.11 multiplied by 811 million items) are presumed fully used to cover real resource costs and represent an alternative charging method rather than a transfer payment.

[n]Money Orders

Money orders are estimated to be outstanding between 5 and 11 days. (See Penzer, Michael L. "The Nature and Size of Money Order and Traveler's Check Markets in California and the Nation." Economic and Financial Information Division, California State Banking Department, 1978, p. 8.) Taking the midpoint (8 days) generates an estimated float benefit of $16 million for postal money orders ($16 million = $12.511 billion annual value of postal money orders outstanding multiplied by 8/365 of a year multiplied by an interest rate of 0.05775).

[o]Wire Transfers

Wire transfer volume in Humphrey and Berger (1990) Table 2-A, pp. 77–9 (84 million) was multiplied by a weighted average commercial bank charge for wire transfers ($7.33, from Trans Data Corporation. *1988 Bank Pricing Program,* 1988, p. 72) to give the total cost of wire transfers ($616 million). The Federal Reserve wire transfer cost components [from Board of Governors of the Federal Reserve System. *Planning and Control System Expense Report* (PACS), 1987] and the PSAF were $66 million, which was assumed to be fully passed to final users in these bank fees.

[p]Wire Transfers

Wire transfer also can create some float, which fluctuates between debit and credit float (none for CHIPS). Over 1987, wire transfer debit float valued at less than $2 million was created. Debit float is a user benefit; credit float is a user cost.

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Are Prices Countercyclical? Evidence From East Asian Countries

Yang Woo Kim

The cyclicality of prices has been in debate recently. One of the key stylized facts that has served as a cornerstone for traditional business cycle models is the procyclical behavior of prices. Recent research has questioned the empirical basis for this stylized fact. Using quarterly U.S. data, Kydland and Prescott (1990) report that cyclical components of U.S. prices and output are correlated negatively in the post–Korean War period. They cite this result as evidence against the conventional understanding that prices are procyclical.

Cooley and Ohanian (1991) confirm the negative correlation in the post-WWII period and also find that if the sample is extended into the nineteenth century, the data are not at all suggestive of procyclical prices, with the important exception of the inter-war period. They interpret their findings of countercyclical prices as being inconsistent with the predictions of demand-driven models and instead supportive of real business-cycle models.

The work of other researchers, such as Backus and Kehoe (1992) and Smith (1992), complements these studies by examining cross-country evidence. For example, Smith finds that, for ten countries, fluctuations in the price level generally are procyclical from the late nineteenth century until WWII, with the exception of a period around WWI. Price-level movements are countercyclical in the post-Depression period, however, with the possible exception of a period in the 1950s or 1960s. These facts suggest that procyclical price movement is not a stable feature across many business cycles.

Chadha and Prasad (1993, 1994) show the importance of making a clear distinction between inflation and the cyclical component of the price level in reports and interpretations of stylized facts regarding business cycles. They find that, in postwar quarterly data for the United States, as well as for the rest of the G-7 countries, the cyclical components of the price-level and output series are negatively correlated. The inflation rate, however, is generally correlated positively with various measures of the cyclical component of output, suggesting that demand-driven models of the business cycle are not necessarily falsified by the countercyclical behavior of the price level.

Similarly, Hall (1995) argues that the conclusions on the sources of the business cycle of Cooley and Ohanian, and Kydland and Prescott are flawed. He shows that a negative correlation between detrended output and detrended prices is predicted by the natural-rate nominal-demand shock model, under reasonable assumptions. In other words, he shows that the natural-rate model suggests that procyclical prices imply a positive correlation between the change in inflation and detrended output. Judd and Trehan (1995) argue that the use of cross-correlation coefficients as indicators for evaluating the empirical relevance of demand-oriented versus supply-oriented macroeconomic theories is problematic in principle. Using two econometric models, they show that correlation coefficients for prices and output could easily be negative even if demand shocks were the primary source of cyclical fluctuations and prices were procyclical. Gavin and Kydland (1995) show that alternative money supply rules can change the

cyclical nature of prices in a flexible-price economy.

The purpose of this paper is to document the empirical evidence on the cyclical behavior of prices and inflation in two rapidly growing developing countries—Korea and Taiwan. I use the methodology of Chadha and Prasad (1994) to see if results from advanced countries are robust when compared to the results from these developing countries, whose business cycles may have different characteristics. In addition to the usual techniques for detrending—linear detrending, first differencing, and Hodrick-Prescott (HP) filtering—two more techniques are utilized. That is, the Zivot-Andrews' (1992) procedure of a unit root test with a structural break at an unknown point in time is used to enable researchers to consider possibilities of a segmented trend of the data. Also, a smooth trend based on the phase average trend (PAT) technique (Klein and Moore, 1985; Zarnowitz, 1992) that is popular in growth-cycle literature is estimated and used in detrending the time series to confirm the robustness of the empirical findings.

The next section of this paper discusses the strategy of the trend-cycle decomposition and related issues. The third and fourth sections present empirical correlations of prices and inflation with the cyclical component of output in Korea and Taiwan. The final section summarizes the main results and implications.

Trend-Cycle Decomposition

To examine the co-movement of macroeconomic variables over the business cycle, it is necessary to use a procedure based on an appropriate measure of the cyclical component of the series. It has been well documented that macroeconomic variables are nonstationary in general. The characterization of the form of the nonstationarity is very important, since it will affect the nature of the stationary component as well as the permanent component of a time series.[1] However, there is no consensus on the correct trend-cycle decomposition method. There are several widely used transformations, including deterministic linear detrending, first differencing, and other types of stochastic detrending such as Hodrick and Prescott (1981) filtering. Since each technique suggested has its own limitations, depending on the nature of the input series and the issues addressed, it is likely that different detrending methods will be useful in different applications.

To get around problems associated with particular detrending methods, some researchers adopt an eclectic strategy in detrending a time series—i.e., instead of using a particular technique for detrending, they try various detrending methods and evaluate the robustness of the results across techniques. Cooley and Ohanian (1991) and Smith (1992) use three filters in calculating the cross-correlations of price and output: linear, first-difference, and HP. Chadha and Prasad (1993,1994) try a segmented trend based on Perron (1989) and a stochastic detrending method used by Beveridge and Nelson (1981) and Blanchard and Quah (1989) as alternatives.

In this study, I basically follow Chadha and Prasad's strategy in using a variety of detrending procedures. I use the three filters—linear, first-difference, and HP—as well as two others. Instead of Beveridge-Nelson detrending (1981) or Blanchard and Quah's method (1989), I investigate the nature of the nonstationarity of the time series more thoroughly by applying Zivot and Andrews' unit root test (1992) under the alternative of trend stationarity with a break at an unknown point in time. A break point identified by this procedure is then used for setting up a segmented linear trend. I also calculate a fifth decomposition with the Growth Cycle program based on the PAT technique.

A deterministic linear trend is free of any cyclical or any other short-run movements; as a result, it guarantees a clear decomposition of the series into a trend and cyclical component. But it is not likely that a deterministic trend, or trend-stationary process, would represent the

[1] Precisely speaking, if a nonstationary stochastic process can be made stationary by a particular transformation, and a different transformation is employed, the spectral representation will be altered. Thus it is important to use the correct transformation.

real world across periods of dramatic changes such as the Great Crash of 1929, or World War II or periods of structural changes in developing economies. Another detrending method, first differencing, is included for completeness, but it is probably not appropriate for studying the cyclical nature of prices, since it removes information at cyclical frequencies. Most real business-cycle researchers have extensively used the Hodrick and Prescott filter (1981). Kydland and Prescott (1982) choose it because it focuses on fluctuations at cyclical frequencies. This technique, however, has been criticized by several researchers (King and Rebelo, 1993; Cogley and Nason, 1995; Harvey and Jaeger, 1993; Gregory and Smith, 1995), because mechanical detrending based on the HP filter could lead investigators to report spurious cyclical behavior. The last two methods I use—the segmented linear method and the PAT technique—have not been widely used in the business-cycle literature. Therefore, I include a detailed discussion of these two methods before analyzing the cyclical behavior of prices in Korea and Taiwan.

The Segmented Linear Method

Since Nelson and Plosser (1982), the popular view has been that most macroeconomic variables have a unit root—that is, they follow stochastic trends. Recently, evidence against this unit root hypothesis has been presented by various authors. Perron (1989) shows that, once a break in the trend is allowed in the data, the unit root hypothesis can be rejected in favor of the alternative hypothesis of stationarity around a deterministic trend that has an exogenous break at either the Great Crash or the 1973 oil shock. This situation is true for postwar quarterly U.S. real GNP as well as for eight of the eleven macroeconomic time series Nelson and Plosser examined. Perron's results are criticized and further elaborated by several researchers, on the ground that his choice of a break point in the trend is ad hoc and hence cannot circumvent the problem of data-mining (Christiano, 1992; Zivot and Andrews, 1992). By treating the breakpoint as endogenous, they find less evidence against the unit root hypothesis than Perron finds for many of the data series but stronger evidence against it for several of the series. Similarly, Banerjee, Lumsdaine, and Stock (1992) examine the unit root hypothesis on postwar real output of G-7 countries using tests based on asymptotic distribution theory, which treats break dates as unknown a priori, and they find that the null hypothesis of a unit root can be rejected only for Japan. Serletis (1994), who bases his research on the Zivot and Andrews' technique (1992), finds that the unit root model can be rejected for real per capita output series in eight out of ten countries over the period of 1870 to 1985, if a one-time break is allowed at an unknown point in time. Using the same technique, Alba and Papell (1995) examine unit roots in aggregate and real per capita GDP for nine newly industrializing countries (NIC) and newly exporting (NEC) countries in east and southeast Asia. In 15 out of 18 cases, they reject the unit root hypothesis in favor of the theory of trend stationarity with a break. Overall, the results from these studies suggest that the international evidence of the unit root model is mixed as far as output is concerned, either real GDP or per capita GDP; the outcome depends on how certain big shocks (such as the Great Crash of 1929) are treated.

Here I use Zivot-Andrews' variant of the sequential Dickey-Fuller test of a unit root, which can be represented by the following equation:

$$(1) \qquad \Delta Y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \alpha Y_{t-1} + \sum c_i \Delta(Y_{t-j}) + e_t$$

where $DU = 1$ and $DT = t - TB$ if $t > TB$ and 0 otherwise. This tests the null hypothesis of a unit root against the alternative hypothesis of a trend stationarity with a one-time break (TB) in the intercept and slope of the trend function at an unknown point in time. For this, different regressions are run for $TB = 2, 3, ..., T-1$, where T is the number of observations adjusted

Table 1

Test for Unit Root: Zivot-Andrews' Procedure 1992

Variables	Sample	Break Point	α	t-value	Model	k
			Korea			
GNP	1970.1Q-95.2Q	1979.2Q	−0.25	−4.6	A	2
Deflator	1970.1Q-95.2Q	1979.4Q	−0.22	−5.41*	C	5
CPI	1970.1Q-95.2Q	1979.3Q	−0.15	−6.20*	C	12
			Taiwan			
GDP	1961.1Q-95.3Q	1977.4Q	−0.23	−4.21	B	10
Deflator	1961.1Q-94.4Q	1973.1Q	−0.06	−4.21	A	4
CPI	1959.1Q-95.4Q	1982.2Q	−0.05	−3.4	B	6

*Significant at the 5 percent level.

for lost data caused by differencing and lag length k. The lag length is selected according to the procedure suggested by Perron (1989). Working backwards from $k = 12$, I choose the first value of k such that the t-statistic on the last lag in the autoregression is greater than 1.6 in absolute value and the t-statistic on the last lag in higher order autoregression is less than 1.6.

A break point is chosen that gives the least favorable result for the null hypothesis and the most weight to the trend-stationary alternative. This result can be accomplished by choosing the minimum t-statistic on the Dickey-Fuller statistic out of T-2 regressions. Also, following Perron (1989), I tried three possible models under the alternative hypothesis to test the unit root: model A, which allows a break in the intercept (DU_t); model B, which allows a break in the slope only (DT_t); and finally model C, which allows a break in both slope and intercept. Model C, which is represented by Equation 1, is used if the t-statistics on both the intercept and the slope dummies are significant. If not, either model A or B is used, depending upon which dummy from the model C is significant.

Table 1 shows the results for a unit root hypothesis of output and prices for Korea and Taiwan based on quarterly data.[2] The Korean output series conforms with model A, implying that there is a change in intercept of the trend, while the Taiwan output series follows model B, in which the slope of the trend changes. In the case of prices, model C is chosen for both the CPI and GNP deflator in Korea, while models A and B are chosen for the Taiwan deflator and CPI respectively. Note that the chosen potential structural break period in the trend of each series is not the same for the two countries[3] (see, also, Figures 1a through 1d on the time paths of the Dickey-Fuller t-statistics). This difference suggests that a break-inducing exogenous event, such as the oil shock in the 1970s, may not have affected these countries at the same time, partly because of differences in government policy and different levels of development in each country. Among the six cases, the unit root hypothesis is rejected for the Korean deflator and CPI at the 5 percent level of significance. The results from Table 1 may imply that the nature of the nonstationarity of the output series is different country-by-country; therefore, care should be taken in applying a specific detrending procedure.

The Phase Average Trend Technique

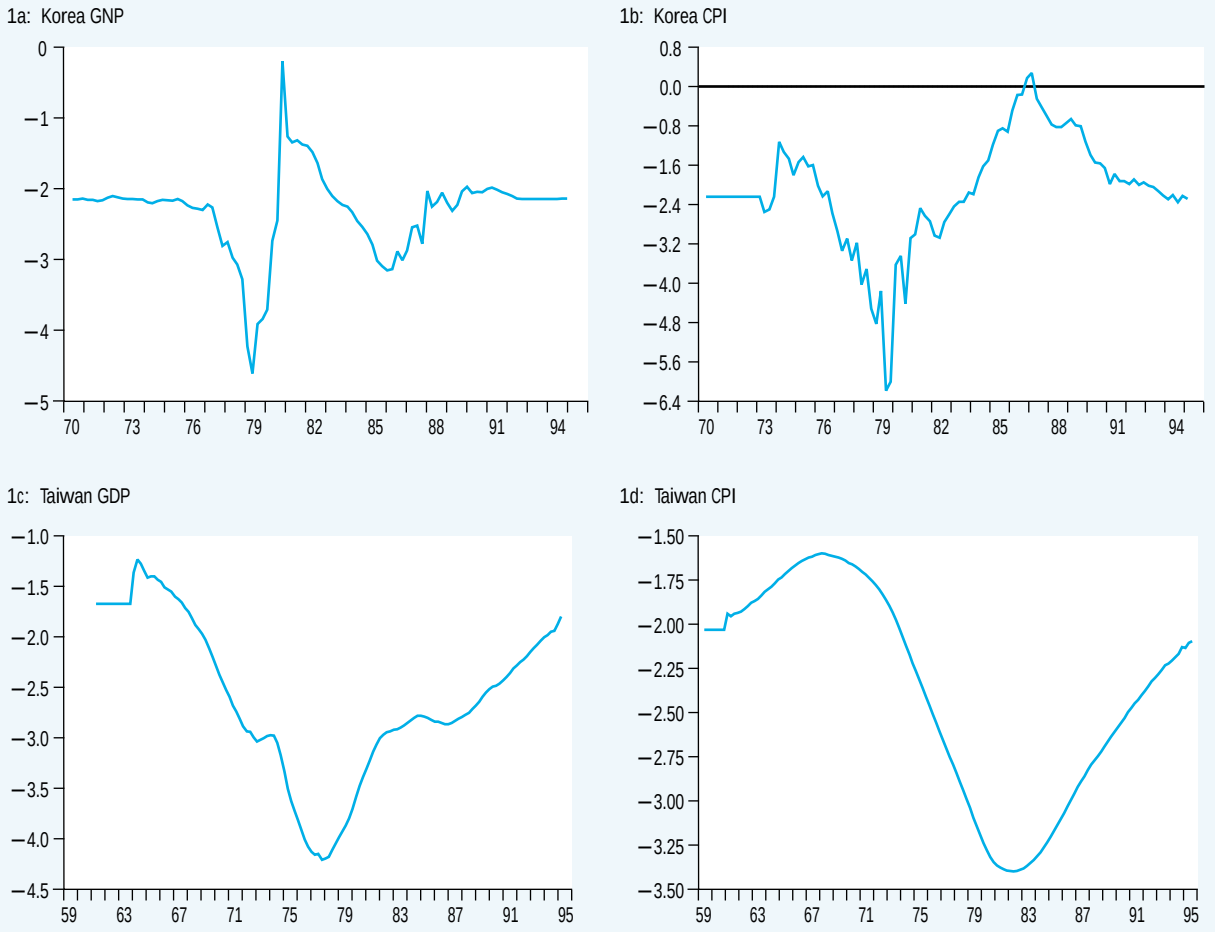
Another trend-fitting measure used is the Phase Average Trend (PAT) technique, combined with the turning-point selection program, which is used in growth-cycle literature. Growth cycles are measured by calculating the observed monthly deviations from the trend. Klein and Moore (1985) have adapted the computer pro-

[2] The results of the standard augmented Dickey-Fuller unit test suggest that output and price series in both countries have a unit root if no break in the trend is taken into account.

[3] The results for the unit root test for the output series are slightly different, in terms of either model chosen or the break point, compared to Alba and Papell (1995). This difference in outcome seems to stem from differences in the data sets. Alba and Papell use annual data collected and adjusted by Summers and Hester (1953–1988 for Korea, 1950–1988 for Taiwan), while I use quarterly data pulled directly out of the IFS from IMF and DRI. Part of the reason for the difference will be the length of the sample period. My data has been updated until recently and hence has a longer sample period than theirs, which ends at 1988.

Figure 1

Dickey-Fuller t-statistics

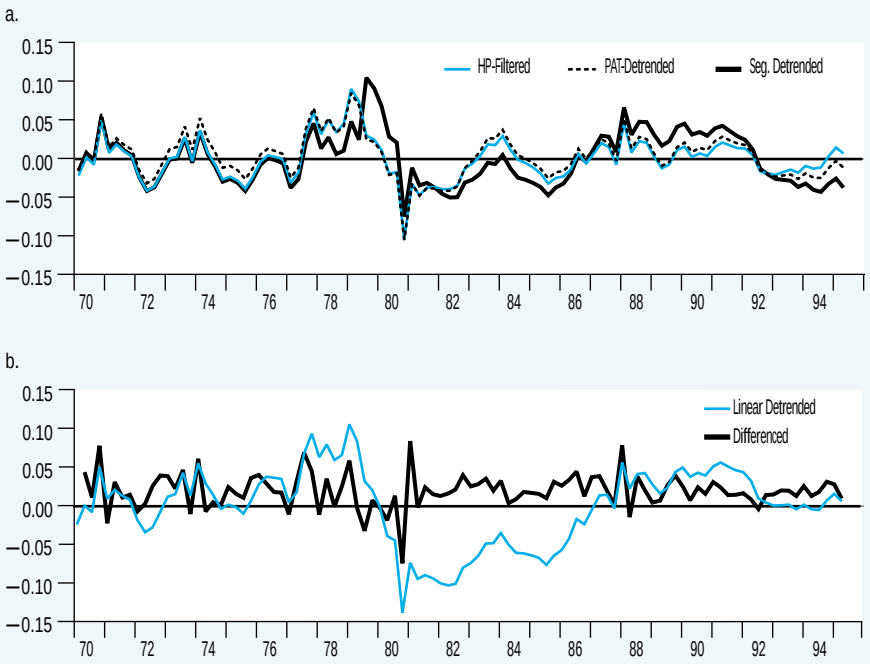


gram for dating classical cycles, originally developed by Bry and Boschan (1971), so that it can be used in producing growth-cycle chronologies. The traditional way of getting a trend from the data in early business-cycle literature is to calculate the moving average of the series for a fixed period of time in the context of the beginning and end points of the data. Klein and Moore find the trend rate calculated in this way to be noticeably affected by the shorter cycles in the series. To correct for this problem, they devised the new trend-fitting technique, PAT.

The PAT technique involves a trend adjustment—a moving average over the two or three phases of cycles of varying duration. For example, after the seasonally adjusted data are smoothed to produce a seventy-five–month moving average, observed deviations from this initial trend are first calculated. From this rough deviation cycle, tentative turning points (peaks and troughs) are identified and temporary phases of varying lengths are determined. Then final trend estimates are computed as a two- or three-phase moving average of the original, seasonally adjusted data, interpolating monthly between the centered values of these averages. The cyclical component of the series can be obtained by calculating the deviations of the original data from this refined and flexible nonlinear trend estimate. Klein and Moore

Figure 2

Detrended Output: Korea



argue that the trend-fitting method will be more satisfactory than the simple moving average in separating cyclical influences from the underlying trend. As a result, they argue, the data can then identify relatively stable trend rates of growth, unassociated with the shorter cycles—a primary concern of business-cycle researchers. This procedure is applied to the Korean and Taiwan data to obtain the alternative measure of cyclical components.

Comparing the Alternative Measures of the Cyclical Component

Figures 2a and 2b depict the five alternative measures of the cyclical component for Korean GNP. The three most similar, shown in Figure 2a, are those derived through the HP, the PAT, and the segmented linear trend methods. For all three methods, the average frequency and amplitude of the calculated cycles appears to be roughly consistent with business cycles lasting 4 to 6 years. Figure 2b includes the two extremes: The linear trend method suggests too few cycles, and the first-difference method suggests too many to be consistent with conventional ideas about the length of business cycles.

To identify the similarities of each calculated cyclical component, correlations between measures are calculated in Table 2. The lower triangle of each panel represents correlations between cyclical components of output, while the higher triangle of each panel represents correlations between cyclical components of price calculations based on the consumer price index. Note that the correlations between the first-differenced series and those detrended by either linear trend or segmented trend are not significant. This is the expected result from Table 1, because output and prices should be modeled as having either a deterministic or a stochastic trend.

In general, the cyclical components of output and prices, when detrended by the PAT technique, are closely related with the cyclical components derived from all other methods. In particular, PAT detrended components are most strongly related with

Table 2

Correlations between Cyclical Components of Output and Prices

Output Prices	Linear Trend	Segmented Trend	HP Filter	PAT	Difference
KOREA					
Linear trend	1	0.3	0.37	0.66	0.08
Segmented trend	0.69	1	0.69	0.52	−0.13
HP filter	0.76	0.74	1	0.81	0.17
PAT	0.76	0.75	0.97	1	0.2
First Difference	0.23	0.18	0.39	0.4	1
TAIWAN					
Linear trend	1	0.8	0.45	0.67	0.1
Segmented trend	0.53	1	0.52	0.8	−0.01
HP filter	0.49	0.91	1	0.9	0.22
PAT	0.6	0.83	0.96	1	0.17
First Difference	0.15	0.24	0.31	0.28	1

* The lower (higher) triangle of each panel represents the correlation between cyclical components of output (prices).

HP filtered series. For example, the correlations between the two measures in Korea are, respectively, 0.97 for output and 0.81 for prices. The cyclical components calculated with the first-difference filter are least correlated with the cyclical components calculated by means of the other methods.

Correlation Between Cyclical Components of Prices and Output

In this section, price-output relationships for each country are investigated by means of various detrended series based on the techniques discussed above. First, I detrend prices and output using a deterministic linear trend. Second, I detrend prices and output using a segmented linear trend, with a break point in either the level and/or slope of the trend, depending on which model is appropriate for each country. The periods for a structural break in the trend of output and prices are different across the countries. Third, I use the HP filter to detrend the prices and output series. Fourth, I detrend prices and output by means of the PAT technique. And finally I take first differences of both prices and output. By construction, these are interpreted as the relation between inflation and economic growth rates. As discussed above, care should be taken in interpreting these results as having cyclical implications, because first-differenced series do not generally yield the cyclical components of the original series.

Table 3 shows the cross-correlations of prices and output, to each of which the same transformation techniques are applied. For each country, two measures of price series are used. The correlations are reported up to four lags and leads, and the standard errors are computed under the null hypothesis that the true correlation coefficient is zero. The results show that the standard errors for cross correlation coefficients are very similar.

The first panel reports the correlations between prices and output series, with both series detrended using a simple linear trend. The numbers are all significantly negative for Korea. However, in the case of Taiwan the correlations are positive at all leads and lags with the deflator, and mostly positive with the CPI.

The second panel shows the result when both prices and output series are modeled as stationary around a segmented time trend, allowing for a different break in each series. The correlations in Korea are still negative, although smaller than those of the first panel. In Taiwan, however, the correlations change their signs to become negative for both the deflator and the CPI.

Table 3

Cross Correlations of Prices and Output with Same Detrending Methods for Both Series

Lead/Lag	Korea		Taiwan	
(− denotes lag)	Deflator	CPI	Deflator	CPI
	Detrended Prices and Output (Linear Trend for Both)			
4	−0.50 (0.10)	−0.59 (0.10)	0.12 (0.09)	−0.02 (0.09)
3	−0.50 (0.10)	−0.61 (0.10)	0.15 (0.09)	−0.00 (0.09)
2	−0.49 (0.10)	−0.61 (0.10)	0.19 (0.09)	0.02 (0.09)
1	−0.47 (0.10)	−0.60 (0.10)	0.23 (0.09)	0.06 (0.09)
0	−0.45 (0.10)	−0.58 (0.10)	0.29 (0.09)	0.11 (0.09)
−1	−0.41 (0.10)	−0.55 (0.10)	0.33 (0.09)	0.16 (0.09)
−2	−0.38 (0.10)	−0.51 (0.10)	0.38 (0.09)	0.21 (0.09)
−3	−0.34 (0.10)	−0.47 (0.10)	0.42 (0.09)	0.27 (0.09)
−4	−0.31 (0.10)	−0.42 (0.10)	0.45 (0.09)	0.32 (0.09)
	Detrended Prices and Output (Segmented Trend for Both)			
4	−0.15 (0.10)	−0.18 (0.10)	−0.14 (0.09)	−0.53 (0.09)
3	−0.09 (0.10)	−0.26 (0.10)	−0.20 (0.09)	−0.55 (0.09)
2	−0.18 (0.10)	−0.34 (0.10)	−0.26 (0.09)	−0.56 (0.09)
1	−0.19 (0.10)	−0.42 (0.10)	−0.29 (0.09)	−0.54 (0.09)
0	−0.29 (0.10)	−0.50 (0.10)	−0.29 (0.09)	−0.49 (0.09)
−1	−0.31 (0.10)	−0.53 (0.10)	−0.29 (0.09)	−0.41 (0.09)
−2	−0.32 (0.10)	−0.43 (0.10)	−0.26 (0.09)	−0.32 (0.09)
−3	−0.22 (0.10)	−0.35 (0.10)	−0.23 (0.09)	−0.24 (0.09)
−4	−0.18 (0.10)	−0.21 (0.10)	−0.23 (0.09)	−0.15 (0.09)
	Detrended Prices and Output (HP Filter for Both)			
4	−0.29 (0.10)	−0.26 (0.10)	−0.68 (0.09)	−0.59 (0.09)
3	−0.32 (0.10)	−0.39 (0.10)	−0.76 (0.09)	−0.73 (0.09)
2	−0.39 (0.10)	−0.51 (0.10)	−0.74 (0.09)	−0.79 (0.09)
1	−0.40 (0.10)	−0.57 (0.10)	−0.63 (0.09)	−0.75 (0.09)
0	−0.47 (0.10)	−0.58 (0.10)	−0.47 (0.09)	−0.63 (0.09)
−1	−0.37 (0.10)	−0.54 (0.10)	−0.27 (0.09)	−0.45 (0.09)
−2	−0.26 (0.10)	−0.48 (0.10)	−0.08 (0.09)	−0.26 (0.09)
−3	−0.15 (0.10)	−0.37 (0.10)	0.07 (0.09)	−0.09 (0.09)
−4	−0.07 (0.10)	−0.21 (0.10)	0.20 (0.09)	0.09 (0.09)

The third panel shows the results for the HP-filtered prices and output. The basic picture remains the same as in the second panel, but negative associations are getting stronger in Korea (see also Figure 3, page 78) and at the leads in Taiwan. The fourth panel shows that the correlations are generally negative for both countries when the cyclical components of price and output series are extracted by PAT technique. A striking feature of this panel is that in Taiwan negative correlations stand out and are stronger than in Korea, especially at the leads.

Finally, the correlations between the first log-differenced prices and output (i.e. inflation and economic growth) are shown in the last panel. Again they are all negative in Korea except lead 1 and lag 3 in the deflator case, although they are weaker

Table 3 (con't)

Cross Correlations of Prices and Output with Same Detrending Methods for Both Series

Lead/Lag	Korea		Taiwan	
(– denotes lag)	Deflator	CPI	Deflator	CPI
	Detrended Prices and Output (PAT for Both)			
4	−0.14 (0.10)	−0.17 (0.10)	−0.55 (0.09)	−0.51 (0.09)
3	−0.13 (0.10)	−0.25 (0.10)	−0.61 (0.09)	−0.62 (0.09)
2	−0.18 (0.10)	−0.33 (0.10)	−0.58 (0.09)	−0.68 (0.09)
1	−0.18 (0.10)	−0.36 (0.10)	−0.49 (0.09)	−0.65 (0.09)
0	−0.23 (0.10)	−0.38 (0.10)	−0.35 (0.09)	−0.55 (0.09)
−1	−0.17 (0.10)	−0.35 (0.10)	−0.17 (0.09)	−0.39 (0.09)
−2	−0.10 (0.10)	−0.31 (0.10)	−0.00 (0.09)	−0.23 (0.09)
−3	−0.03 (0.10)	−0.24 (0.10)	0.14 (0.09)	−0.07 (0.09)
−4	0.01 (0.10)	−0.14 (0.10)	0.26 (0.09)	0.08 (0.09)
	First Differences of Prices and Output			
4	−0.08 (0.10)	−0.05 (0.10)	−0.20 (0.09)	−0.21 (0.09)
3	−0.07 (0.10)	−0.16 (0.10)	−0.34 (0.09)	−0.28 (0.09)
2	−0.14 (0.10)	−0.21 (0.10)	−0.31 (0.09)	−0.32 (0.09)
1	0.01 (0.10)	−0.20 (0.10)	−0.20 (0.09)	−0.29 (0.09)
0	−0.28 (0.10)	−0.20 (0.10)	−0.13 (0.09)	−0.23 (0.09)
−1	−0.05 (0.10)	−0.10 (0.10)	0.01 (0.09)	−0.04 (0.09)
−2	−0.03 (0.10)	−0.20 (0.10)	0.13 (0.09)	0.00 (0.09)
−3	0.03 (0.10)	−0.15 (0.10)	0.09 (0.09)	0.01 (0.09)
−4	−0.05 (0.10)	−0.01 (0.10)	0.15 (0.09)	0.15 (0.09)

* Figures in parentheses indicate standard errors.

than those by other detrending methods, implying the negative association between inflation and economic growth. In Taiwan, however, correlations are negative for all the leads and insignificantly positive at most lags.

In sum, the implication from Table 3 is that, whichever method is used in detrending, the cross correlations of the cyclical components of prices and output are negative for all the cases for Korea and for most cases for Taiwan, although the significance of the relationship is different.[4] The results do not change much regardless of which measure of prices, either the deflator or CPI, is used. This indicates that there is strong evidence for the countercyclical price behavior in Korea and Taiwan as in the case for the industrialized countries documented in Chadha and Prasad (1994).

Correlation Between Inflation and the Cyclical Component of Output

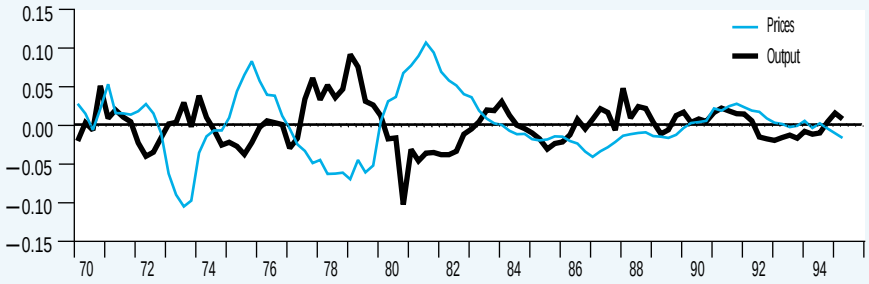
As discussed above, many conventional models of business cycles imply that the inflation rate, rather than the price level, is procyclical. Hence the correlations are calculated again between inflation and detrended output. The comparison of inflation versus the detrended price level is illustrated for the HP method in Figure 3. Figure 3a shows the clearly countercyclical nature of price and output reported in Table 3. Figure 3b shows the procyclical nature of inflation that is documented below.

Figure 3b plots the inflation rate with the deviations of output from the HP trend. Table 4 presents correlations between inflation and various measures of the cyclical component of output similarly

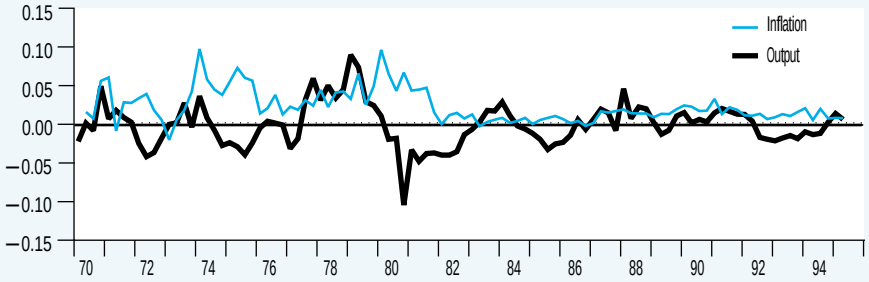
[4] In Taiwan, detrending using a simple linear trend may not be appropriate, since all the other detrending methods give similar results.

Figure 3

a. HP-Filtered Prices and Output: Korea



b. Inflation and HP-Filtered Output: Korea



defined as in Table 3. The rate of inflation is measured as the first difference of the log of the price level. The remarkable features of Table 4 are that (1) the positive correlations between inflation and output are prevalent across all the detrending methods, contrary to the correlations between price level and output, which are negative in most cases, and (2) that the magnitudes of the correlations are larger in Taiwan than in Korea. The first panel shows that the correlations between inflation and output that have been detrended using a linear trend are all positive for Taiwan, regardless of price measures, and for Korea they are all positive when inflation is measured by the deflator. The second through fourth panels show that the correlations between inflation and output are generally positive for both countries, no matter which method is used to take this trend out of the data.

Finally, the correlations between inflation and cyclical output that have been detrended by the PAT technique are again basically positive for both countries, a result that is very similar to that shown in panels 2 and 3. The results in Table 4 indicate procyclical variations in inflation for most cases, in contrast to the case when price level is used. This finding is consistent with the findings for G-7 countries presented by Chadha and Prasad (1994).

Table 5 presents the results for the test of the possibilities of a change in correlation structure between prices or inflation and cyclical output before and after the identified break point by Zivot and Andrews' procedure (1992). Although output series in both Korea and Taiwan turn out to be difference-stationary statistically, both countries may have experienced a structural change. Hence the same analysis is done during the subsample period, before and after the break point. The break point used for each country is that for output from the Zivot and Andrews test (Table 1). Instead of reporting all the cross correlations, the correlation between cyclical prices and inflation and output, based on the HP filter and the growth cycle program, are presented.

Table 4

Cross Correlations of Inflation and Cyclical Components of Output

Lead/Lag	Korea		Taiwan	
(– denotes lag)	Deflator	CPI	Deflator	CPI
	Inflation and Detrended Output (Linear Trend)			
4	0.06 (0.10)	−0.11 (0.10)	0.16 (0.09)	0.07 (0.09)
3	0.10 (0.10)	−0.09 (0.10)	0.22 (0.09)	0.12 (0.09)
2	0.13 (0.10)	−0.02 (0.10)	0.31 (0.09)	0.20 (0.09)
1	0.19 (0.10)	0.08 (0.10)	0.40 (0.09)	0.27 (0.09)
0	0.19 (0.10)	0.16 (0.10)	0.46 (0.09)	0.36 (0.09)
−1	0.31 (0.10)	0.26 (0.10)	0.49 (0.09)	0.42 (0.09)
−2	0.34 (0.10)	0.30 (0.10)	0.47 (0.09)	0.43 (0.09)
−3	0.35 (0.10)	0.40 (0.10)	0.43 (0.09)	0.42 (0.09)
−4	0.34 (0.10)	0.47 (0.10)	0.40 (0.09)	0.42 (0.09)
	Inflation and Detrended Output (Segmented Trend)			
4	−0.00 (0.10)	−0.09 (0.10)	−0.20 (0.09)	−0.30 (0.09)
3	−0.03 (0.10)	−0.08 (0.10)	−0.09 (0.09)	−0.19 (0.09)
2	0.03 (0.10)	−0.00 (0.10)	0.08 (0.09)	−0.05 (0.09)
1	0.14 (0.10)	0.12 (0.10)	0.25 (0.09)	0.11 (0.09)
0	0.10 (0.10)	0.18 (0.10)	0.36 (0.09)	0.26 (0.09)
−1	0.20 (0.10)	0.31 (0.10)	0.43 (0.09)	0.38 (0.09)
−2	0.23 (0.10)	0.33 (0.10)	0.44 (0.09)	0.41 (0.09)
−3	0.20 (0.10)	0.33 (0.10)	0.39 (0.09)	0.41 (0.09)
−4	0.14 (0.10)	0.36 (0.10)	0.35 (0.09)	0.41 (0.09)
	Inflation and Detrended Output (HP Filter)			
4	−0.08 (0.10)	−0.25 (0.10)	−0.26 (0.09)	−0.37 (0.09)
3	−0.06 (0.10)	−0.27 (0.10)	−0.15 (0.09)	−0.26 (0.09)
2	−0.04 (0.10)	−0.20 (0.10)	0.06 (0.09)	−0.09 (0.09)
1	0.04 (0.10)	−0.08 (0.10)	0.25 (0.09)	0.09 (0.09)
0	−0.01 (0.10)	0.03 (0.10)	0.37 (0.09)	0.27 (0.09)
−1	0.18 (0.10)	0.14 (0.10)	0.45 (0.09)	0.40 (0.09)
−2	0.21 (0.10)	0.18 (0.10)	0.45 (0.09)	0.42 (0.09)
−3	0.21 (0.10)	0.31 (0.10)	0.37 (0.09)	0.41 (0.09)
−4	0.17 (0.10)	0.41 (0.10)	0.32 (0.09)	0.41 (0.09)
	Inflation and Detrended Output (PAT)			
4	−0.04 (0.10)	−0.25 (0.10)	−0.16 (0.09)	−0.29 (0.09)
3	−0.01 (0.10)	−0.25 (0.10)	−0.05 (0.09)	−0.18 (0.09)
2	0.01 (0.10)	−0.17 (0.10)	0.14 (0.09)	−0.02 (0.09)
1	0.10 (0.10)	−0.05 (0.10)	0.33 (0.09)	0.16 (0.09)
0	0.06 (0.10)	0.06 (0.10)	0.45 (0.09)	0.32 (0.09)
−1	0.24 (0.10)	0.17 (0.10)	0.53 (0.09)	0.46 (0.09)
−2	0.27 (0.10)	0.20 (0.10)	0.52 (0.09)	0.47 (0.09)
−3	0.26 (0.10)	0.32 (0.10)	0.45 (0.09)	0.46 (0.09)
−4	0.23 (0.10)	0.42 (0.10)	0.40 (0.09)	0.46 (0.09)

Note: Standard errors are provided in parentheses.

[5] The test for statistical significance is based on the Wald test described in Ostle (1963), pages 225-227. The Wald statistic is distributed as a Chi-square with one degree of freedom. The value for a ten percent critical region is 2.71.

Table 5

Cross Correlations of Prices and Output: Pre- and Post- Break

Lead/Lag (– means lag)	Korea						Taiwan					
	Deflator			CPI			Deflator			CPI		
	Full Sample	Pre-Break	Post-Break	Full Sample	Pre-Break	Post-Break	Full Sample	Pre-Break	Post-Break	Full Sample	Pre-Break	Post-Break
Detrended Prices and Output (HP Filter for Both)												
4	−0.29	−0.18	−0.36	−0.26	−0.23	−0.19	−0.68	−0.73	−0.49	−0.59	−0.57	−0.60
3	−0.32	−0.12	−0.44	−0.39	−0.33	−0.33	−0.76	−0.85	−0.48	−0.73	−0.77	−0.59
2	−0.39	−0.21	−0.50	−0.51	−0.47	−0.45	−0.74	−0.83	−0.48	−0.79	−0.86	−0.58
1	−0.40	−0.25	−0.49	−0.57	−0.56	−0.52	−0.63	−0.70	−0.44	−0.75	−0.83	−0.54
0	−0.47	−0.37	−0.55	−0.58	−0.55	−0.59	−0.47	−0.50	−0.38	−0.63	−0.69	−0.49
−1	−0.37	−0.25	−0.45	−0.54	−0.43	−0.54	−0.27	−0.26	−0.30	−0.45	−0.46	−0.41
−2	−0.26	−0.11	−0.38	−0.48	−0.30	−0.46	−0.08	−0.05	−0.21	−0.26	−0.26	−0.31
−3	−0.15	0.04	−0.30	−0.37	−0.17	−0.40	−0.07	0.13	−0.14	−0.09	−0.06	−0.19
−4	−0.07	0.05	−0.22	−0.21	−0.05	−0.30	0.20	0.27	−0.06	0.09	0.13	−0.07
Detrended Prices and Output (PAT for Both)												
4	−0.14	−0.10	−0.26	−0.17	−0.23	−0.08	−0.55	−0.74	−0.34	−0.51	−0.55	−0.51
3	−0.13	−0.01	−0.32	−0.25	−0.28	−0.17	−0.61	−0.86	−0.30	−0.62	−0.72	−0.49
2	−0.18	−0.09	−0.35	−0.33	−0.41	0.24	−0.58	−0.85	−0.26	−0.68	−0.81	−0.46
1	−0.18	−0.13	−0.33	−0.36	−0.47	−0.28	−0.49	−0.72	−0.21	−0.65	−0.80	−0.39
0	−0.23	−0.25	−0.33	−0.38	−0.47	−0.32	−0.35	−0.53	−0.14	−0.55	−0.69	−0.32
−1	−0.17	−0.15	−0.28	−0.35	−0.34	−0.32	0.17	−0.30	−0.05	−0.39	−0.50	−0.21
−2	−0.10	−0.03	−0.23	−0.31	−0.22	−0.29	0	−0.08	0.04	−0.23	−0.32	−0.09
−3	−0.03	0.09	−0.19	−0.24	−0.10	−0.28	0.14	0.09	0.14	−0.07	−0.15	0.05
−4	0.01	0.10	−0.17	−0.14	0.03	−0.26	0.26	0.22	0.24	0.08	0.01	0.19
Inflation and Detrended Output (HP Filter)												
4	−0.08	−0.15	−0.33	−0.25	−0.21	−0.51	−0.26	−0.44	0.15	−0.37	−0.54	0.10
3	−0.06	−0.01	−0.42	−0.27	−0.20	−0.59	−0.15	−0.28	0.18	−0.26	−0.39	0.17
2	−0.04	−0.08	−0.32	−0.20	−0.21	−0.44	0.06	0.02	0.20	−0.09	−0.19	0.23
1	0.04	−0.07	−0.14	−0.08	−0.11	−0.29	0.25	0.26	0.29	0.09	0.03	0.33
0	−0.01	−0.12	−0.16	0.03	0.10	−0.21	0.37	0.40	0.35	0.27	0.25	0.36
−1	0.18	0.09	0.03	0.14	0.21	−0.04	0.45	0.50	0.38	0.40	0.42	0.41
−2	0.21	0.10	0.01	0.18	0.17	0.04	0.45	0.47	0.41	0.42	0.41	0.48
−3	0.21	0.13	0.06	0.31	0.20	0.04	0.37	0.39	0.39	0.41	0.40	0.52
−4	0.17	−0.06	0.09	0.41	0.21	0.15	0.32	0.32	0.40	0.41	0.38	0.54
Inflation and Detrended Output (PAT)												
4	−0.04	−0.16	0.32	−0.25	−0.23	−0.51	−0.16	−0.40	0.28	−0.29	−0.50	0.22
3	−0.02	−0.02	−0.40	−0.25	−0.22	−0.58	−0.05	−0.24	0.32	−0.18	−0.36	0.30
2	0.01	−0.09	−0.31	−0.17	−0.22	−0.45	0.14	0.06	0.36	−0.02	−0.16	0.37
1	0.10	−0.05	−0.14	−0.05	−0.09	−0.30	0.33	0.31	0.45	0.16	0.07	0.47
0	0.06	−0.09	−0.17	0.06	0.13	−0.24	0.45	0.45	0.51	0.32	0.29	0.50
−1	0.24	0.14	0	0.17	0.25	−0.08	0.53	0.56	0.56	0.46	0.46	0.56
−2	0.27	0.15	−0.02	0.20	0.21	−0.02	0.52	0.52	0.59	0.47	0.45	0.61
−3	0.26	0.18	0.02	0.32	0.25	0	0.45	0.43	0.56	0.46	0.44	0.64
−4	0.23	−0.03	0.05	0.42	0.26	0.10	0.40	0.37	0.55	0.46	0.42	0.64

Note: Shaded cells indicate instances in which the difference is significant at the 10% level.

The differences between the correlations across the assigned break point that are significant at a 10 percent level are shaded in Table 5.[5] In the case of Taiwan, 33 of 72 reported correlations are significantly different. This result is consistent with the findings of Backus and Kehoe (1992), who report that the output-price correlations vary across countries and time periods. It is also consistent with Gavin and Kydland (1995), who find a significant break in the covariance structure of output and prices for the United States, which they attribute to a policy change in 1979. In the case of Korea, only five of the seventy-two differences are significant at the 10 percent level. The lower rejection rate for Korea is associated with both fewer large differences and the smaller sample size used to construct the test statistics.

CONCLUSION

The main finding of this paper is that, in Korea and Taiwan, the detrended price level is negatively correlated with cyclical output, while inflation is positively correlated with the cyclical component of output. The results generally hold, whether price is measured by the deflator or by the consumer price index, for a number of filtering procedures and for subsamples before and after the estimated dates of structural breaks in output. This result confirms the findings of Chadha and Prasad (1994) in G-7 countries, that the price level is countercyclical, while inflation is procyclical.

The results do not seem to suggest any decisive conclusions regarding the appropriate model for the business cycle. While the countercyclical behavior of the price level is consistent with the predictions the supply-determined models of the business cycle, the procyclical behavior of the inflation rate is consistent with the predictions of conventional demand-determined models of the business cycle. This finding is consistent with the recent contradictory findings concerning the sources of economic fluctuations in Korea; Yoo (1992) finds that supply shocks are a dominant factor in output fluctuations, while Jun (1992) finds that aggregate demand shocks are important. These two researchers both used a slightly different structural VAR model of the Blanchard and Quah (1989) type.

Further research is needed to reconcile these contradictory findings. For instance, in cases where covariance structure is stationary, it may be useful to apply a coherence measure in spectral analysis, which represents the proportion of the variance of either series that can be explained by the other, frequency by frequency. In cases where the correlation structure between output and prices has changed, it is important to use theories for a better understanding of why the changes have occurred.

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