# Economic Review

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## Federal Reserve Bank of Atlanta

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## Federal Reserve Bank of Atlanta



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# Facing Up to Our Ignorance about Measuring Monetary Policy Effects

Eric M. Leeper

Macroeconomists have a reputation for disagreeing about almost everything. Deserved or not, that reputation encourages decisionmakers to view economists' advice and predictions with skepticism. The disagreements among economists stem in large part from differences of opinion about the economic behavior underlying observed data, differences that can be resolved only through economic research explicitly demonstrating the linkage of movements in economic variables with the actions of specific players in the economy. Such efforts to build a consensus make economists' predictions more credible and thus more useful to decisionmakers.

One important phenomenon on which there is widespread agreement, however, is that an increase in the money supply lowers the interest rate in the short run. This "liquidity effect" plays a central role in popular, political, and academic discussions of monetary policy. Casual discussions that equate "high" interest rates with "tight" monetary policy implicitly assume that the liquidity effect exists.[1]

The liquidity effect is important because it is the channel through which monetary policy affects the economic conditions that policymakers want to influence. Although the Federal Reserve ultimately wants to influence such things as output and inflation, it cannot control these variables directly. However, over time horizons that are relevant for policy, the Fed can directly control a monetary measure that appears on its balance sheet. At the same time, there is strong evidence that interest rates are correlated with future movements in output and prices. The liquidity effect, therefore, is the nexus between what the Fed can influence directly and what the Fed ultimately seeks to influence. The goal of current empirical research on the liquidity effect is to establish stable relationships between a monetary measure

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and interest rates and between interest rates and other variables in the hopes of finding stable relationships between a controllable variable and the variables that monetary policymakers want to influence. Understanding the relationship between money growth and the interest rate is important for practical policymaking.

The economic profession's consensus that the liquidity effect exists can be seen in the many theoretical analyses that build in the liquidity effect as the first step in the process for transmitting monetary policy effects to the rest of the economy. The liquidity effect is a critical element in traditional Keynesian models (based on James Tobin's 1947 work) and in the monetarist approaches of Milton Friedman (1968) and Phillip Cagan (1972). Recent neoclassical models (for example, Robert E. Lucas, Jr. 1990 and Timothy S. Fuerst 1992) have included the liquidity effect to remedy the apparent deficiency of earlier neoclassical models in which monetary expansions tend, if anything, to raise the nominal interest rate.[2]

Although most economists believe that the liquidity effect exists, the profession is far from a consensus on a way to measure the effects of monetary policy on the interest rate. The disagreements arise mostly because empirical work on the liquidity effect has traditionally made incredible assumptions about both private and policy behavior. Without first specifying plausible behavior, it is impossible to make credible predictions of the effects of policy.

This article reinterprets the traditional empirical work and explores various ways to quantify the liquidity effect by presenting a largely atheoretical characterization of the relationship between the federal funds rate (a short-term interest rate) and the monetary base (currency in circulation plus bank reserves) over the 1954-91 period.[3] For much of this period, the Fed targeted the federal funds rate by conducting open market purchases and sales of U.S. Treasury securities. These open market operations affected the amount of reserves the Fed provided to the banking system, thereby affecting the monetary base. Thus, although the Fed has never targeted the monetary base per se, it achieves its targeted level of the federal funds rate through open market operations that necessarily influence the base.

The article also considers whether the relationship between the funds rate and the monetary base is stable over four subperiods that are commonly viewed as reflecting different policy environments. The research replicates the pattern of correlations traditionally interpreted as evidence of the liquidity effect and shows that this pattern is sensitive to which variables are held fixed when the correlations are calculated. For example, when lagged interest rates, consumer prices, and industrial production are held fixed, as the traditional theory of the liquidity effect suggests they should be, all evidence of the liquidity effect disappears: the correlation between unexpected changes in money growth and the interest rate is zero or positive.[4] In addition, the study finds that the relationships between the funds rate and the monetary base are unstable, changing sign and size across the four subperiods considered.

These results lead to one of two possible conclusions: either the widespread belief in the existence of the liquidity effect is incorrect, or the observed short-run correlations between money growth and the interest rate do not primarily reflect the liquidity effect. The latter conclusion seems more likely. The traditional theoretical analysis of the liquidity effect is based entirely on demand-side behavior. Using the traditional analysis to interpret correlations requires assuming that the data are dominated by money demanders' responses to changes in monetary policy. It is more likely, however, that the correlations arise in large part from the responses of monetary policy to changes in economic conditions. The findings reported here underscore the need to separate money-supply and money-demand behavior carefully when estimating and interpreting the effects of monetary policy on the interest rate.

In addition to discussing the traditional theoretical analysis of the liquidity effect and the money growth/interest rate correlations that the analysis implies, this article examines ways the analysis is used to interpret data. The article defines what it means to "identify" economic behavior and uses the example of the liquidity effect to show how failure to identify an economic model can lead to misleading interpretations of the data. This discussion leads to a simple way to think about how to use data to isolate the monetary policy shocks that generate the liquidity effect. Finally, there is a description of the data set used to characterize the liquidity effect and a report on the empirical results.

By raising questions about the nature of the relationship between money growth and the interest rate, this article argues that the economics profession is woefully ignorant about how to measure this most immediate and fundamental effect of monetary policy. Without thoroughly understanding the liquidity effect, the profession cannot claim to understand precisely the effects of monetary policy on inflation, output, or other economic variables.

## The Traditional Analysis of the Liquidity Effect

The traditional theoretical analysis of the liquidity effect, as presented in Friedman (1968) or Cagan (1972), abstracts from many real-world complications to focus entirely on the behavior of money demanders. The analysis implies that an increase in the rate of growth of the money supply, holding income and prices constant in the short run, causes the nominal interest rate to fall (see the money market graph in Chart 1).

The theory assumes that the demand for real (or inflation-adjusted) money balances depends on a short-term nominal interest rate, $R$, and real income (or the level of transactions), $y$:

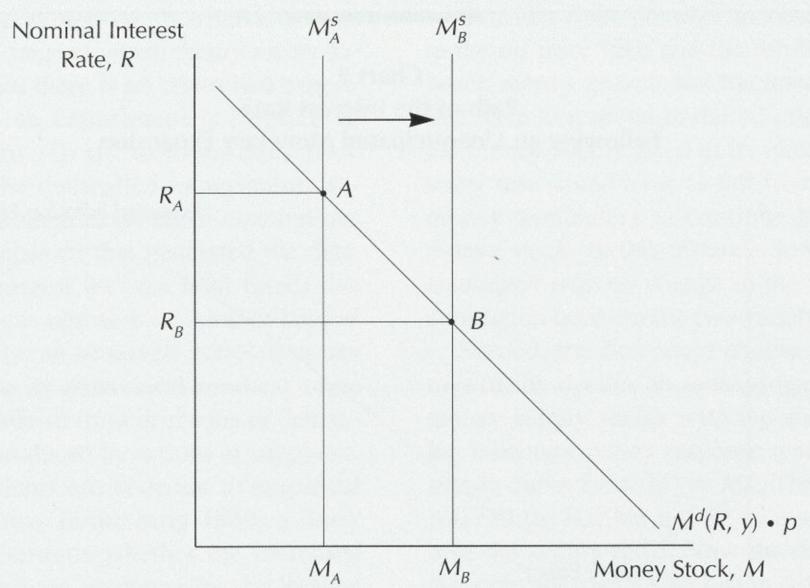
$$\frac{M_t^d}{p_t} = M^d(R_t, y_t), \qquad (1)$$

where $M^d$ is the quantity of nominal balances demanded, $p$ is the general price level, and $M^d/p$ is the demand for real balances. The subscripts denote variables measured at date $t$. The nominal interest rate represents the opportunity cost of holding money. As this opportunity cost rises, demanders will substitute out of money and into assets that earn the increasing rate of return, decreasing the quantity of money demanded. This negative interest elasticity of money demand produces the downward-sloping demand curve in Chart 1. Higher income boosts the transactions demand for money, and demanders will want to hold more money at any given interest rate, shifting the demand curve to the right.

Drawing the supply of money, $M^s$, vertically implies that the Fed does not adjust the money supply in response to changes in the interest rate. The traditional theoretical analysis typically assumes that the Fed also sets the money supply independently of the level of income and prices. These assumptions correspond to treating monetary policy as exogenous, or unrelated to prevailing economic conditions. Treating monetary policy as exogenous amounts to assuming that changes in the money supply are arbitrary and random.

Equilibrium in the money market occurs at the point where demand and supply coincide: $M^d = M^s$. In the short run, because income and prices are treated as fixed, the money market determines the equilibrium levels of the money stock and the nominal interest rate.

**Chart 1**
**The Money Market: Conceptual Experiment Underlying the Liquidity Effect**



To generate the liquidity effect, consider the following exercise: The Fed conducts an open market purchase of Treasury securities, increasing bank reserves. An open market purchase shifts the money-supply curve outward from $M_A^s$ to $M_B^s$. In the short run the nominal interest rate must fall to induce money demanders to slide down their stable demand curve from point *A* to point *B* and hold the new higher level of both nominal and real money balances. This response of demanders produces the liquidity effect.

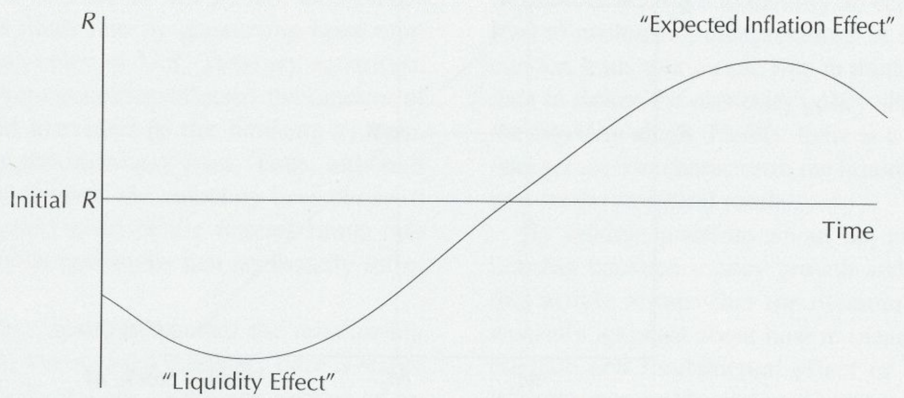
Eventually, actual (and expected) inflation will adjust to the higher growth rate of money, and bondholders will drive up the nominal interest rate to maintain the premonetary expansion real return on bonds; the long-run correlation between money growth and the nominal interest rate is positive.[5] The long-run tendency for changes in money growth to be reflected in expected inflation, and, thus, the nominal interest rate, is the "expected inflation effect." The negative interest elasticity of money demand produces the liquidity effect in the short run, but in the long run the expected inflation effect dominates the liquidity effect. Chart 2 graphs the path of the nominal interest rate that the traditional theoretical analysis predicts will follow a monetary expansion.[6]

In recent extensions of this theory, the sooner people come to expect a monetary expansion, the sooner the expected inflation effect begins to dominate the liquidity effect and the milder and briefer the decline in the interest rate will become. The modern models associated with Lucas (1990) and Fuerst (1992) employ an extreme version of this logic: only unanticipated increases in the money supply can lower interest rates. Anticipated changes in money growth immediately affect the expected inflation rate, driving up the nominal interest rate and producing only the expected inflation effect.

Many researchers have used the traditional theory of the liquidity effect to interpret data. If the analysis in Chart 1 completely described observed movements in the nominal interest rate and money growth, the two variables would be negatively correlated in the short run and positively correlated in the long run. Researchers such as Lawrence J. Christiano (1991) and Christiano and Martin Eichenbaum (1991a) explicitly interpret the short-run correlations as reflecting the liquidity effects of monetary policy that Chart 1 depicts.

Other researchers regress the interest rate against current and past monetary aggregates and interpret the regression coefficients as measures of the effects of monetary policy on interest rates (see, for example, Cagan 1966, 1972; Cagan and Arthur Gandolfi 1969; William E. Gibson 1970a, 1970b; and Michael Melvin 1983). Recent empirical work tries to isolate unanticipated changes in the money supply and traces out the response of the interest rate to unanticipated monetary expansions (see John H. Cochrane 1989; Christiano and Eichenbaum 1991b; Vefa Tarhan 1991; and Steven Strongin 1991).

**Chart 2**
**Path of the Interest Rate**
**Following an Unanticipated Monetary Expansion**



## Identifying Money-Demand and Money-Supply Behavior

Because the traditional theory of the liquidity effect holds many variables fixed, the correlations between observed money growth and interest rates frequently cannot be interpreted directly in terms of Chart 1. The theory is entirely a demand-side story that relies on the Fed's expanding the money supply for reasons that do not simultaneously shift the money-demand curve. With no explanation of why the Fed chooses its policy, the traditional analysis provides no guidance about when an observed change in the money supply corresponds to the supply shift depicted in Chart 1. When researchers apply the traditional theory directly to interpret correlations, they implicitly assume that every change in the money supply arises for reasons that do not perturb the stable money-demand curve. In practice, however, the Fed frequently changes the money supply in response to shocks that also shift money demand. When the variation in money-supply shocks is not independent of money demand, simple statistical methods cannot distinguish how much of the money growth/interest rate correlation is owing to the liquidity effect and how much of the correlation arises from the dependence of money supply and interest rates on other variables. To sort out which empirical regularities should be explained by the liquidity effect and which are products of the response of monetary policy to economic conditions, econometricians seek to identify money-demand and money-supply behavior.

Identification is the stage at which theory meets data. In applied economics there is no controlled experiment, although such an experiment is implicit in theoretical discussions. To try to make data more closely conform to the controlled experiments assumed by theory, econometricians make assumptions about the economic behavior that generated the data. These assumptions "control for" (or hold fixed) one kind of behavior to focus attention on another kind of behavior. Consequently, an observed correlation can then be separated into its behavioral sources: some movements of the data arise from decisions of demanders while others are produced by actions of suppliers.

Identification problems are endemic to empirical work in macroeconomics. In the early 1980s a flurry of work sought to determine whether the increased federal government deficits produced by the Reagan Administration's tax cuts would drive up interest rates. Most theoretical models imply an affirmative answer. Most empirical work concluded either that there was no relationship or that higher deficits are associated with lower interest rates. The perverse negative correlations arise from researchers' failure to control for the fact that deficits are countercyclical and interest rates are procyclical: during recessions government revenues automatically decline, and government expenditures automatically rise at the same time that interest rates tend to fall. If such cyclical fluctuations are the dominant source of movements in deficits and interest rates, simple statistical methods will find that the two variables are negatively correlated. Implicitly the empirical work equates all observed changes in deficits with the conceptual experiment performed in theoretical models of fiscal policy. The researchers have not plausibly identified the theoretical experiment in the data, making the predictions about the interest rate effects of tax cuts unbelievable.

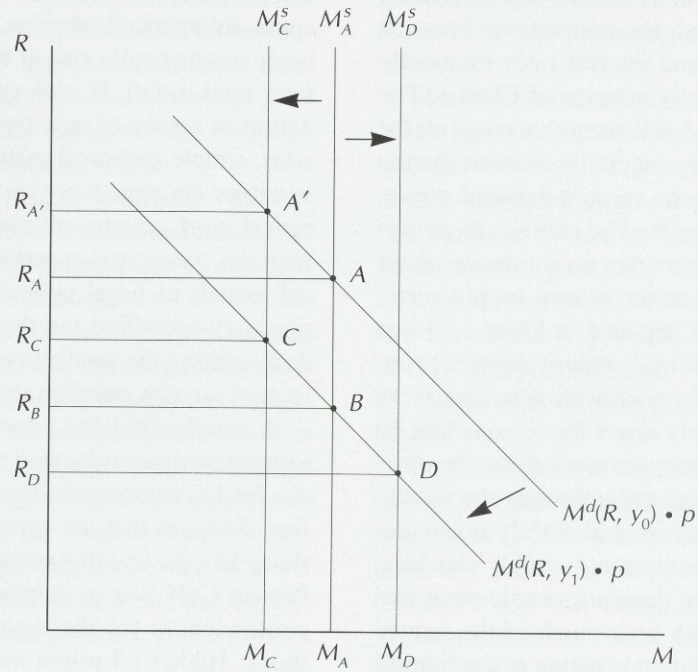
A simple extended example illustrates how failing to separate money-demand and money-supply behavior can lead to mistaken inferences about the liquidity effect. Suppose that the economy is hit by an oil price shock like the one that occurred at the beginning of the Persian Gulf War in August 1990. Chart 3 shows the consequences for the money market of an oil price shock. Higher oil prices increase the relative price of energy, which is an input for producing a wide range of goods and services. Producers respond to the higher oil price by cutting back on employment and output. Income falls from $y_0$ to $y_1$, decreasing money demand and shifting the money-demand curve from $M^d(R, y_0) \cdot p$ to $M^d(R, y_1) \cdot p$.

Consider three possible monetary policy responses to the oil price hike and the resulting correlations between money growth and the interest rate. First, if the Fed were to respond to the oil price shock by keeping the money supply fixed at its initial level, $M^s_A$, the interest rate would have to fall from $R_A$ to $R_B$ to induce money demanders to continue holding the existing money stock. In this instance, lower interest rates are associated with no change in the money stock, so the correlation between the two variables is zero.

Second, the Fed could choose partial accommodation of the decline in money demand by making the money supply shrink with income. An accommodating monetary policy response would shift the money-supply curve from $M^s_A$ to $M^s_C$. The interest rate would still fall (to $R_C$) but not by as much as if the Fed had held the supply fixed. Now the decline in the interest rate coincides with a decline in the money growth rate, so the correlation is positive.

Third, if the Fed were concerned with trying to offset the deleterious employment and output effects of

## Chart 3
## Possible Monetary Policy Responses to an Oil Price Increase




The oil price increase reduces income from $y_0$ to $y_1$, shifting money demand from $M^d(R, y_0) \bullet p$ to $M^d(R, y_1) \bullet p$. The variable $M_A^s$ is the initial money supply, $M_C^s$ is the money supply when the Fed partially accommodates the decline in money demand, and $M_D^s$ is the money supply when the Fed tries to offset the decline in the income by expanding the money stock.

the oil price shock, it could instead expand the money supply to $M_D^s$, driving the interest rate still lower to $R_D$. This policy response produces a negative correlation between money growth and the interest rate.

The example illustrates that, although assumptions about private behavior remain the same in the three policy scenarios (namely, that the interest elasticity of money demand is negative), the resulting correlation between money growth and the interest rate varies with assumptions about policy behavior. The reason for the result is straightforward: neither the increase nor the decrease in the money supply in the last two cases corresponds to the conceptual experiment underlying the liquidity effect in Chart 1. To deduce that the different correlations arise from different policy behavior, it is necessary to dispense with simple correlations and control the experiment by making specific assumptions about how the Fed responds to oil price shocks.

The simple correlations experience an identity crisis because the correlations cannot help decompose the ultimate decline in the interest rate into the amount based on demanders' behavior and that resulting from the supplier's behavior. Suppose that instead of relying on simple correlations, a model that fully identified the behavior underlying Chart 3 were constructed—that is, estimates of how money demand depends on the interest rate and income and how money supply depends on income were available. Then the movement from the equilibrium at point $A$ to the equilibrium at point $C$, which arose when the Fed partially accommodated the decline in money demand, could be decomposed into two parts: (1) the increase in the interest rate caused by moving from $A$ to $A'$ up the initial demand curve (the demand response to a shift in supply) and (2) the decrease in the interest rate based on moving from $A'$ to $C$ on the new lower demand curve (the interest rate response to a decline in income). The liquidity effect can then accurately be identified as the negative correlation produced by demanders moving along their initial demand curve from $A$ to $A'$ as the money supply contracts.

## Specifying Policy to Recover the Liquidity Effect

To recover the liquidity effect of monetary policy, it is not necessary to identify money-demand and money-supply behavior completely, as in the example. If disturbances that shift the $M^s$ curve but do not shift the $M^d$ curve can be isolated—that is, if the monetary policy shock is identified—it is possible to calculate the resulting change in the interest rate and attribute the full change in the interest rate to demanders sliding along a fixed demand curve. This approach has been taken by many researchers recently (see, for example, Christopher A. Sims 1986, 1988; Christiano and Eichenbaum 1991b; Strongin 1991; and Tarhan 1991).

Surprisingly, monetary theorists traditionally have modeled monetary policy behavior as an arbitrary, random process. This assumption is made implicitly in empirical work by Cagan (1972), Cagan and Gandolfi (1969), Gibson (1970a, 1970b), and Melvin (1983), to name a few, and explicitly by Cochrane (1989), Christiano (1991), Christiano and Eichenbaum (1991a), and Robert G. King (1991). In effect, these researchers treat today's value of the money growth rate as the outcome of the spin of a roulette wheel.[7]

Any serious specification of monetary policy must recognize that the Fed behaves purposefully. The Fed tries to fulfill its congressional mandate to stabilize the economy by making adjustments to the growth rate of money based on a vast array of information. To the extent that the congressional mandate does not change and the economic environment evolves only gradually, the Fed's purposeful behavior will have a large systematic component.[8]

Even if the Fed behaves purposefully and systematically, there will remain some aspect of policy choices that cannot be predicted by private decisionmakers in the economy.[9] The unpredictable part of policy choice could arise from the fact that private agents are uncertain about the weights that members of the Federal Open Market Committee will place on various monetary policy objectives when they vote on policy decisions.[10] The implication is that the Fed's choice of the money supply can be modeled as depending on information the Fed knows at the time of the decision plus a random error, which is revealed to private decisionmakers only at the time the policy choice is made.

$$M_t^s = M^s(Z_t) + \epsilon_t. \qquad (2)$$

The variable $Z_t$, which summarizes the information available when the Fed chooses the money supply at time $t$, may include such things as the unemployment rate, income, prices, interest rates, exchange rates, commodity prices, past monetary aggregates, and so on.[11] $M^s(\bullet)$ is a function that translates the information into a systematic policy choice, and $\epsilon_t$ is the aspect of policy choice that appears to be random from the perspective of private agents. The policy shock $\epsilon$ cannot be predicted from past information, implying that, given information available today, the private sector's best guess of $\epsilon$ tomorrow is zero.

The specification of policy behavior in equation (2) can be coupled with the money-demand behavior in equation (1) to produce a new graph analogous to Chart 1, except that the money-supply curve is no longer vertical. For example, if the Fed increases the money supply in response to increases in the interest rate, the supply curve will be positively sloped. In addition, fluctuations in prices and income, which shift the money-demand curve, may also shift the money-supply curve if these variables are part of the information to which the Fed responds systematically—the $Z_t$. By assumption, however, disturbances to $\epsilon_t$ are shocks that shift the supply curve for money but do not shift the demand curve. Moreover, because the value of $\epsilon$ is unpredictable one period ahead, disturbances to $\epsilon$ reflect unanticipated shifts in the money-supply curve. If an econometrician can extract a time series of $\epsilon$'s from the data, she can conduct the controlled experiment in Chart 1 by perturbing $\epsilon$ and tracing out the resulting path of the interest rate. All empirical work on the liquidity effect requires making some assumption about how to extract the time series of $\epsilon$'s from the data.[12]

## Data Considerations

The empirical part of this study evaluates the traditional interpretation of money growth/interest rate correlations as primarily reflecting the liquidity effect. The work concentrates on relationships between the monthly series for the monetary base and the federal funds rate. The monetary base is chosen for two reasons. First, as the sum of two liabilities on the Fed's balance sheet, the monetary base is closely associated with the open market operations that underlie the liquidity effect. Second, the monetary base is a variable over which the Fed can exert control, although the Fed has chosen to passively supply some components of the base, such as currency.[13]

In addition to its being the Fed's target variable during much of the 1954-91 period, there are two virtues to using the federal funds rate. First, the funds rate is extremely short term, a characteristic that helps separate liquidity effects from expected inflation effects without imposing a theory of the term structure and expected inflation. Second, for data at a monthly frequency interest rates with maturity structures longer than one month would need to be converted to one-month holding period returns (as, for example, Frederic S. Mishkin 1983 does).

Mimicking the theoretical liquidity experiment in Chart 1 requires monthly data on the price level and income. The consumer price index is used for the price level, and industrial production is used for income. As a gauge of manufacturing output, industrial production clearly is not an ideal monthly measure of income, but its use allows these results to be compared with those from other empirical studies, which use industrial production as a proxy for income.

Some previous work found that the correlations between money growth and the interest rate change over time. To investigate this possibility, the post–Korean War period is subdivided into four nonoverlapping periods that reflect different policy environments: 1954:7 to 1972:12, 1973:1 to 1979:9, 1979:10 to 1982:11, and 1982:12 to 1991:11. The relationships are also estimated over the full 1954:7 to 1991:11 period. Several considerations guided the choice of subperiods. Marvin Goodfriend (1991) lists the 1950s, 1960s, and the period since 1982 as times when the Fed indirectly targeted the funds rate, suggesting from 1954 to 1972 and from 1982 to 1991 as subperiods. Melvin (1983) writes of the "vanishing liquidity effect" after 1972, when the United States moved to a flexible exchange rate system. The early 1970s also saw the Fed gradually shift to targeting the funds rate tightly (see Timothy Cook and Thomas Hahn 1989 and Goodfriend 1991), leading to the choice of the 1973 to 1979 period. Finally, Cochrane (1989) shows the liquidity effect returns during the October 1979 to November 1982 period when the Fed targeted nonborrowed reserves.

## Estimation and Empirical Results

The data set and estimation techniques used in this research can replicate the results from traditional regression analyses that have been interpreted as evidence of the liquidity effect. In particular, an unanticipated monetary expansion is followed by the path of interest rates depicted in Chart 2. The traditional regressions, however, impose strong and unrealistic restrictions on the relationship between money growth and the interest rate. When these restrictions are relaxed, all evidence of the liquidity effect disappears.

**Traditional Regressions with Exogenous Money Growth.** The traditional empirical approach to measuring the liquidity effect, associated with Cagan and Gandolfi (1969) and others, estimates a relationship between the interest rate and current and past money growth rates:[14]

$$r_t = \alpha + \beta_0 \rho_t + \beta_1 \rho_{t-1} + \ldots + \beta_n \rho_{t-n} + \eta_t \qquad (3)$$
$$= \alpha + \sum_{j=0}^{n} \beta_j \rho_{t-j} + \eta_t,$$

where $r$ is the level of the federal funds rate, $\rho$ is the growth rate of the monetary base, and $\eta$ is a regression error term.[15] Each of the $\beta$ coefficients is an estimate of the correlation between the federal funds rate and money growth at some date. For example, $\beta_0$ reports the correlation between the funds rate this month and money growth this month, after controlling for the influence of past money growth rates on this month's funds rate; $\beta_1$ is the correlation between the funds rate this month and money growth last month, holding fixed the influence of current and more distant lags of money growth. Leeper and Gordon (1992) report estimates of the $\beta$ coefficients from this regression that closely resemble those found by earlier researchers.

Recent monetary theories emphasize that unanticipated changes in money growth produce the liquidity effect while anticipated changes in money growth produce only the expected inflation effect. To give the traditional work a modern twist it is necessary to construct a time series of unanticipated changes in money growth. In the spirit of the interpretations that Cagan and others give to their traditional regression results, this study initially maintains the assumption that money growth is exogenous so that an unanticipated change in money is the change that cannot be predicted using past money growth rates.[16] Thus, appended to equation (3) is a description of how money growth evolves over time:

$$\rho_t = \delta_0 + \sum_{i=1}^{n} \delta_i \rho_{t-i} + \epsilon_t. \qquad (4)$$

This equation assumes that the Fed's systematic choice of money growth today depends only on past money growth rates. Much of the existing empirical work on the liquidity effect implicitly treats this specification of money growth as a description of monetary policy behavior, so the $Z_t$ variable in equation

(2) includes only money growth rates for dates $t-1$ and earlier. The variable $\epsilon_t$, which is the part of policy choice that the private sector cannot predict from past information, is called an "innovation" to current money growth. To mimic the conceptual experiment in Chart 1, this empirical work interprets perturbations in $\epsilon_t$ as shifts in the money-supply curve and uses equation (4) to produce a time path for money growth. The path for money growth is fed into equation (3) to produce a predicted path of the interest rate.

Chart 4 reports the path of the federal funds rate implied by estimating the econometric model in equations (3) and (4) during each of the sample periods. The path shows how the interest rate moves for thirty-six months following a one-time unanticipated change in the growth rate of the monetary base of one percentage point. When both dashed lines lie above (or below) the zero axis, the interest rate is significantly higher (or lower) than its value before the money growth innovation.

In Chart 4 monetary base innovations have a negative contemporaneous correlation with the funds rate for all periods except the one from 1973 to 1979. The path of the interest rate during the 1954-72 period closely matches Friedman's (1968) traditional description of the effects of a monetary expansion, shown in Chart 2. The average response shows that the funds rate declines at impact and stays below its initial level for nine months; three years after the innovation in the money growth rate, the funds rate is significantly above its initial level.

Melvin's "vanishing liquidity effect" is the difference in the funds rate paths between the 1954-72 and 1973-79 periods. In the latter period, the funds rate response to a monetary base innovation is zero or positive over the full thirty-six-month horizon. Melvin attributes this response to enhanced inflation sensitivity that led the expected inflation effect of a monetary expansion to dominate the liquidity effect. As Cochrane found, the funds rate response is sharply negative during the 1979-82 period, when an innovation in the base is associated with a forty-basis-point decline in the funds rate at impact. The interest rate is persistently lower in the 1982-91 period.

Chart 4 also underscores how misleading it may be to estimate relationships over the full postwar sample. Although the interest rate path for the 1954-91 period is close to that described by Friedman, the path is an average of very disparate patterns of responses over the four subperiods.

**Vector Autoregression with Exogenous Money Growth.** The estimation procedures underlying Chart 4 impose very strong assumptions about how the interest rate and money growth rates are related. By relating the interest rate only to current and past money growth rates, equation (3) assumes that if other variables help determine the interest rate, the other variables do so only through their influence on the money supply. Equation (4) assumes that only past growth rates of the money supply help to predict the current growth rate. More generally, equations (3) and (4) assume that no other variables induce interest rates and money growth to move together to generate the correlations estimated in traditional regressions.[17]

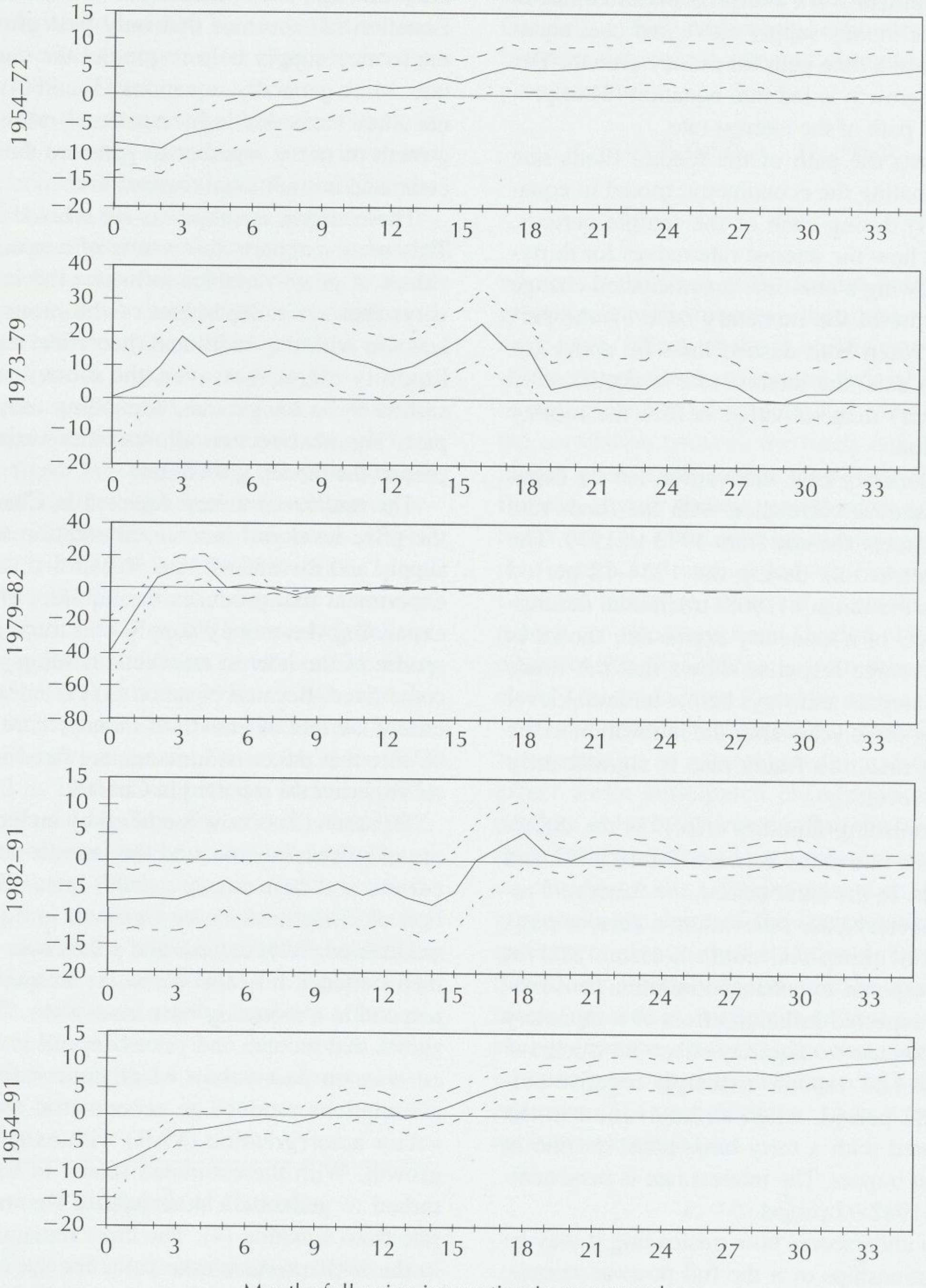
These strong assumptions are relaxed in two steps. This section reports the results of assuming that past values of other variables influence the interest rate in ways that are independent of the money supply. In keeping with the traditional theoretical analysis of the liquidity effect, however, the money supply is assumed to be exogenous, depending only on its own past. The next section allows other variables to help predict the money growth rate.

The traditional theory depicted in Chart 1 involves the price level and income, in addition to the money supply and the interest rate. Recall that the conceptual experiment that produces the liquidity effect requires expanding the money supply and tracing out the response of the interest rate while holding prices and income fixed. Because equation (3) excludes all variables except the rate of growth of money, there is no way to be sure that prices and income are fixed in the empirical experiments reported in Chart 4.

Equation (3) is now modified by including past values of prices, income, and the interest rate along with current and past money growth rates. The specification of exogenous money growth in equation (4) is maintained. With income and prices now in the econometric model, it is also necessary to specify how they respond to a monetary base innovation. The model assumes that income and prices depend in an unrestricted way on past values of all four variables. These assumptions produce an econometric model called a vector autoregression (VAR) with exogenous money growth. With the estimated model in hand $\epsilon_t$ is perturbed to generate a time path of the money growth rate from equation (4). The three remaining equations in the VAR produce time paths for the funds rate, income, and prices, using the generated path of money growth as an input to the equations.

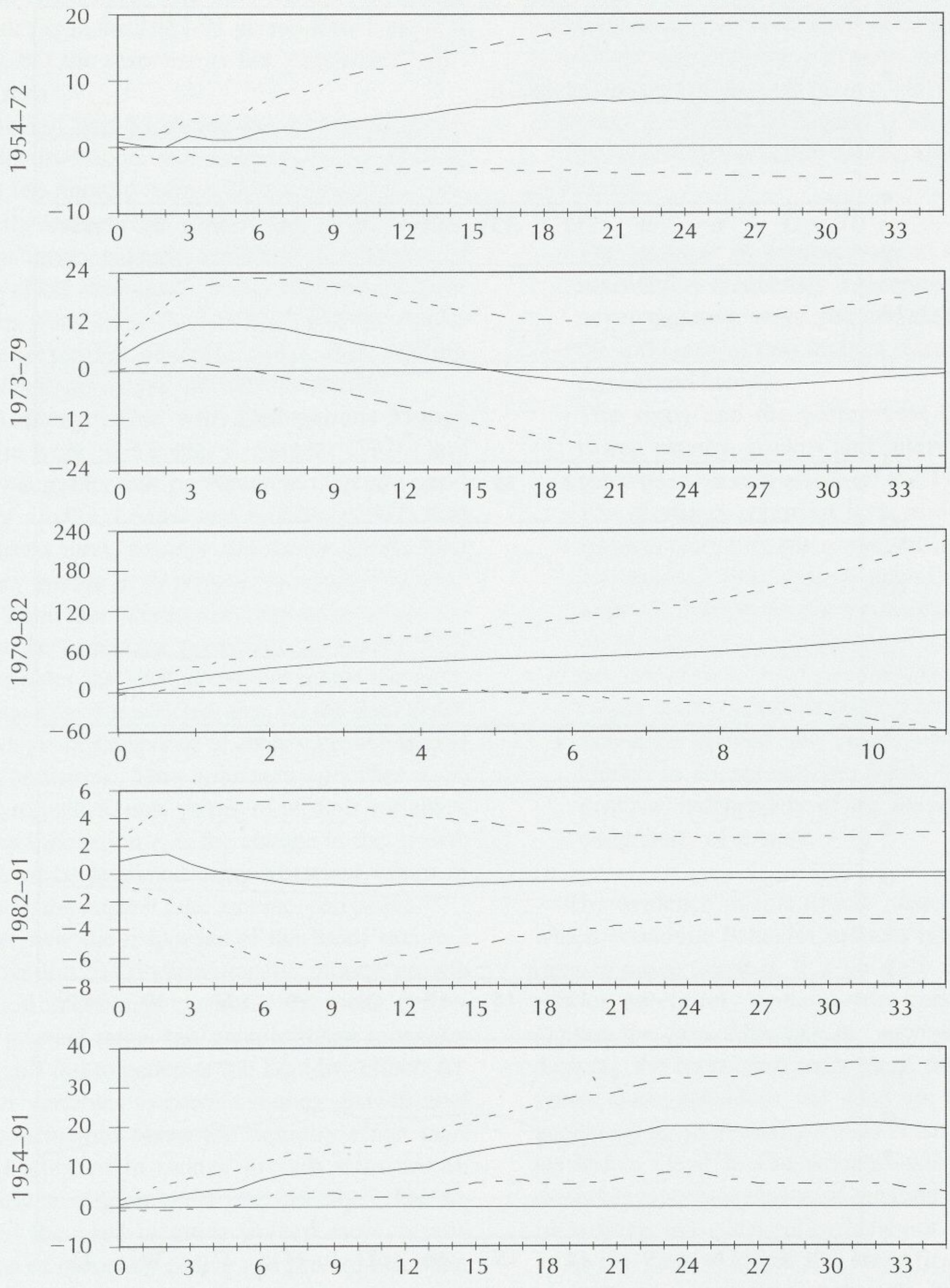
Chart 5 reports the responses of the funds rate to a 1 percent money growth innovation.[18] The contemporaneous correlation between unanticipated monetary growth and the funds rate is never negative and is

## Chart 4
### The Response of the Federal Funds Rate to a 1 Percent Monetary Base Innovation: Traditional Regressions with Exogenous Money Growth



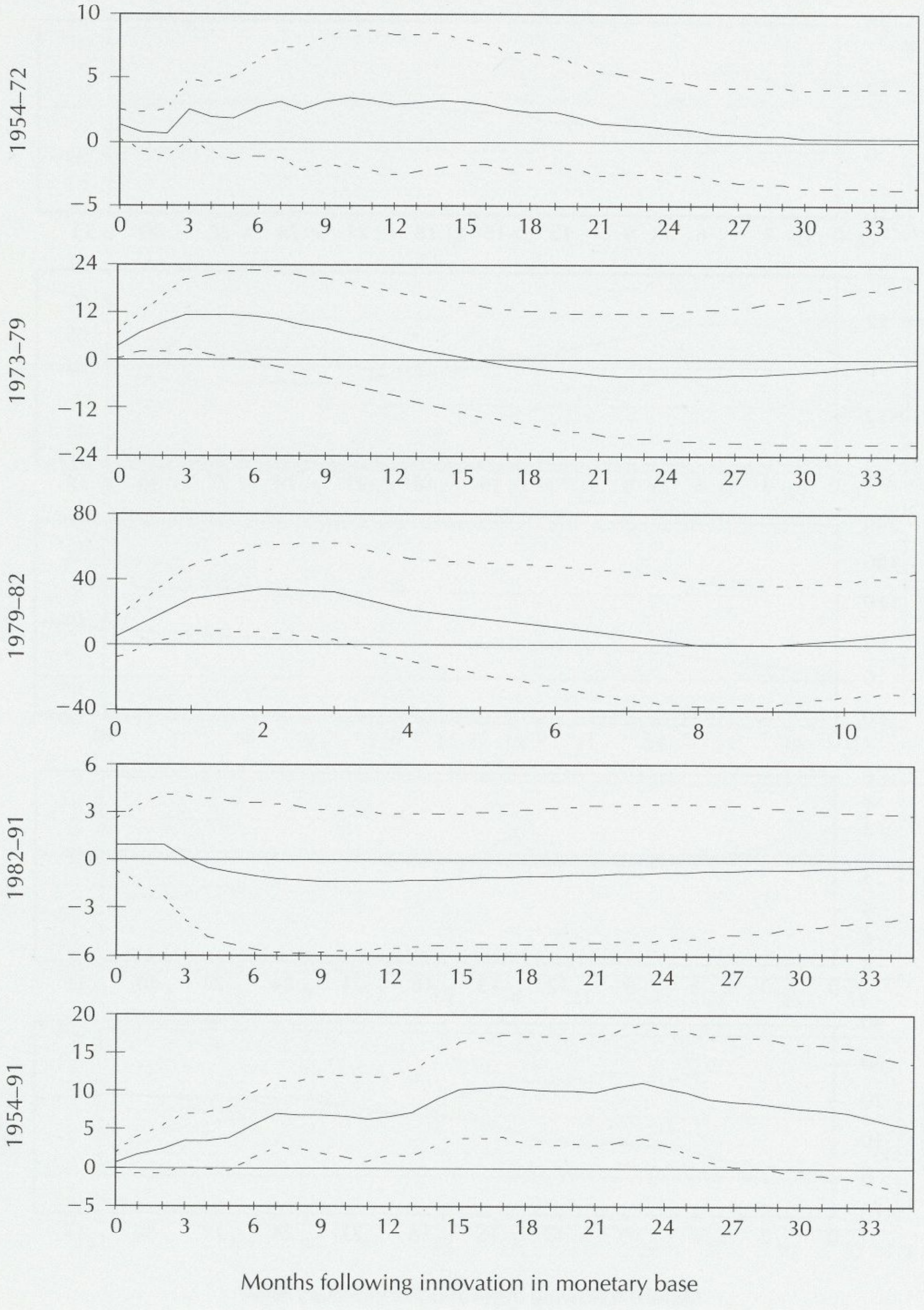

The funds rate is measured in basis points. The solid line is the point estimate, and the dashed lines are significance bands (generated using the Bayesian Monte Carlo integration procedure described in Doan 1990). The interest rate regressions were estimated with the following lag lengths: 1954-72 (thirty-six lags), 1973-79 (eighteen lags), 1979-82 (six lags), 1982-91 (eighteen lags), and 1954-91 (thirty-six lags). The zero month is the contemporaneous response of the funds rate.

## Chart 5
## The Response of the Federal Funds Rate to a 1 Percent Monetary Base Innovation: Vector Autoregressions with Exogenous Money Growth




The funds rate is measured in basis points. The solid line is the point estimate, and the dashed lines are significance bands (generated using the Bayesian Monte Carlo integration procedure described in Doan 1990). The vector autoregressions were estimated with the following lag lengths: 1954-72 (twelve lags), 1973-79 (three lags), 1979-82 (three lags), 1982-91 (three lags), and 1954-91 (eighteen lags). The zero month is the contemporaneous response of the funds rate.

**Chart 6**
**The Response of the Federal Funds Rate to a 1 Percent Monetary Base Innovation: Vector Autoregressions with Endogenous Money Growth**




The funds rate is measured in basis points. The solid line is the point estimate, and the dashed lines are significance bands (generated using the Bayesian Monte Carlo integration procedure described in Doan 1990). The vector autoregressions were estimated with the following lag lengths: 1954-72 (twelve lags), 1973-79 (three lags), 1979-82 (three lags), 1982-91 (three lags), and 1954-91 (eighteen lags). The zero month is the contemporaneous response of the funds rate.

strongly positive in some subperiods. In most subperiods, the funds rate rises steadily following a money growth innovation. Surprisingly, in the period from 1979 to 1982, during which the strongest contemporaneous liquidity effect showed up in Chart 4, the funds rate response is positive. The only negative response of interest rates is in the 1982-91 period after a lag of a few months, but the response is not significantly different from zero.

The results in Chart 5 indicate that it is questionable to interpret the traditional regression results as primarily reflecting the liquidity effect. When empirical work controls for the influence of past interest rates, income, and prices, as theory suggests it should, all evidence of the liquidity effect disappears. If the traditional regression analyses were correctly specified and the results primarily reflected the liquidity effect, then holding other variables fixed should not alter the results.

**Vector Autoregression with Endogenous Money Growth.** The work of Thomas J. Sargent (1976) and Sims (1980) suggests that past interest rates are good predictors of money. Leeper and Gordon (1992) find that past interest rates, income, and prices jointly help predict money growth in all periods except the one from 1973 to 1979 and that interest rates and income individually tend to be important predictors of money. This section reestimates the VAR above but leaves the money growth equation unrestricted also, so the data determine the endogenous response of money growth to past economic conditions. This approach specifies $Z_t$ in equation (2) to include past values of all four variables, so the money innovation $\epsilon_t$ is the change in the growth rate that cannot be predicted using historical values of money growth, the interest rate, income, and prices.[19]

Chart 6 reports the responses of the funds rate to a money innovation.[20] Conditioning the money growth innovation on additional variables dampens the responses of interest rates, but unanticipated monetary expansions still fail to generate the liquidity effect. Allowing other variables to predict money growth does not affect conclusions about the liquidity effect once variables in addition to money growth rates are allowed to influence the interest rate directly.[21] The results suggest the need to move toward more careful identification of monetary policy and private behavior.

## Summary and Conclusions

There is broad agreement that the negative interest elasticity of money demand is the economic mechanism that produces the liquidity effect. There is also a widespread belief that the observed correlations between money growth and interest rates should be interpreted as the liquidity effect dominating the economy's short-run response to monetary policy shocks. Given this consensus, it is surprising that the data do not support explaining money/interest rate correlations entirely with the demand-side economic behavior described by Friedman (1968) and Cagan (1972) and embedded in models developed by Lucas (1990) and others.

The results of this study can be briefly summarized as follows:

- The response of interest rates to a money growth innovation frequently becomes positive and is never negative when the correlations control for the influence of past interest rates, money growth, prices, and income.
- The signs and the patterns of correlations between money growth and interest rates are not robust across subperiods of the 1954-91 sample.
- The findings reported here and in Leeper and Gordon (1992) imply a statistical rejection of the assumption that money growth is exogenous, which is critical to the traditional interpretations of the data. The assumption of exogeneity is also not sufficient to produce a negative correlation between unanticipated money and the interest rate. When the interest rate, prices, and income are included in an unrestricted VAR, the correlation is positive, independent of the assumption about the exogeneity of money.

The evidence in this article raises questions about which economic behavior induces money and interest rates to move together. It is unlikely that analyses that rely on an entirely demand-side story will be able to explain the data. Although the economic behavior underlying the traditional analysis of the liquidity effect seems quite plausible, the data are almost certainly generated by more complicated behavior than that described in Chart 1. The demand-side mechanisms are an incomplete description of the data in the absence of identifying monetary policy behavior.

In the United States the identification problem is actually more complicated than the extended example in the text suggests. Money-demand and money-supply decisions are inherently simultaneous at data frequencies of one month or longer. Demanders are choosing a quantity of the monetary base to hold as a function of the current federal funds rate, prices, and income, as well as past information. The Fed supplies the monetary base to hit a federal funds rate target during this period. Even under the assumption that the Fed does not observe current prices and income, the Fed does observe a vast array of other information that may serve effectively as proxies for current prices and income. Thus it is extremely difficult to argue on a priori grounds that there are readily available data series that shift money supply but do not shift money demand and vice versa.

By not offering up a measure of the effect on the interest rate of a given open market operation, these results may appear exceedingly negative. Unfortunately, the results accurately reflect the current state of economic knowledge about the short-run effects of monetary policy. They also lead the way toward future research by pointing out the need to go beyond simple correlations when identifying monetary policy effects. Recent work separates money-supply shocks and money-demand shocks by identifying vector autoregression models in a way that leaves the dynamics of the model unrestricted (Sims 1986, 1988; Jordi Gali 1990). Interestingly, this approach tends to find liquidity effects from identified money-supply shocks. Only by facing up to our ignorance about the effects of monetary policy will future research help resolve the uncertainty about the role of money in the economy.

## Notes

1. Discussions of the liquidity effect often leave "the money supply" undefined. Throughout this article "the money supply" refers to the monetary base.
2. In addition, many researchers seem to treat the liquidity effect as a criterion of acceptability in the specification, estimation, and simulation of economic models. For example, Christiano (1991, 3) labels the negative short-run response of interest rates to a surprise monetary expansion "a basic premise guiding the implementation of monetary policy," which is an "important characteristic for a good model to have." Bryant, Holtham, and Hooper (1988) report that all but one of the dozen econometric models they study produce declines in short-term nominal interest rates following a U.S. monetary expansion. Laidler writes, "Of the literally hundreds of studies of the demand for money . . . I am aware of only three that have failed to find a significant negative relationship between the rate of interest and the demand for money" (1985, 124).
3. Roberds (1992) discusses American monetary policy behavior during this period and presents evidence on federal funds rate volatility from 1976 to 1991.
4. Similar results already exist. Mishkin (1983) fails to uncover a negative relationship between unanticipated money and interest rates. Sims (1980, 1986) and Litterman and Weiss (1985) report that unanticipated changes in the money supply are not associated with sizable short-run declines in interest rates.
5. The reasoning follows from the Fisher relationship, which states roughly that the nominal interest rate equals the real interest rate plus the expected inflation rate over the maturity of the instrument being priced. Implicit in the traditional theoretical analysis is the assumption that monetary policy cannot influence the real interest rate in the long run. See Espinosa (1991) for a different perspective on this contentious issue in monetary theory.
6. Although the conceptual experiment in Chart 1 involves the level of the money stock, empirical work frequently uses the growth rate of money. This practice is less of an inconsistency than it may appear. The liquidity effect arises from changes in the level of the money supply, while the expected inflation effect arises from changes in current and expected future growth rates of money. Of course, the level of money today can be expressed in terms of current and past growth rates and the level of money at some initial date. The connection between levels and growth rates allows the two measures to be used interchangeably. As a practical matter, the empirical results presented later in the article hold whether the money stock is in levels or growth rates.
7. To be more precise, this body of work often allows the growth rate of money today to depend on past growth rates plus the outcome of a spin of a roulette wheel today.
8. Roberds (1992) offers a clear presentation of interest rate smoothing, one well-recognized proximate goal of monetary policy.
9. These arguments draw on Sims (1987).
10. Heller (1988), former member of the Board of Governors of the Federal Reserve System, makes this point. After listing several variables whose performance could bring forth a discretionary open market operation, Heller writes, "FOMC members often differ on the relative importance of these factors" (428).
11. The Fed's behavior is couched in terms of the money supply because, even when the Fed targets the federal funds rate, it does so through open market operations that alter certain monetary entries on the Fed's balance sheet.
12. As mentioned above, this claim says nothing about having to extract analogous shocks to money demand to measure the liquidity effect.
13. In contrast, many earlier articles on the liquidity effect use broader monetary aggregates, such as M1 or M2. Because private behavior strongly influences these aggregates, the Fed cannot control them under any operating procedure and they are only loosely connected to the open market operations that the Fed conducts to achieve its target variable.

Leeper and Gordon (1991) report results that use M1 and M2 in place of the base.

14. Some studies regress the level of the interest rate against the level of the money stock (Gibson 1970b and Stokes and Neuburger 1979), some use the growth rate of money as the independent variable (Cagan 1966; Gibson 1970a; Reichenstein 1987; and Cochrane 1989), and some regress the change in interest rates against the change in money growth (Cagan and Gandolfi 1969; Cagan 1972; Gibson 1970a; and Melvin 1983). This is not an exhaustive list of studies or functional forms of the regressions that have been estimated.
15. The following lag lengths are used: 1954:7 to 1972:12 (thirty-six lags), 1973:1 to 1979:9 (eighteen lags), 1979:10 to 1982:11 (six lags), 1982:12 to 1991:11 (eighteen lags), and 1954:7 to 1991:11 (thirty-six lags). These lag lengths are consistent with those used in previous studies.
16. This specification of money growth denies any sort of purposeful monetary policy behavior. The specification is used only because it is consistent with how the literature on the liquidity effect has traditionally modeled money growth.
17. This is the thrust of Tobin's (1970) classic critique of evidence in favor of monetarism (see, for example, Friedman and Schwartz 1963a, 1963b and Friedman and Meiselman 1963).
18. These regressions estimate more coefficients than does equation (3), so the lag lengths were shortened as follows: 1954:7 to 1991:11 (eighteen lags), 1954:7 to 1972:12 (twelve lags), 1973:1 to 1979:9 (three lags), 1979:10 to 1982:11 (three lags), and 1982:12 to 1991:11 (three lags). The system for the 1979:10 to 1982:11 period includes only past interest rates and money growth. Leeper and Gordon (1991) show that the results do not change when different lag lengths are used.
19. The new money growth specification should be seen as a statistical representation of money growth rather than as a description of actual Fed behavior. Leeper and Gordon (1991) show that the results do not change when current values of income and prices are permitted to predict money growth.
20. These VARs are estimated with the same lag lengths as in the VARs with exogenous money growth.
21. A third variant on the traditional specification in equations (3) and (4) is to impose that only current and past money growth rates influence the interest rate but to allow other variables to predict money. Leeper and Gordon (1992) consider this specification and find that allowing money growth to respond to other variables is sufficient to overturn the traditional results portrayed in Chart 4.

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# Exchange Rate Variability and International Trade

**Vikram Kumar and Joseph A. Whitt, Jr.**

During the past two decades, the growth rate of international trade among the major industrial countries has been substantially slower than during the 1950s and 1960s. Moreover, exchange rate variability has been much greater since the 1973 breakdown of the Bretton Woods system of fixed exchange rates. Are the two phenomena connected?

To investigate the question of a relationship, this article examines the record of exchange rate variability for a number of major industrial countries over the past several decades. The increase in variability since the Bretton Woods system collapsed has not been uniform, particularly as members of the European Monetary System (EMS) have had some success in limiting the variability of their effective exchange rates. The study explores possible explanations for the variability, focusing on whether the move to flexible exchange rates may have added variability and uncertainty to monetary and fiscal policy, both of which have a major impact on market-determined exchange rates. In addition, the authors consider the effect of exchange rate variability on the volume of international trade. Though some investigators are unable to find evidence of any influence, an accumulating body of research points toward a modest depressing effect. The possibility of a depressing effect is serious because decreases in international trade would reduce the extent of economic specialization, which promotes economic welfare in all countries.

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## *E*xchange Rate Systems since World War II

The Bretton Woods system was created in the waning days of World War II by negotiation among governments, particularly the United States and Great Britain. It was a comprehensive attempt to create a system of fixed exchange rates, modeled in many respects after the gold standard of the late nineteenth century. However, contrary to the gold standard, the Bretton Woods agreement provided for occasional changes in exchange rates if a country were in "fundamental disequilibrium." In particular, if a country experienced a continuing balance-of-payments deficit that reduced its international reserves to unacceptable levels, it could devalue its currency in order to reverse the deficit.

For a number of years the Bretton Woods system appeared to perform well. The volume of international trade among the major industrialized countries grew rapidly, as did real (inflation-adjusted) incomes in those countries. Exchange controls on trade in goods and services were reduced or eliminated without putting undue pressure on government-chosen exchange rate pegs.

By the mid-1960s, however, the system was being strained. The British pound suffered as a widening trade deficit plus capital outflows caused a reduction in official reserves. For several years the British government attempted to maintain the pound's exchange rate through a variety of special tariffs and limitations on imports, plus special subsidies for exports. These measures not only reduced the efficiency of the British economy but ultimately failed to stave off a substantial devaluation of the pound, which occurred in late 1967. Advocates of flexible exchange rates suggested that, if their preferred system had been in place, the special tariffs and subsidies would never have been imposed, and the pound would have depreciated gradually instead of all at once, with less consequent disruption of the economy.

Further strains arose that involved the United States, Germany, and Japan. Each of these countries felt that its policy choices were being restricted in an unacceptable manner by the continuation of the Bretton Woods system.[1] In early 1973 these pressures resulted in the end of the Bretton Woods system as governments gave up trying to peg exchange rates.

Since then exchange rates between the major currencies have been floating, determined on a day-to-day basis by market forces. Nevertheless, governments have continued to influence exchange rates significantly: changes in monetary or fiscal policy sometimes cause dramatic changes in exchange rates, and governments have sometimes directly intervened in exchange markets.

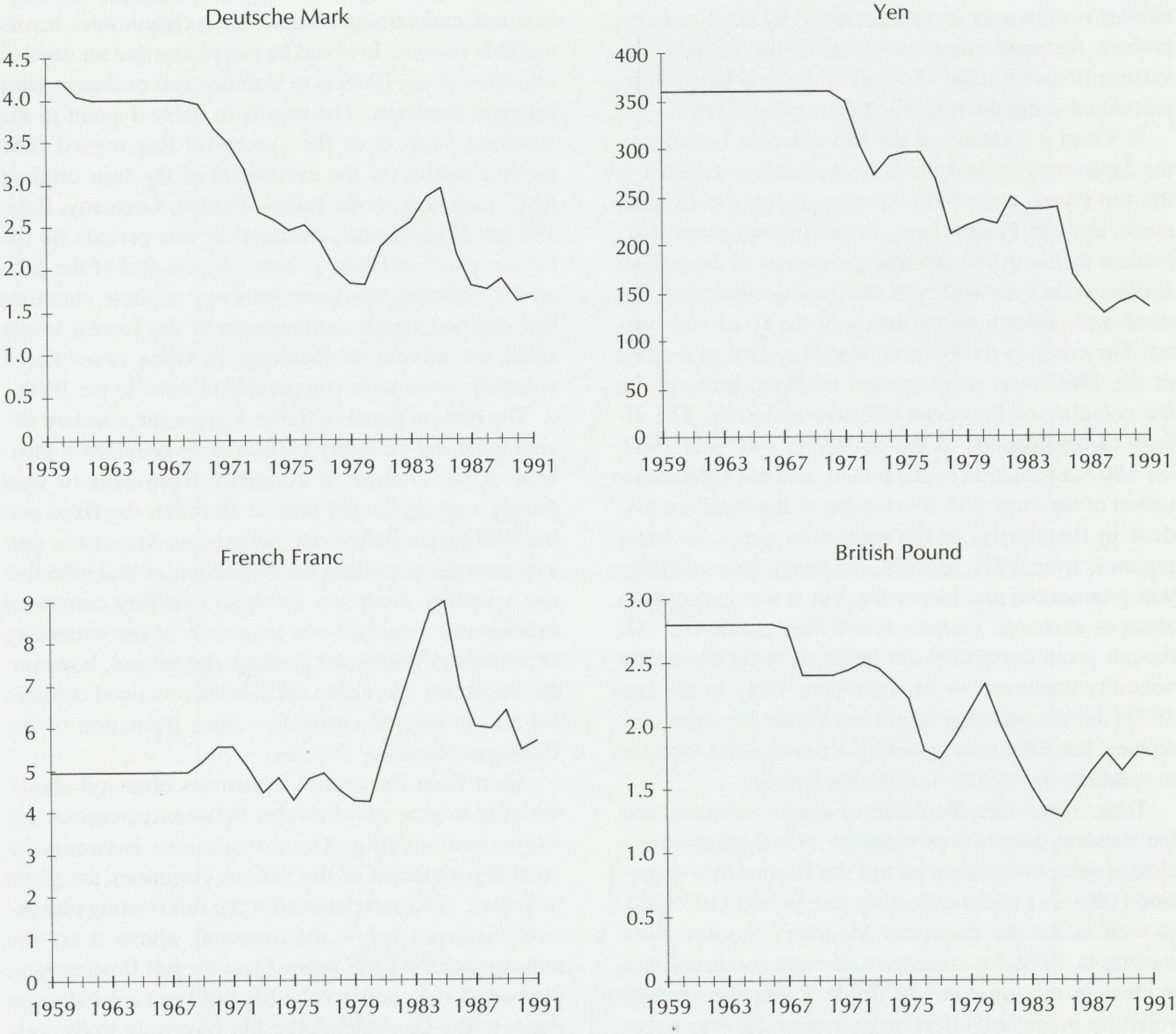
Moreover, not all exchange rates have been floating freely. Many small countries have chosen to peg to their major trading partners. In addition, a group of European countries have banded together in the European Monetary System. Their currencies are essentially pegged within narrow bands vis-a-vis members of the group, but they float together as a bloc in relation to outside countries, such as the United States and Japan.

## *E*xchange Rate Fluctuations

Prior to the advent of floating exchange rates in 1973, debate on the effects of exchange rate variability was largely theoretical because the prevailing system imposed tight restrictions on exchange rate movements.[2] Supporters of fixed exchange rates used concern about the possible trade-dampening effects of exchange rate variability as one argument for maintaining the Bretton Woods system.[3] On the other side, supporters of flexible exchange rates argued that allowing exchange rates to float would not result in wild gyrations; instead, exchange rates would move only in response to changes in demand or supply, which would normally develop slowly. Sharp movements would presumably occur only occasionally, in response to major events such as unexpected reversals of government policy (Milton Friedman 1967, 77; Harry G. Johnson 1972, 213). They pointed to the experience of Canada, whose flexible exchange rate did not fluctuate wildly from 1950 to 1962.[4] They argued further that market participants who wished to avoid bearing exchange rate risk would be able to do so by hedging in forward and futures markets.

After the collapse of the Bretton Woods system and the move to generalized floating among the major exchange rates, it soon became clear that large movements in exchange rates were occurring far more frequently than many flexible rate advocates had expected. The increase in the volatility of the nominal exchange rates between the leading currencies after Bretton Woods is seen in Chart 1. For instance, Egon Sohmen (1969, 228) reports that from 1952 to 1960 the floating Canadian dollar never moved more than 6 percent against the U.S. dollar in a single year; the average range of fluctuations was 3.85 percent in a year.

**Chart 1**
**Nominal U.S. Dollar Exchange Rates, 1960–90**
*(Annual average)*




Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

By contrast, Joseph A. Whitt, Jr. (1990, 9-11) reports that during the period from June 1973 to December 1989, the British pound/U.S. dollar rate had fourteen separate episodes during which it moved more than 10 percent in six months. Moreover, frequent large fluctuations were not confined to the British pound; the German mark and the Japanese yen had similar numbers of large fluctuations vis-a-vis the U.S. dollar.

Real trade flows presumably are affected by real exchange rates—that is, nominal rates adjusted for domestic and foreign inflation. Moreover, different bilateral exchange rates commonly move by different amounts, making it useful to have a single summary measure such as the effective exchange rate. The effective exchange rate is a weighted average of a country's bilateral exchange rates. The weights are based on trade shares, ensuring that a major trading partner gets more weight than a minor one. A variety of statistical measures of exchange rate volatility have been used in the literature, though as Peter B. Kenen and Dani Rodrik (1984, 6) argue, they all tend to yield similar results over longer periods.[5] Chart 2 presents perhaps the most common statistic—the standard deviation of percentage changes in the exchange rate, calculated using the real effective exchange rate.

In Chart 2 volatility of the real effective U.S. dollar, the Japanese yen, and the British pound is depicted in the top panel, and of the Dutch guilder, the German mark, and the French franc in the bottom panel. It is evident that with the sporadic exceptions of the guilder and the pound, instability in the leading currencies was small and uniform during much of the fixed rate period. The crisis in the Bretton Woods system at the end of the 1960s was accompanied by sharp increases in the volatility of European effective real rates. The effects of revaluations of the guilder in 1961 and 1962, the 1967 devaluation of the pound, and the 1969 revaluation of the mark and devaluation of the franc are evident in the charts. In the transition years between regimes, from 1971 to 1974, exchange rate volatility was pronounced and increasing, but it was expected to abate as exchange markets found their equilibria.[6] Although some currencies did begin to settle down, the volatility continued to be significant. Only in the late 1970s did the volatility begin to subside for some currencies, but there was generally a pronounced increase in volatility during the flexible rate regime.

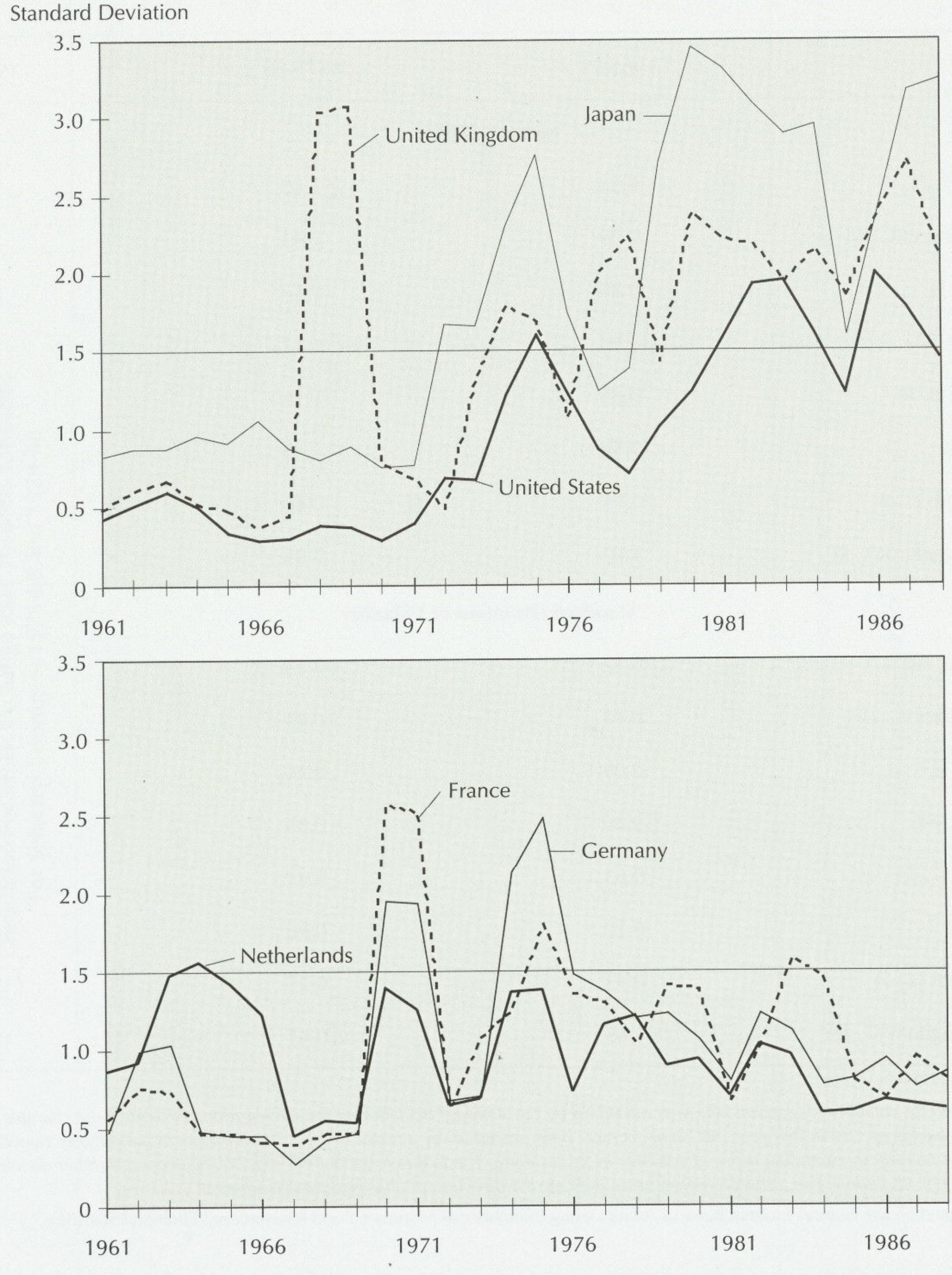
Table 1 provides the mean (average) volatility and the standard deviation of volatility in real effective exchange rates for a major part of the Bretton Woods period (1961-71) and the floating rate period (1975-88), as well as for the European Monetary System years starting in 1979, for currencies of eight countries. It is evident in the top panel of Table 1 that the average volatility in the real effective exchange rate was larger during the floating rate period for all currencies except the guilder. In many instances mean volatility increased to a level 200 percent to 300 percent of its Bretton Woods level. In most cases the currencies maintained their relative volatility rankings (given in parentheses) between regimes; the yen and the British pound were consistently high in volatility, and the Canadian dollar consistently low. The U.S. dollar is something of an exception; it had the lowest volatility in this group under Bretton Woods but had the third-highest volatility during the float.

The subperiod from 1979 to 1988 is especially revealing; these are the years in the sample during which the European Monetary System formally existed. It is the stated aim of the European Monetary System to contain currency fluctuations between members within smaller bands than the free market has generated; accomplishing that goal calls for strict policy coordination and maintaining comparable inflation rates across member nations. It would be fair to say that an implicit objective of the EMS is to stabilize real exchange rates between members. The results in Table 1 point to the stunning success of the system in this regard. The mean volatility of the currencies of the four original EMS members in the table—France, Germany, Italy, and the Netherlands—declined in this period. As the bottom panel of Chart 2 shows, by the end of the period the volatility measures for three of these countries had reached rough convergence at the lowest levels since the advent of floating; in some cases these volatility levels were comparable to those in the 1960s.

The bottom panel of Table 1 gives the standard deviation of the volatility measures. It provides a measure of the change in volatility from year to year during a given sample period. Between the fixed and the floating exchange rate periods, no systematic pattern emerges regarding the dispersion of real effective rate volatility. Both low and high volatility currencies experienced increases and decreases in the variability of volatility. Within the floating rate period, however, the variability has either declined or remained constant for all the sample currencies since formation of the European Monetary System.

Apart from the central tendencies observed above, the year-to-year relationships between currencies are vague and shifting. The correlations between the volatility measures of the various currencies are given in Table 2. The correlations for the full floating rate period are given below the diagonal; above it are the numbers for the EMS years. Over the full floating sample period U.S. dollar volatility has been related negatively to the Canadian dollar but positively to the yen. The deutsche mark and the franc have both been related positively to the guilder, negatively to the pound, and positively with each other. The lira's volatility moves against the yen's but with the guilder's. In the 1979-88 subsample, the volatility in the deutsche mark and the guilder continues to be positively associated, and there is a strong tripartite relationship between fluctuations in the lira and the U.S. and Canadian dollars. Somewhat surprisingly, all the other intra-EMS correlations fade away; no wider systematic relationships are evident. Taken as a whole then, exchange rate volatility seems to elude simple patterns of associations, and those that do exist seem to be less than permanent.

## Chart 2
### Exchange Rate Volatility, 1961–88
*(Real effective rates)*




Note: *Volatility for a given year was measured by the standard deviation of eleven monthly percentage changes. Total trade weights were used in the calculations. For example, the weight of France in the U.S. effective exchange rate equals total U.S. trade with France (exports plus imports) as a fraction of total U.S. trade with the included countries (data on twenty industrial countries were included) during the base year, 1977.*

Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

**Table 1**
**Mean and Standard Deviation of Real Effective Exchange Rate Volatility Measures for Selected Countries**

| | 1961-71 | 1975-88 | 1979-88 |
|---|---|---|---|
| **Mean Volatility** | | | |
| Canada (7, 7) | 0.55 | 1.05 | 1.06 |
| United States (8, 3) | 0.39 | 1.43 | 1.57 |
| Japan (4, 1) | 0.88 | 2.57 | 2.88 |
| France (3, 5) | 0.93 | 1.17 | 1.08 |
| Germany (5, 6) | 0.85 | 1.16 | 0.97 |
| Italy (6, 4) | 0.57 | 1.40 | 1.13 |
| Netherlands (1, 8) | 1.07 | 0.86 | 0.76 |
| United Kingdom (1, 2) | 1.07 | 2.03 | 2.17 |
| **Standard Deviation of Volatility** | | | |
| Canada (↓, ↔) | 0.32 | 0.24 | 0.24 |
| United States (↑, ↓) | 0.11 | 0.41 | 0.34 |
| Japan (↑, ↓) | 0.09 | 0.76 | 0.55 |
| France (↓, ↔) | 0.86 | 0.35 | 0.35 |
| Germany (↓, ↓) | 0.63 | 0.44 | 0.19 |
| Italy (↑, ↓) | 0.10 | 0.56 | 0.17 |
| Netherlands (↓, ↓) | 0.43 | 0.25 | 0.17 |
| United Kingdom (↓, ↓) | 1.05 | 0.41 | 0.34 |

Note: *Exchange rate volatility for a given year was measured by the standard deviation of the eleven monthly percentage changes in the real effective exchange rate in that year. All numbers have been scaled up by a factor of 100. The numbers in parentheses denote the ranking of the country in ascending order of volatility of its currency. The first number is for 1961-71; the second number denotes the rank for the 1975-88 period. The arrows in parentheses indicate the direction of change between adjacent columns.*

Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

**Table 2**
**Correlations between Exchange Rate Volatility Measures For Selected Countries, 1975-88 and 1979-88**

| | Canada | United States | Japan | France | Germany | Italy | Netherlands | United Kingdom |
|---|---|---|---|---|---|---|---|---|
| Canada | | −0.551* | 0.431 | 0.573* | 0.389 | −0.639** | 0.427 | −0.189 |
| United States | −0.482* | | 0.143 | −0.162 | −0.038 | 0.871*** | 0.073 | 0.542 |
| Japan | 0.107 | 0.618* | | 0.219 | 0.103 | 0.053 | 0.300 | 0.407 |
| France | 0.119 | −0.116 | 0.012 | | 0.488 | −0.235 | 0.516 | −0.329 |
| Germany | −0.267 | −0.130 | −0.195 | 0.669*** | | −0.296 | 0.915*** | −0.468 |
| Italy | −0.005 | −0.429 | −0.615** | 0.169 | 0.439 | | −0.236 | 0.536 |
| Netherlands | 0.149 | −0.297 | −0.248 | 0.554** | 0.781*** | 0.680*** | | −0.234 |
| United Kingdom | 0.209 | 0.337 | 0.376 | −0.460* | −0.513* | 0.071 | −0.149 | |

Note: *Correlations for the 1975-88 period are below the diagonal; those for the 1979-88 period are above the diagonal. The symbols ***, **, * denote significance levels of 0.01, 0.05, and 0.10, respectively.*

Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

## Sources of Exchange Rate Fluctuations

What causes the large exchange rate fluctuations described above? The most common explanations economists offer have focused on the role of expectations about the future in determining today's exchange rates.

To introduce the role of expectations, it is instructive to consider the open interest parity condition, which essentially states that if capital mobility is not restricted, investors will engage in arbitrage between financial markets to ensure equalized expected rates of return on domestic and foreign securities. In this context, capital mobility means that at least some investors can readily borrow or lend in both the domestic and foreign financial markets without government restrictions.

The open interest parity condition can be represented mathematically as follows:

$$1 + r_t = (1 + r_t^*)\{[E_t(S_{t+1})]/S_t\}. \qquad (1)$$

In equation (1) $r$ and $r^*$ are the interest rates on domestic and foreign bonds, respectively. $S_t$ is the domestic currency price at time $t$ of a unit of foreign currency, and $E_t\,(S_{t+1})$ is the expectation prevailing at time $t$ regarding the exchange rate one period hence. The left side of the equation represents the expected return to a U.S. investor on a U.S. bond, while the right-hand side represents the expected return to a U.S. investor on a foreign bond investment, taking into account conversion between dollars and the foreign currency. Profit-seeking investors presumably compare the two returns and invest in the one promising higher returns; if many investors make the same choice, domestic and foreign expected returns are forced into equality.

Suppose, for example, that a U.S. investor wishes to decide between buying a \$100.00 U.S. government bond and an equivalent amount of French bonds at the prevailing exchange rate of $S_t$ = \$0.20/franc. If the U.S. and French interest rates are 8 percent and 5 percent, respectively, the investor will receive \$108.00 from the U.S. bond one year later. An alternative strategy would be to convert \$100.00 into (\$100/$S_t$) = 500 francs. At the 5 percent French interest rate the investor would receive 500(1 + 0.05) = 525 francs one year later. If the U.S. investor is interested in dollar-denominated returns, he or she will be indifferent to the choices if and only if the proceeds of the French bond (525 francs) are expected to be worth \$108.00—that is, $E_t(S_{t+1})$ = \$108/525 = \$0.2057/franc. Hence the investor will be in equilibrium only if the dollar is expected to depreciate by roughly 3 percent. In other words, the expected change in the exchange rate offsets the interest rate differential, leaving the investor indifferent.[7]

It is clear that for given interest rates $r$ and $r^*$, equation (1) can be solved for the ratio $E_t(S_{t+1})/S_t$ but not for $S_t$ alone. For example, if $r$ is equal to $r^*$, equation (1) implies that $S_t$ must equal $E_t(S_{t+1})$, but it provides no way of determining whether $S_t$ is \$0.20 per franc, \$0.13 per franc, or any other amount, as long as it equals $E_t(S_{t+1})$. Indeed, an infinite number of values of $S_t$ are consistent with open interest parity and the given values of $r$ and $r^*$. Moreover, the expectation $E_t(S_{t+1})$ is never directly observed even though data for $S_t$ are available whenever the exchange market is open.

If governments are not pegging exchange rates but are allowing market forces to determine rates, which of the infinite number of possible values of $S_t$ will prevail? A partial answer is provided by equation (1): given interest rates $r_t$ and $r_t^*$, plus the expected future exchange rate $E_t(S_{t+1})$, only one value of today's exchange rate is consistent with open interest parity.

Furthermore, Ronald I. McKinnon (1988), among others, argues that expectations about exchange rates are volatile, being extremely sensitive to minor changes in expectations about economic fundamentals such as monetary and fiscal policy. If so, equation (1) implies that the spot exchange rate will be volatile as well except in the unlikely event that changes in expectations are exactly offset by the correct pattern of interest rate movements. Any event—the fall of the Berlin Wall, an announcement like the annual release of the President's budget proposals, or even a change in the attitudes of market participants—that changes market expectations about the future value of the exchange rate will feed back immediately into changes in the current exchange rate $S_t$.

The above discussion shows how today's exchange rate should be affected heavily by the expected future exchange rate, but it begs the question of what determines the expected future exchange rate. To answer that question various economists have developed the idea that exchange rates are asset prices, somewhat analogous to stock prices.

In the case of stocks the fundamental determinant of value is earnings; the theory of finance indicates that the price of a stock today is equal to the present value of expected future earnings. For exchange rates the fundamental determinants presumably include monetary policy, fiscal policy, real growth, and a variety of other factors. Accordingly, it seems reasonable to think that the expected future exchange rate would be determined by expected monetary policy, fiscal policy, and other conditions.

Michael Mussa (1976) formalized this result (see the box on page 26). Within the basic framework of an open-economy money-demand model, he demonstrates three important features of exchange rate determination. First, a country's current exchange rate depends on current monetary policy and economic conditions and on expectations about the entire future path of these factors. Thus a change in expectations as well as a change in current conditions will immediately influence the current exchange rate. Second, the impact of a change in expectations in the distant future is less than the impact of the same change expected to occur soon. For example, a 10 percent jump in the money supply expected to occur ten years from now will have much less effect on today's exchange rate than a 10 percent jump expected to occur ten weeks from now. Finally, an increase in variability of the money stock will raise exchange rate variability. Accordingly, unstable monetary policy is one possible source of exchange rate fluctuations.

According to Paul De Grauwe's (1989) "reduced discipline" hypothesis, the shift from fixed exchange rates to the current system of flexible exchange rates gave governments increased leeway in policy choices in both monetary and fiscal policy. In the Mussa framework increased variability of the money stock directly increases exchange rate variability. Although a measure of fiscal policy does not appear explicitly in Mussa's analysis, changes in fiscal policy have an influence through their effect on interest rates; moreover, in many countries budget shortfalls are frequently financed by monetary expansion.

What evidence is available regarding the variability in economic policy? The upper panel of Table 3 presents the mean and standard deviations of the

**Table 3**
**Mean and Standard Deviation in Budget Deficit/GDP and In the Growth of Money Supply during the Fixed and Flexible Exchange Rate Regimes**

| | Fixed Rates | | Flexible Rates | |
|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation |
| | | **Budget Deficit/GDP** | | |
| United States | −0.31 | 0.33 | −3.12 | 1.65 |
| Japan | 0.90 | 0.27 | 3.62 | 1.26 |
| Germany | −0.08 | 0.35 | −1.50 | 0.63 |
| France | −0.18 | 0.15 | −1.60 | 1.16 |
| | | **Growth in M1** | | |
| United States | 4.21 | 2.08 | 7.01 | 3.58 |
| Japan | 20.48 | 8.37 | 6.70 | 4.53 |
| Germany | 8.47 | 3.34 | 8.77 | 6.46 |
| France | 10.11 | 5.40 | 10.35 | 6.33 |

Note: *The fixed rate period figures for the United States and France are based on data from 1959 to 1971; for Japan and Germany, from 1960 to 1971. Data for the flexible rate period are from 1974 to 1990 except for Germany's budget deficit data, which cover the 1974-89 period. The budget deficit is the actual, not full-employment or structural, deficit.*

Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

## Exchange Rates and Expected Change in Policy and Economic Conditions

Mussa (1976) provides a simple illustration of the influence of expectations about policy and economic conditions on the exchange rate. Suppose that money market equilibrium for the home country in period $t$ is represented by the following (all variables are in logarithms):

$$m_t = m_t^d = \alpha s_t - \beta D_t + Z_t, \quad \text{(B1)}$$

where $m_t$ is the nominal stock of money in the home country, $m_t^d$ is nominal money demand, $s_t$ is the exchange rate (domestic currency per unit of foreign currency), $D_t$ is the expected rate of depreciation of the home currency, and $Z_t$ measures the effect on money demand of all other variables, such as real output.

Although equation (B1) may appear unusual, it is actually similar to more familiar formulations of money market equilibrium, in which nominal money is positively related to the price level, negatively related to the interest rate (or sometimes the inflation rate), and positively related to output. In equation (B1), the term $\alpha s_t$ takes the place of the price level; other things being equal, a rise (depreciation) of the exchange rate raises the home country's price level, thereby raising the nominal demand for money. Hence $\alpha$ should be positive.

Similarly, the term $-\beta D_t$ takes the place of the more familiar interest (or inflation) rate. Indeed, $D_t$ is closely related to the domestic interest rate through the open-interest parity condition. The expected depreciation rate is defined as follows:

$$D_t = E_t[ln(S_{t+1}) - ln(S_t)] = E_t(s_{t+1}) - s_t. \quad \text{(B2)}$$

Using the approximation that for small values of $x$, $ln(1 + x) = x$, and taking logarithms of both sides of equation (1) yields the following transformation of equation (1):

$$r_t = r_t^* + E_t(s_{t+1}) - s_t. \quad \text{(B3)}$$

Hence

$$D_t = r_t - r_t^*. \quad \text{(B4)}$$

Taking foreign interest rates as given by conditions abroad, equation (B4) shows that increases in expected depreciation, $D_t$, are likely associated with increases in $r_t$, the domestic interest rate. In the usual money-demand equation, increases in interest rates reduce money demand. Hence it is expected that $-\beta$, the coefficient on $D_t$ in equation (B1), should be negative.

Substituting equation (B2) into (B1) and rearranging gives the solution for today's exchange rate in terms of the money supply and $Z_t$ today, plus the expected exchange rate:

$$s_t = [1/(\alpha + \beta)][m_t - Z_t + \beta E_t(s_{t+1})]. \quad \text{(B5)}$$

It is presumed that market participants know that when they reach period $t + 1$, its prevailing exchange rate will be determined in the same way as in period $t$. Only the time subscripts will be different:

$$s_{t+1} = [1/(\alpha + \beta)][m_{t+1} - Z_{t+1} + \beta E_{t+1}(s_{t+2})]. \quad \text{(B6)}$$

Today's expectation about next period's exchange rate can be obtained by calculating the expected value of equation (B6).

$$\begin{aligned} E_t(s_{t+1}) &= [1/(\alpha + \beta)]\{E_t(m_{t+1}) \quad \text{(B7)} \\ &\quad - E_t(Z_{t+1}) + \beta E_t[E_{t+1}(s_{t+2})]\} \\ &= [1/(\alpha + \beta)][E_t(m_{t+1} - Z_{t+1}) + \beta E_t(s_{t+2})]. \end{aligned}$$

Substituting equation (B7) back into (B5) yields an expression for $s_t$ in terms of current and expected money and other variables ($Z$), plus the expected exchange rate two periods hence, $E_t(s_{t+2})$. Repeating this procedure over and over for exchange rates farther in the future ($E_t[s_{t+2}]$, $E_t[s_{t+3}]$, and so on) results in an expression for today's exchange rate that involves only the economic fundamentals, current and expected money supplies and Zs.

$$\begin{aligned} s_t &= [1/(\alpha + \beta)]\{(m_t - Z_t) \quad \text{(B8)} \\ &\quad + [\beta/(\alpha + \beta)][E_t(m_{t+1} - Z_{t+1})] \\ &\quad + [\beta/(\alpha + \beta)]^2[E_t(m_{t+2} - Z_{t+2})] + \ldots\}. \end{aligned}$$

Equation (B8) clearly shows that today's exchange rate depends not only on today's values of $m_t$ and $Z_t$ but also on the entire expected future path of these variables. For example, any alteration in the expected future course of monetary policy will have an immediate impact on the exchange rate today.

Another feature of equation (B8) that seems reasonable is that changes in expectations about the distant future have less impact than changes expected to occur soon. The reason for this result is that the terms involving expectations in equation (B8) are multiplied by powers of $[\beta/(\alpha + \beta)]$.

As discussed earlier, $\alpha$ and $\beta$ should both be positive; hence $[\beta/(\alpha + \beta)]$ should be positive but less than one. The expectation about the money supply and other variables $n$ periods hence, $E_t(m_{t+n} - Z_{t+n})$, is multiplied by $[\beta/(\alpha + \beta)]$ raised to the $n$th power; for periods farther in the future, $n$ is larger, but the coefficient $[\beta/(\alpha + \beta)]^n$ shrinks toward zero. Another result that seems intuitively clear from inspection of equation (B8) is that an increase in the variability of the money stock, other things being equal, will raise the variability of the exchange rate.

share of the budget deficit as a proportion of gross domestic product (GDP) for four countries. In each case the variability during the flexible rate regime has increased significantly; in three of the countries the standard deviations have more than quadrupled. The lower panel provides the means and standard deviations of the growth in M1 for the same countries. It is apparent that except for Japan the growth in money supply has fluctuated more during the flexible rate period as well. These variations may partially explain the volatility in exchange rates.

A study by De Grauwe (1989) raises the possibility that the volatility in policy may not have been caused by the "reduced discipline" required of governments but rather that the large oil shocks of the 1970s may have prompted large policy responses in their wake. The question essentially seems to be whether fiscal policy in particular is "truly" driven by external forces, or, within the context of the particular political realities of modern democracies, it responds endogenously to the given state of the economy. The fiscal policies of the United States, Germany, and Japan, De Grauwe notes, have diverged significantly since the late 1970s; despite a common oil shock, countries have felt free to chart independent courses of action, providing circumstantial support in favor of the "reduced discipline" hypothesis.

It seems reasonable to believe that the behavior of economic policy has had repercussions in currency markets and made market exchange rates more variable. Concurrently, uncertainty regarding the future course of policy may have cast a long shadow on the market's ability to predict exchange rates with any reasonable degree of accuracy. Here lies the core of concern regarding exchange rate volatility. Expected variations would rationally be incorporated into current decisions and may not impose any real costs. The same is not true for unexpected changes. There is considerable evidence that forward markets, where traders hedge against exchange rate uncertainty, have repeatedly failed to predict exchange rates by wide margins and have often failed to predict correctly even the direction of exchange rate changes (see, for instance, Robert E. Cumby and Maurice Obstfeld 1984).

Has the exchange rate volatility observed since the end of Bretton Woods been excessive in some sense? The question is difficult to answer because economists do not agree on what the appropriate amount of volatility is. One approach is based on purchasing-power parity, which provides a simple, easy-to-calculate way of estimating equilibrium exchange rates. According to this approach, if the domestic rate of inflation exceeds the foreign rate of inflation by $x$ percent over some period, the domestic currency should depreciate by that same $x$ percent. Therefore, the volatility of the exchange rate between two countries should be approximately the same as the volatility of price index ratios.

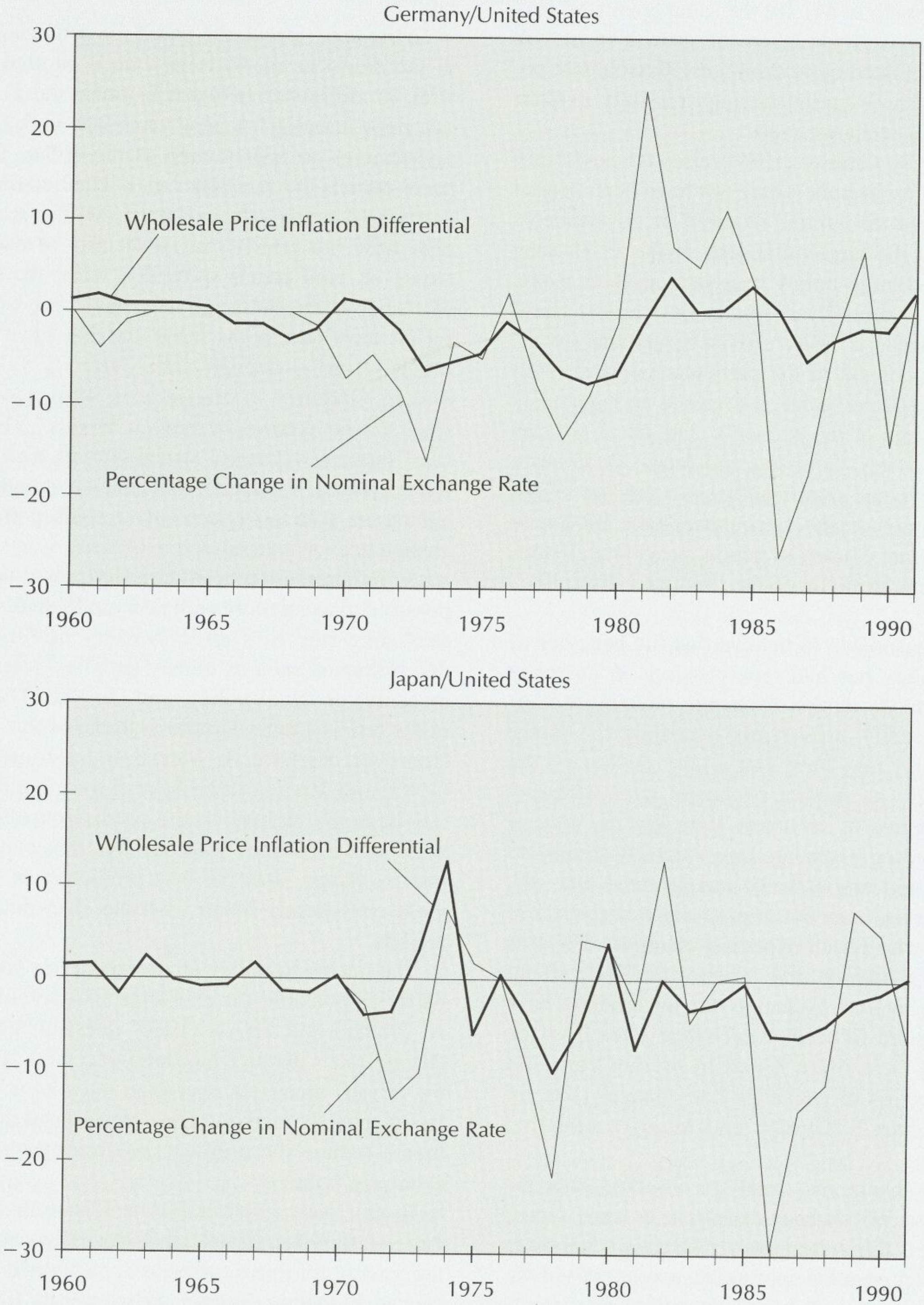
In the upper panel of Chart 3 the percentage change in the deutsche mark/dollar rate is plotted together with the difference between German and U.S wholesale price inflation.[8] A positive change in the exchange rate denotes an appreciation of the dollar. The lower panel depicts the same for Japan. If purchasing-power parity held exactly, the exchange rate line would coincide with the relative inflation line in each panel. However, both panels show that while the directions of change in the exchange rates have been as expected for the most part, in the sense that they have moved to offset inflation differentials, currency values have moved violently in comparison with goods prices since the breakdown of Bretton Woods.[9] The "excessive" movement has not abated through time; rather, it has increased. It appears that relative inflation differentials are able to explain only a small portion of the change in exchange rates.

As an alternative to purchasing-power parity, it is possible to use a more complex model that relates the exchange rate to a wider variety of fundamental determinants, such as money supplies, interest rates, measures of fiscal policy, and the like. The analysis in the box is a fairly simple example of this approach. However, Richard A. Meese and Kenneth Rogoff (1983) and Meese (1990) have shown that fundamentals have not helped in the prediction of exchange rates; naive random walk models that consider current exchange rates the best predictors of the future yield consistently better forecasts than the structural models.

The uncertain policy environment has been at least partly responsible for exchange rate volatility. Jacob A. Frenkel and Mussa (1980) question whether exchange rate volatility has been excessive, noting that by various measures exchange rates have fluctuated less than stock markets. They recommend that governments reduce the public's uncertainty about future economic policy.

In any event, there is little evidence that exchange rate volatility has shrunk since the early years of floating, except for those currencies constrained by the European Monetary System. Whatever its fundamental source, the volatility seems likely to continue for the foreseeable future.

**Chart 3**
**Wholesale Price Inflation Differential and Percentage Change in Nominal Exchange Rate, 1960–90**




Source: Calculated by the Federal Reserve Bank of Atlanta using International Monetary Fund International Financial Statistics.

## International Trade and Exchange Rate Volatility

Perhaps the most widely discussed concern about exchange rate variability is its possible negative effect on the volume of international trade and hence on economic welfare. In traditional international trade theory, the basis for trade is comparative advantage: if the United States is relatively efficient in producing machinery while France is relatively efficient in producing champagne, both countries will benefit if the United States exports machinery to France in exchange for champagne.

Moreover, the joint welfare of the United States and France would be maximized under conditions of free trade. Tariffs or import quotas imposed by either country would reduce the volume of trade below the free-trade amount and would also reduce the joint welfare of the countries below the free-market level.[10] (These conclusions were derived from economic theories that did not explicitly include uncertainty about exchange rates.)

Exchange rate variability, or, more precisely, unexpected exchange rate movements, represent a source of risk. For example, suppose that a U.S. firm is selling machinery in France, with the sales contract specifying that the U.S. firm is to receive payment of $100.00 per machine three months after shipment is made. The French importer placed the order because it had a contract to sell the machine in France for 525 francs. If, when the contracts were signed, the exchange rate were 5 francs per dollar and the importer expected it to remain so, then the importer would expect to pay its debt to the U.S. firm with 500 francs, leaving a profit for itself of 25 francs. However, if the exchange rate changed in the weeks between the signing of the contracts and final settlement, the French importer's profit would be affected. For instance, if the franc depreciated to 5.5 francs per dollar, the importer's expected profit would turn into an actual loss of 25 francs, whereas if the franc appreciated to 4.75 francs per dollar the importer's profit would double to 50 francs.[11] A similar risk would be faced by companies involved in exporting from France to the United States.

If firms are risk-averse, they would presumably tend to favor low-risk activities and avoid high-risk ones. Accordingly, if exchange risk increases, some marginal firms would give up exporting or importing entirely, and others would cut back their efforts in these activities to concentrate on domestic sales, thereby causing the total volume of international trade to decline.[12]

Not surprisingly, the high variability of exchange rates since 1973 has stimulated empirical work on the relationship of exchange rate variability to the volume of trade. Peter Hooper and Steven W. Kohlhagen (1978) studied bilateral trade among major industrialized countries during the period from 1965Q1 to 1975Q4; they found no evidence that exchange risk significantly affected the volume of trade. Later work by the International Monetary Fund (1984), Padma Gotur (1985), and Martin J. Bailey, George S. Tavlas, and Michael Ulan (1986) reached similar conclusions.

Other authors have found evidence that exchange rate variability does reduce trade volume. M. Akbar Akhtar and R. Spence Hilton (1984) studied trade in manufactures for the United States and West Germany. For the post-Bretton Woods years from 1974 to 1981, they found that increases in the standard deviation of nominal effective exchange rates significantly reduced Germany's total exports and imports and had a marginally significant negative impact on U.S. exports. No significant impact on export or import prices was found for either country. However, Gotur (1985) reported that the results in Akhtar and Hilton are highly sensitive to small changes in specification or sample period; in addition, extending the analysis to include three more countries yielded mixed results. In Gotur's view the overall results did not, for the most part, support the conclusion that exchange rate variability has had a significant negative effect on the volume of international trade.

David O. Cushman (1983) studied U.S. and German bilateral trade flows with each other and with several other industrialized countries, using a sample period that began in 1965, during the Bretton Woods era, and ended in 1975, two years after the definitive move to floating exchange rates. Out of fourteen trade quantity equations estimated, seven showed significant negative effects of exchange rate risk on trade volume. However, in three cases a significant positive effect was estimated.

In further analysis, Cushman (1986) considered the possibility of third-country effects on risk. For example, if the riskiness of the pound-mark and mark-dollar increased substantially, trade flows between the United States and the United Kingdom might rise despite an increase in bilateral risk as exporters in both the United States and United Kingdom shifted their efforts away from the even more risky German market. Using data on U.S. exports Cushman found empirical evidence that third-country effects are important. He concludes that, as a result of exchange risk, U.S. exports to six major countries were reduced only 0.5 percent in 1967, when pegged exchange rates prevailed, but the negative effect grew to over 2 percent of exports in the early part of the floating rate period (1974Q3 to 1975Q2) and to 4.6 percent in 1983. Cushman (1988) studied U.S. bilateral trade flows during the period of floating exchange rates only. He concluded that, in the absence of exchange rate risk, U.S. imports from the countries included would have been about 9 percent higher and U.S. exports about 3 percent higher, on average.

Kenen and Rodrik (1986) examined the effects of various measures of real effective exchange rate volatility on manufactured imports of eleven major industrialized countries, using data solely from the post–Bretton Woods era. In four of the eleven cases (the United States, Canada, West Germany, and the United Kingdom) they found a statistically significant negative impact of volatility on import volume. In three cases there is a negative but insignificant impact, and in the other four cases the sign is wrong (positive) but insignificant.

Jerry G. Thursby and Marie C. Thursby (1987) studied bilateral exports among seventeen industrialized countries. For ten of them, exchange rate variability has a significant negative effect on exports; for the others, this variable is insignificant. Unfortunately, because Thursby and Thursby have data only on nominal exports and not on the volume of trade, it is uncertain whether their significant results reflect the impact of exchange rate variability on export volumes or on export prices.

In a study of long-run growth rates of bilateral trade flows among ten major industrial countries, De Grauwe (1988) analyzes two periods: a period of fixed exchange rates (1960-69) and a period of floating rates (1973-84). A unique feature of De Grauwe's work is the inclusion of variables to represent trade integration. For example, he posits that during the 1960s, even after accounting for the other variables such as income growth or relative price shifts, French exports to Germany would be likely to grow faster than French exports to the United States because of the reductions in trade barriers that occurred during those years as a result of French and German membership in the European Community (EC). This effect on export growth rates would not be permanent; once the process of trade barrier reduction was completed and industries had time to adjust to the new pattern of trade restrictions, this differential in growth rates would fade away.

Besides a trade integration variable for the original members of the EC, De Grauwe also includes a variable to pick up any effects on export growth from 1973 to 1984 of the addition of the United Kingdom to the European Community as well as variables to pick up the extraordinary growth of Japanese exports as that country was integrated into world markets.

De Grauwe found that exchange rate variability, especially variability of the real exchange rate, has a significant negative impact on the growth rate of trade volumes. The trade integration variables were also important determinants of trade flows; other things being equal, trade between the United Kingdom and the original members of the EC grew an extra 5 percent per year in the years following U.K. entry.

Overall, the average rate of growth of international trade among these ten countries from 1973 to 1984 was less than half the rate prevailing in the earlier period (1960-69). According to De Grauwe's results, about half the decline can be attributed to the slowdown in real income growth that occurred in most industrial countries after 1973. About 30 percent of the decline resulted from a slowdown in trade integration—a slowing in Japan's trade penetration into other markets and in trade integration among the original members of the EC, only partly offset by the reduction in trade barriers between the United Kingdom and the original members of the EC. The increase in exchange rate variability after the breakup of Bretton Woods accounts for the remaining 20 percent of the overall decline.

The importance of exchange rate variability in explaining the decline in trade growth between the two periods is not uniform for all the countries in De Grauwe's study. For intra–European Community trade (bilateral trade among the original members of the European Community), the declining rate of trade integration accounts for most (two-thirds) of the trade growth slowdown; exchange rate variability accounts for only about 5 percent of the decline. Of course, the original European Community members had less variability of within-group exchange rates than the other countries, perhaps reflecting the impact of the European Monetary System. By contrast, for trade that was not between two original European Community members, De Grauwe found that about one-third of the decline in trade growth from the earlier period to the later one results from the increase in exchange rate variability.

## Conclusion

Accumulating evidence supports the view that exchange rate fluctuations tend to reduce international trade, thereby harming economic welfare. However, the evidence is not unanimous, and the negative effect on trade does not appear large enough to make reducing exchange rate variability a top priority of the world community. The successful operations of the European Monetary System demonstrate that it is still possible to limit exchange rate fluctuations, but it is doubtful whether a similar system will develop on a global basis. The European Monetary System arose in particular economic and political circumstances; the wide chasms that exist in policy preferences and economic situations between the United States, Japan, and the European Monetary System members make it unlikely that the present era of floating, highly variable exchange rates will end in the foreseeable future.

## Notes

1. These strains are described at length in Solomon (1977).
2. Under the Bretton Woods system, governments agreed on par values for their exchange rates and were obligated to intervene to ensure that exchange rates in the markets would deviate no more than 1 percent from the par values.
3. Nurkse (1944) argued that floating exchange rates would be extremely volatile, as (in his view) they were during the 1920s, thereby disrupting international trade; Roosa (1967) and Einzig (1970) expressed similar sentiments.
4. The Canadian experience is discussed in Wonnacott (1965), Yeager (1966, chap. 24), and Sohmen (1969, 225-37).
5. The statistics that have been used to measure exchange rate volatility include the standard deviation of percentage changes, the mean absolute percentage change, and the percentage deviation from trend.
6. This view is implicit in the writings of the advocates of a flexible exchange rate regime, among them Johnson (1972), Haberler (1970), and Friedman (1953).
7. If the investor were risk-averse and the only source of risk was the possibility of exchange rate changes, he or she would seek, in equilibrium, a return of more than $108.00 on the French bond, the excess being the compensation for bearing the risk. In practice this risk premium appears to be large and volatile. The open interest parity condition does not include the risk premium and does not perform particularly well in empirical tests. However, it provides a convenient framework for illustrating the role of expectations in exchange rate determination.
8. If a large share of national output is nontradable the consumer price and GNP deflator inflations can diverge significantly from wholesale or producer price inflations; the latter two variables are heavily influenced by tradable goods prices. The question of which particular inflation variable is conceptually more consistent with the spirit of purchasing-power parity theory is unsettled. Frenkel (1976) provides a discussion of this issue.
9. Dornbusch (1976) provides an "overshooting" model in which he argues that, if goods prices adjust sluggishly but financial markets clear instantly and people have rational expectations, then, following a monetary shock, exchange rates will first overshoot their long-run value before reversing course. Consequently, exchange rate variations in excess of price variations would be expected.
10. Under certain conditions it is possible for one country to improve its welfare by imposing the so-called "optimum tariff." However, the gain to one country is less than the loss to the other, resulting in a loss of welfare to the world as a whole. Moreover, the possibility of retaliation makes it less likely that any country can gain by imposing tariffs. See Grubel (1981, 150-53).
11. Sometimes exporters agree to take payment in the importing country's currency. In the example in the text the U.S. exporter would then do the currency conversion, which is necessary to enable payment to workers and suppliers in dollars, and the exporter bears the exchange rate risk. Exchange rate risk is not eliminated by this procedure but merely transferred from the importing company to the exporter.
12. Recent developments in economic theory challenge the common conclusion that increases in exchange risk cause reductions in trade volume in all circumstances. For instance, De Grauwe (1988) shows that if firms have constant relative (not absolute) risk aversion, increased variability of exchange rates may raise the marginal utility of exporting even as it lowers total utility, leading to more exports, not fewer.

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# FYI

# Commercial Bank Profitability Rises as Interest Margins and Securities Sales Increase

Robert E. Goudreau

Last year's environment of declining interest rates allowed U.S. commercial banks to earn higher adjusted net interest margins and to take profits on investment securities sales. Interest expenses declined substantially more than interest revenues, and prices for investment securities purchased in previous years advanced as interest rates fell during 1991, particularly in the year's final quarter. Adjusted net interest margins expanded during 1991 for nearly all bank size categories.[1] This margin advanced most for the nation's largest banks (those with assets exceeding $1 billion) because interest expenses for this category declined considerably, more than offsetting falling interest revenues. The nation's largest banks have added markedly, but by about the same amount, to loan-loss provisions for three consecutive years.[2] Adjusted margins for small banks (assets under $50 million) and midsize banks (assets greater than $50 million and no more than $500 million) increased modestly in 1991 as additions to loan-loss provisions for these categories diminished.

While adjusted net interest margins for the banking industry moved forward, it was a singular gain from sales of investment securities that accounted for much of last year's increase in returns on assets and equity for banks across the nation (see "Commercial Banking Performance" 1991 and "Bond Sales" 1992). All size classifications of U.S. banks benefited from profits on securities sales, with the largest banks gaining the most. Net operating income for the industry remained approximately the same as the preceding year's because the increase in adjusted net interest margin was more than offset by changes in noninterest income and expense.[3] Noninterest expenses,

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strongly influenced by rising Federal Deposit Insurance Corporation (FDIC) fees, rose considerably more than noninterest income.

Profitability for the nation's smallest banks continued to rise, with last year's return on assets exceeding those posted by the two largest size groups. However, returns for the smallest banks remained below figures recorded by the industry's most consistently profitable competitors, which during the 1987-91 period were midsize banks. Despite the recent improvement, higher noninterest operating expenses relative to total assets continued to dampen profitability for the nation's smallest banks. Additionally, last year's profitability gains for the industry were broad-based as the weakest, average, and most profitable banks in most asset classifications achieved higher returns.

Southeastern banks outperformed commercial banks nationwide during the most recent year owing mainly to higher profitability for the region's largest banks.[4] These banks' advance in profitability was driven by their lower additions to loan-loss provisions, marked decline in interest expense, and substantial gains from investment securities sales. The smallest three categories of southeastern banks (those with assets of no more than $100 million), however, did not fare as well as respective national counterparts in adjusted net interest margin largely because the regional banks added comparatively more to loan-loss provisions. The most striking disparity between national and southeastern profitability patterns is evident for the smallest size class. Southeastern banks with assets totaling less than $25 million floundered during the 1987-91 period while overall the nation's smallest banks demonstrated a steady improvement in profitability.

The extensive tables at the end of this article contain a substantial amount of information about bank profitability in 1991 and preceding years. The remainder of this presentation highlights some of the more interesting patterns that emerged or continued last year.

## Profitability at the Nation's Banks

**Profitability Measures**. Bank profitability can have different meanings. For the purposes of this report the focus is on three profitability measures and their components: adjusted net interest margin, return on assets (ROA), and return on equity (ROE).[5] These measures are described in detail in the appendix. Briefly, adjusted net interest margin indicates a bank's interest revenues less interest costs as a proportion of interest-earning assets. For this analysis, revenues are adjusted to take into account different proportions of tax-free interest income earned by various banks and for credit risk. The credit risk adjustment is calculated by subtracting a bank's annual provisions for loan losses, which approximate expected losses, from interest earnings. Net interest margin is similar to a business's gross profit margin, differing among other ways in that it omits earnings from fees for services provided, an increasingly important source of revenue for the nation's largest banks.

Return on assets and return on equity are more general measures of a bank's ability to earn from its total operation. A measure of net income as a proportion of total assets, ROA gauges how effectively a bank uses all of its financial and real investments to earn interest and fees. ROE reflects how effectively a bank is using shareholders' investments.

**Profitability Patterns**. The adjusted net interest margin for U.S. commercial banks advanced last year to 3.15 percent of interest-earning assets. (See Tables 1-4 for data on adjusted net interest margin, interest revenue, interest expense, and loan-loss provisions by size class for the years from 1987 through 1991.) Adjusted margins for the nation's largest banks and for the banking industry as a whole have been limited for three years by the largest banks' sizable additions to loan-loss provisions, which annually represented roughly 1.3 percent of interest-earning assets. The largest banks in the nation account for an overwhelming majority of bank assets; therefore, changes in their earnings performance strongly influence industrywide profitability. In 1989 these banks, particularly the money center banks, raised loan-loss provisions to account for anticipated losses on troubled less developed country (LDC) debt and commercial real estate loans. The largest banks continued to add to loan-loss provisions during the past two years because of persistent delinquencies on commercial and industrial loans and commercial real estate loans.[6]

Although well below margins for other classifications, last year's increase in adjusted net interest margin for the nation's largest banks contributed significantly to the overall margin expansion for the industry. Interest expenses dropped significantly in 1991 as short-term interest rate declines were particularly pronounced. Banks with assets exceeding $1 billion usually experience slightly better interest earnings but markedly higher interest expenses per dollar of interest-earning assets than banks in any other classification. In recent years, these banks, which raise greater proportions of their funds in the money market than other banks, have paid interest expenses 25 percent above the average faced by banks in smaller categories. Consequently, the largest banks' interest margins, notwithstanding additions to loan-loss provisions, would be lower than margins earned by those in smaller asset categories. The same pattern held true for 1991, but the interest expense disadvantage for the largest banks dropped last year from 25 percent to 14 percent. Accordingly, the adjusted net interest margin for the largest banks across the nation rose to 2.74 percent of interest-earning assets from 2.60 percent the year before.

Adjusted net interest margins for small and midsize banks increased moderately as these banks reduced additions to loan-loss provisions during 1991. Declines in interest revenue and interest expense were approximately equal for these banks. Commercial banks with assets between $500 million and $1 billion posted lower adjusted net interest margins because of increased loan-loss provisions and a greater decrease in interest revenue relative to interest expense. Last year's interest revenue decline for this size class was greater than all other asset classes except the largest. Interest expenses dropped noticeably for banks in the $500 million to $1 billion asset-size category, but the reduction was not enough to offset diminished interest revenues. Moreover, these larger banks' rise in nonperforming loans as a percentage of total loans last year was surpassed only by that of the nation's largest banks (see Table 5).

In recent years, the percentage of banks with assets between $500 million and $1 billion that recorded negative returns on assets has been less than the comparable proportion for banks with assets exceeding $1 billion. For example, 12.3 percent and 13.8 percent of banks with assets of from $500 million to $1 billion had negative ROAs in 1991 and 1990, respectively. Comparable respective figures of 17.7 percent and 20.0 percent for banks with assets greater than $1 billion held for 1991 and 1990.

The average performance of these two largest size categories appears to be tied to problems of larger banks in New England (consisting of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) and the Mid-Atlantic region (defined here as New Jersey, New York, and Pennsylvania). For banks in these two categories about 50 percent that posted negative ROAs in 1990 were based in the New England and Mid-Atlantic regions, and the proportion for 1991 was approximately 40 percent.

Commercial banks with assets less than $25 million continued to build on a recovery that began in 1987 as they tied with banks in the $25 million to $50 million asset-size category to record the highest 1991 adjusted net interest margin among the various size categories. Although the smallest banks' returns on assets (0.64 percent) exceeded returns for the two largest size groups, their ROAs remained below figures for midsize banks, as mentioned earlier. Indeed, midsize banks have earned substantially better returns on assets than the smallest banks for the last two years even though adjusted interest margins for these banks slid below margins for the smallest banks. Comparatively larger loan-loss provisions made by the nation's smallest banks before 1989 reduced their profitability. However, additions to loan-loss provisions for these banks since 1989 have been the same or markedly below provisions for midsize banks, and interest margins during these years, irrespective of additions to loan-loss provisions, have been essentially equal for the smallest and midsize banks. Accordingly, adjusted net interest margins for the smallest banks surpassed those for midsize banks in 1990 and 1991, leading to the conclusion that low returns on assets for banks with assets less than $25 million nationwide are largely attributable to high noninterest operating expenses. Noninterest expenses relative to total assets for banks in this class averaged 3.9 percent of total assets during the 1987-91 period, noticeably exceeding ratios logged by other asset-size classifications.

The smallest asset-size classification has diminished with respect to the actual number of banks and in the proportion of total banks nationally and regionally during the past five years. Banks in the nation with assets less than $25 million totaled 4,305 in 1987 (32.7 percent of all size banks that year), and for 1991 these banks were 2,846 in number (24.7 percent of the total) across the country. In the Southeast the smallest bank class had 380 institutions (24.5 percent of all southeastern banks) in 1987, and for 1991 banks in this category equaled 241 (15.3 percent of the regional total). This category has declined in size because many of these banks (both healthy and weak) were acquired by or merged into larger institutions. Many other small banks moved into larger size categories through asset growth.

With rising delinquencies, particularly on commercial real estate and commercial and industrial loans, nonperforming loans for the banking industry increased steadily over the 1989-91 period, from 2.97 percent of total loans in 1989 to 3.76 percent last year.[7] This two-year rise is attributable to sharply increasing nonperforming loans for the two largest size groups. The ratio of nonperforming loans to total loans for the nation's largest banks has risen most and stands much higher, at 4.34 percent of total loans, than figures posted for all other size categories, including banks with assets between $500 million and $1 billion. Although nonperforming loan amounts have increased across the nation, sour commercial real estate loans held by large banks in the Northeast during recent years have contributed greatly to rising nationwide figures. In the West, California banks began to encounter serious repayment problems on their commercial real estate loans in 1991.[8] On the other hand, nonperforming loan-to-total loan ratios for each of the first three asset-size classes (banks with assets up to $100 million) generally declined throughout the 1987-91 period.

Net operating income for 1991 was roughly equal to the preceding year's income as changes in noninterest income and expense (see Tables 6 and 7) counterbalanced the advance in adjusted interest margin for U.S. commercial banks. Noninterest expenses advanced more than noninterest revenues for all asset classes, but the net change was greatest for the nation's largest banks. About one-quarter of the increase in noninterest expenses for the industry represented costs associated with higher deposit insurance premiums (see "Commercial Banking Performance" 1991). Other components of noninterest expense—wage and salary costs and occupancy expense—remained unchanged as a proportion of the industry's total assets. The residual category of noninterest expenses, which includes deposit insurance premiums, moved up sharply in 1991.

A $3 billion net gain from sales of Treasuries and other securities contributed earnings that approximated the year's increase in return on assets and equity for commercial banks nationwide (see Tables 8 and 9). Declining interest rates in 1991 allowed banks to take profits on these investments as securities' prices rose during the year. Most sales were made during the fourth quarter (see "Bond Sales" 1992). Although banks of all sizes benefited from investment securities sales last year, these gains relative to total assets of banks with assets greater than $1 billion were about twice as large as gains posted by small and midsize banks across the country.

Changes in return on equity closely reflected ROA changes, but increases in capital-to-asset ratios for most asset classifications tempered ROE gains for the nation's commercial banks last year (see Table 10). As in previous years, larger banks' lower capital ratios allowed them to return more on book value of equity for every dollar of ROA.[9] Although the ROE for the nation's smallest banks stands below equity returns for all other categories, this group's recent history of steady improvement suggests that small banks have regained some of their competitive vitality, and shareholder interest may not diminish.

## Southeastern Banks

Overall profitability for southeastern banks as a group was buoyed by markedly better profitability for the region's largest banks. Last year's returns on assets also advanced for most other asset-size categories.[10] Unlike during 1990, when additions to loan-loss provisions for the largest southeastern banks matched those of national counterparts, last year's provisions for the region's largest bank group fell by almost one-fifth to 1.08 percent of interest-earning assets.[11] (Data on southeastern banks' profitability are in Tables 11-20.) Accordingly, adjusted net interest margin for the region's largest banks rose from 3.17 percent of interest-earning assets to 3.57 percent. Returns on assets for these banks increased from 0.41 percent to 0.60 percent, and returns on equity advanced from 6.47 percent to 8.80 percent last year. Returns were raised significantly by gains from investment securities sales, which equaled 0.14 percent (before taxes) of total assets and far outweighed the gains recorded by other regional and national asset classes.

The largest southeastern banks' reduced additions to loan-loss provisions in 1991 indicate that they may be resolving repayment problems associated with their nonperforming loans, particularly commercial real estate loans (see "How Banks Are Doing" 1992). In 1990 and 1991 they recorded nonperforming loan-to-total loan ratios one-third below figures for their national counterparts, and last year's rise in nonperforming loans for the largest regional banks was significantly less than the increase posted by banks in this size category across the nation. Nonperforming loans as a percentage of total loans, though, have increased for most regional size groups during the last two years. Since 1989 the first five regional asset classifications have posted nonperforming loan-to-total loan ratios that approximate national figures.

Additions to loan-loss provisions taken by the region's banks in the three smallest categories during 1991 surpassed those taken by their respective national counterparts, providing the main reason that ROAs for these banks fell short of returns registered by the nation's banks in the same categories. Additionally, the smallest regional banks experienced a relatively greater decline in interest revenue vis-a-vis interest expense. Profitability for the nation's smallest banks advanced to respectable levels during the 1987-91 period, but earnings performance for the region's smallest banks was quite unimpressive throughout these years partly because of higher additions to loan-loss provisions and occasionally unfavorable changes in interest revenue versus interest expense. In 1991 the Southeast's smallest banks returned a slim 0.20 percent on assets compared with 0.64 percent for their national counterparts. In addition, noninterest operating expenses have been extraordinarily high and have restrained earnings performance for these banks.

A significant part of poor returns on assets and equity for the smallest southeastern banks is traceable to a concentration of new small banks in Florida and Georgia. The average return on assets for Florida's smallest banks was negative for the entire 1987-91 period, and ROA for Georgia's banks in this category dwindled to near zero in 1991.[12] Banks established in the Southeast (and the nation) during the past five years are concentrated in Florida and Georgia. Many more de novo banks were established in these states from 1987 to 1991 than elsewhere, including the nation's most populous states. Since January 1987, 101 and 87 new banks have commenced operations in Florida and Georgia, respectively. California, Texas, and New Jersey hold distant third-, fourth-, and fifth-place positions with 57, 34, and 32 de novo bank establishments, respectively, during the same period. Many of these banks in Florida and Georgia have grown slowly and are recording high noninterest expenses relative to size. Hence, their return on assets is quite low or negative. In Florida and Georgia, respectively, 61 and 27 small banks had negative returns on assets in 1991, and slightly more than one-half of these unprofitable banks in each state opened for business within the past five years.

Despite slight returns at the region's smallest banks, southeastern banks as a whole recorded a 0.67 percent return on assets compared with a 0.55 percent figure for U.S. commercial banks. The ROA for U.S. commercial banks was crimped by poor profitability performance of banks in the New England and Mid-Atlantic regions. If banks of all size categories in these two regions are excluded, last year's return on assets in all other states was a more respectable 0.71 percent.

The region's overall gain on investment securities as a proportion of total assets was moderately higher than advances for the banking industry overall. Returns on assets increased for the region's midsize banks and banks with assets between $500 million and $1 billion. Gains on investment securities also added appreciably to returns for these midsize and larger banks, as well as to returns for the two smallest southeastern bank classifications.

Southeastern states' economic performance during the 1990-91 recession noticeably influenced bank profitability for component states. During the late 1980s the economies of Georgia and Florida consistently outperformed other regional states', but during the recent recession these states were the region's worst performers in terms of employment and personal income growth. Louisiana and Mississippi seemed most immune to the national downturn while the economies in Alabama and Tennessee closely mirrored the national economy during the last two years (see "Southeastern Recovery Stumbles" 1991). Alabama banks, which have maintained good asset quality and added only moderately to loan-loss provisions, continued to lead the region in profitability with a 1.04 percent return on assets for 1991. Notable changes, however, occurred in other southeastern states (see Tables 21-26). Mississippi banks, which have earned consistently respectable profits throughout the 1987-91 period, captured second place last year with an ROA of 0.90 percent. Although Georgia banks had scored the highest ROA in the Southeast in 1989 and earlier, profitability for this state's banks ranked third during the most recent year. Tennessee banks rebounded from lackluster returns in 1990 by slashing last year's additions to loan-loss provisions. Although additions to loan-loss provisions remain high for Florida banks, last year's statewide reduction helped raise the return on assets for Florida banks to 0.50 percent.

Louisiana banks, which had been awash in red ink, recorded a 0.20 percent and 0.22 percent return on assets for 1990 and 1991, respectively. Profitability for Louisiana banks has been modest or negative since 1986, the year in which oil prices dropped from previously robust levels. Louisiana banks, though, may have achieved a measure of success in working out problem loans as their returns on assets and equity during the past two years rose through lower additions to loan-loss provisions.

## The Distribution of Bank Profitability

Examining changes in overall profitability for banks of differing profitability levels reveals certain clues about the ways banks have responded to difficulties facing them and other financial institutions during the 1980s and early 1990s. One way to analyze banks' profitability distribution within a given asset-size category is to rank all its banks in ascending order of profitability, divide the group into quartiles, and describe the profitability of the most profitable bank in each quartile. For example, the bank with the highest ROA in the first (lowest) quartile would be the one at the 25th percentile; that is, 25 percent of all banks in a particular size category are less profitable than the bank at the 25th percentile. The change in profitability of the bank at the 25th percentile over time would suggest the degree to which the least profitable banks in that asset category are experiencing earnings improvement or deterioration. Likewise, movements in the ROA for the bank at the 75th percentile over time would indicate changes in the earnings of the more profitable banks in that size category. A rise in profitability over time at the various percentiles suggests improved conditions; downward movements indicate deterioration. Tables 27-29 present the national profitability distribution for each of the six asset-size categories during the past five years.

The banks with the lowest profitability in nearly all size classes demonstrated improved profitability in 1991. The sole exception was in the category of banks having assets between $100 million and $500 million; that bank's return on assets stayed the same. Last year's proportionate advance among the least profitable banks was greatest for the largest asset class, where ROA more than doubled from the previous year. Return on assets for the lowest quartile banks with assets less than $25 million and with assets between $500 million and $1 billion also increased markedly. After declining in 1990, ROA for most 50th percentile and 75th percentile banks in various asset groups advanced last year. Mid- and upper-quartile banks with assets of $500 million to $1 billion were the exception as returns for these banks diminished. Like banks in the weakest quartile, profitability among the nation's average and most profitable banks improved greatly for the largest banks.

## Conclusion

Two major forces drove profitability of the nation's banks in 1991. While falling interest rates brought down both interest revenues and expenses, banks succeeded in cutting expenses by a greater amount than revenue dropped. Banks also took advantage of declining interest rates to profit from securities sales. At the same time that banks benefited from falling interest rates, however, increasing FDIC insurance fees and other operating costs partially offset their gains.

Benefits related to interest rate declines may well be cyclical, particularly gains from securities sales. Increased deposit insurance costs, on the other hand, seem likely to be with banks for some time to come. In addition, nonperforming loan ratios continued to rise at banks with assets greater than $50 million. Consequently, the improved bank profitability seen in 1991 may well be a temporary hiatus rather than a signal that the worst is over for the nation's banks.

## Appendix

### Profitability Measures

Three different measures have been used to provide information on bank performance: adjusted net interest margin, return on assets, and return on equity. Adjusted net interest margin gauges the difference between a bank's interest income and expenses and is roughly similar to a business's gross profit margin. Gross profit is the amount received from sales minus the cost of goods or services sold; other expenses such as sales, advertising, salaries, and rent have not been deducted. For banks, this indicator is calculated by subtracting interest expense from tax-adjusted interest revenue (net of loan-loss provisions) and dividing that result by net interest-earning assets. For this calculation, interest revenue from tax-exempt securities is adjusted upward by the bank's marginal tax rate to avoid penalizing institutions that hold substantial state and local securities portfolios, which reduce tax burdens.

Loan-loss expenses are subtracted from interest revenue to place banks that make lower-risk loans at lower interest rates on a more equal footing with commercial banks that make higher-risk loans, which can generate greater interest income. For example, interest rates on credit cards have been substantially higher than rates on prime commercial loans, but loan losses on credit cards have also been larger. Charge-offs on credit cards were 3.4 percent of total credit card volume in 1990 for the nation's top 100 banks in credit card operations, according to "Top 100 Banks" (1991).

Banks also bring in noninterest revenue in the form of loan origination fees; deposit service charges; and charges for letters of credit, loan commitments, and other off-balance-sheet services, to name a few. Gains from sales of securities also provide added income. Moreover, banks incur noninterest expenses such as expenditures on employee salaries, computer equipment, and maintenance. Therefore, Bank X with a comparatively low adjusted interest margin may achieve a higher return on assets than Bank Y, which attained a larger margin. That is, Bank X may record a higher return on assets by realizing higher noninterest revenues or lower noninterest expenses.

The return on assets (ROA) ratio—the result of dividing a bank's net income by its average assets—gauges how well a bank's management is using the firm's assets. The return on equity (ROE) figure tells a bank's shareholders how much the institution is earning on the book value of their investments. ROE is calculated by dividing a bank's net income by its total equity. The ratio of ROA to ROE falls as the bank's capital-to-assets ratio rises. Smaller banks typically have higher capital-to-assets ratios.

Analysts who want to compare profitability while ignoring differences in equity capital ratios tend to focus on ROA. People wishing to focus on returns to shareholders look at ROE. Highly capitalized banks that post the same return on assets as less well capitalized competitors will record a lower return on equity. Because return on equity is computed by dividing a bank's net income by its capital reserve, a bank's return on equity will decline as its capital reserve increases, assuming net income remains fixed.

**Profitability Data and Calculations**

The data in this article are taken from reports of condition and income filed with federal bank regulators by insured commercial banks. The sample consists of all banks that had the same identification number at the beginning and end of each year. The number of banks in the 1991 sample is 11,519.

The three profitability measures used in this study are defined as follows:

Adjusted Net Interest Margin =

$$\frac{\text{Expected Interest Revenues} - \text{Interest Expense}}{\text{Average Interest-Earning Assets}}$$

Return on Assets =

$$\frac{\text{Net Income}}{\text{Average Consolidated Assets}}$$

Return on Equity =

$$\frac{\text{Net Income}}{\text{Average Equity Capital}}$$

Average interest-earning assets, consolidated assets, and equity capital are derived by averaging beginning-, middle-, and end-of-year balance sheet figures. The expected interest income component to net interest margin incorporates two significant adjustments from ordinary interest income. If profits before tax are greater than zero, the lesser of revenue from state and local securities exempt from federal tax or the bank's profits before tax is divided by 1 minus the bank's marginal federal tax rate. Loan-loss expenses are subtracted from interest revenue.

## Table 1
**Adjusted Net Interest Margin as a Percentage of Interest-Earning Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 2.65 | 3.75 | 3.89 | 4.07 | 4.15 | 3.85 | 1.98 |
| 1988 | 3.74 | 4.03 | 4.15 | 4.26 | 4.26 | 3.85 | 3.55 |
| 1989 | 3.13 | 4.24 | 4.32 | 4.38 | 4.38 | 4.17 | 2.61 |
| 1990 | 3.06 | 4.26 | 4.24 | 4.23 | 4.11 | 3.97 | 2.60 |
| 1991 | 3.15 | 4.29 | 4.29 | 4.25 | 4.14 | 3.70 | 2.74 |

Source: Figures in all tables have been computed by the Federal Reserve Bank of Atlanta from data in "Consolidated Reports of Condition for Insured Commercial Banks" and "Consolidated Reports of Income for Insured Commercial Banks," 1987-91, filed with each bank's respective regulator.

## Table 2
**Tax-Equivalent Interest Revenue as a Percentage of Interest-Earning Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 9.84 | 9.78 | 9.86 | 9.89 | 9.97 | 9.98 | 9.81 |
| 1988 | 10.68 | 10.11 | 10.17 | 10.26 | 10.33 | 10.34 | 10.87 |
| 1989 | 11.67 | 10.76 | 10.91 | 10.96 | 11.20 | 11.31 | 11.90 |
| 1990 | 11.28 | 10.59 | 10.68 | 10.67 | 10.79 | 11.13 | 11.49 |
| 1991 | 10.06 | 9.86 | 10.00 | 9.99 | 10.03 | 9.95 | 10.09 |

## Table 3
**Loan-Loss Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 1.49 | 0.92 | 0.81 | 0.68 | 0.69 | 0.90 | 1.84 |
| 1988 | 0.65 | 0.72 | 0.63 | 0.57 | 0.59 | 0.79 | 0.66 |
| 1989 | 1.11 | 0.59 | 0.56 | 0.50 | 0.59 | 0.69 | 1.33 |
| 1990 | 1.11 | 0.49 | 0.50 | 0.50 | 0.66 | 0.98 | 1.31 |
| 1991 | 1.17 | 0.40 | 0.44 | 0.47 | 0.63 | 1.07 | 1.40 |

**Table 4**
**Interest Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 5.71 | 5.11 | 5.16 | 5.14 | 5.13 | 5.23 | 5.98 |
| 1988 | 6.29 | 5.36 | 5.39 | 5.43 | 5.47 | 5.69 | 6.66 |
| 1989 | 7.43 | 5.93 | 6.04 | 6.07 | 6.23 | 6.45 | 7.96 |
| 1990 | 7.11 | 5.83 | 5.94 | 5.93 | 6.00 | 6.19 | 7.58 |
| 1991 | 5.73 | 5.17 | 5.26 | 5.26 | 5.26 | 5.19 | 5.95 |

**Table 5**
**Nonperforming Loans as a Percentage of Total Loans**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 3.63 | 3.63 | 3.10 | 2.72 | 2.27 | 2.48 | 4.08 |
| 1988 | 3.11 | 2.98 | 2.66 | 2.31 | 2.01 | 2.52 | 3.44 |
| 1989 | 2.97 | 2.59 | 2.31 | 2.10 | 1.96 | 2.09 | 3.32 |
| 1990 | 3.38 | 2.25 | 2.14 | 2.01 | 2.05 | 2.32 | 3.85 |
| 1991 | 3.76 | 2.12 | 2.08 | 2.03 | 2.19 | 2.73 | 4.34 |

**Table 6**
**Noninterest Income as a Percentage of Total Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 1.39 | 0.97 | 0.76 | 0.74 | 0.92 | 1.13 | 1.62 |
| 1988 | 1.44 | 0.91 | 0.75 | 0.82 | 0.90 | 1.12 | 1.68 |
| 1989 | 1.52 | 1.08 | 0.78 | 0.86 | 0.98 | 1.11 | 1.76 |
| 1990 | 1.64 | 1.09 | 0.82 | 0.83 | 0.94 | 1.26 | 1.91 |
| 1991 | 1.73 | 1.09 | 0.85 | 0.88 | 1.05 | 1.24 | 2.02 |

**Table 7**
**Total Noninterest Expense as a Percentage of Total Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 3.34 | 3.87 | 3.39 | 3.24 | 3.32 | 3.58 | 3.31 |
| 1988 | 3.37 | 3.84 | 3.39 | 3.31 | 3.36 | 3.49 | 3.35 |
| 1989 | 3.39 | 3.86 | 3.41 | 3.31 | 3.40 | 3.34 | 3.39 |
| 1990 | 3.50 | 3.94 | 3.45 | 3.32 | 3.34 | 3.54 | 3.53 |
| 1991 | 3.73 | 3.99 | 3.56 | 3.39 | 3.47 | 3.59 | 3.81 |

**Table 8**
**Securities Gains (Losses) before Taxes as a Percentage of Total Assets***
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.05 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 |
| 1988 | 0.01 | 0.00 | (0.00) | 0.01 | 0.01 | 0.00 | 0.01 |
| 1989 | 0.02 | 0.00 | 0.01 | 0.01 | 0.01 | (0.00) | 0.03 |
| 1990 | 0.01 | 0.00 | 0.00 | 0.00 | (0.00) | 0.01 | 0.02 |
| 1991 | 0.09 | 0.04 | 0.05 | 0.05 | 0.06 | 0.07 | 0.10 |

**0.00 indicates securities gains (losses) that are less than 0.01 percent of total assets.*

**Table 9**
**Percentage Return on Assets**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.09 | 0.26 | 0.46 | 0.66 | 0.73 | 0.51 | −0.15 |
| 1988 | 0.83 | 0.36 | 0.61 | 0.77 | 0.80 | 0.58 | 0.89 |
| 1989 | 0.50 | 0.60 | 0.73 | 0.88 | 0.91 | 0.88 | 0.35 |
| 1990 | 0.50 | 0.60 | 0.71 | 0.81 | 0.79 | 0.77 | 0.39 |
| 1991 | 0.55 | 0.64 | 0.75 | 0.86 | 0.85 | 0.56 | 0.45 |

### Table 10
**Percentage Return on Equity**
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 1.49 | 2.75 | 5.39 | 8.02 | 9.93 | 7.51 | −2.80 |
| 1988 | 13.51 | 3.79 | 6.96 | 9.15 | 10.53 | 8.67 | 16.40 |
| 1989 | 7.85 | 6.15 | 8.14 | 10.12 | 11.81 | 12.72 | 6.21 |
| 1990 | 7.81 | 6.02 | 7.81 | 9.29 | 10.14 | 10.37 | 6.86 |
| 1991 | 8.21 | 6.46 | 8.10 | 9.68 | 10.78 | 7.85 | 7.49 |

### Table 11
**Adjusted Net Interest Margin as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 4.23 | 4.13 | 4.24 | 4.38 | 4.44 | 3.58 | 4.21 |
| 1988 | 4.34 | 4.30 | 4.27 | 4.35 | 4.39 | 4.14 | 4.35 |
| 1989 | 3.92 | 4.20 | 4.37 | 4.33 | 4.35 | 3.61 | 3.73 |
| 1990 | 3.56 | 4.12 | 4.30 | 4.15 | 4.17 | 4.05 | 3.17 |
| 1991 | 3.81 | 4.02 | 4.20 | 4.21 | 4.21 | 3.92 | 3.57 |

### Table 12
**Tax-Equivalent Interest Revenue as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 10.20 | 10.21 | 10.30 | 10.25 | 10.14 | 9.95 | 10.23 |
| 1988 | 10.64 | 10.55 | 10.55 | 10.52 | 10.43 | 10.42 | 10.75 |
| 1989 | 11.24 | 11.31 | 11.37 | 11.24 | 11.17 | 11.14 | 11.26 |
| 1990 | 10.91 | 10.87 | 11.01 | 10.90 | 10.86 | 11.41 | 10.85 |
| 1991 | 9.97 | 9.98 | 10.28 | 10.21 | 10.09 | 9.94 | 9.87 |

**Table 13**
**Loan-Loss Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.81 | 0.97 | 0.87 | 0.69 | 0.69 | 1.21 | 0.80 |
| 1988 | 0.65 | 0.71 | 0.69 | 0.58 | 0.63 | 0.56 | 0.67 |
| 1989 | 0.79 | 0.84 | 0.62 | 0.53 | 0.60 | 0.96 | 0.88 |
| 1990 | 1.07 | 0.75 | 0.56 | 0.62 | 0.66 | 1.04 | 1.31 |
| 1991 | 0.90 | 0.62 | 0.59 | 0.61 | 0.61 | 0.76 | 1.08 |

**Table 14**
**Interest Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 5.17 | 5.11 | 5.19 | 5.19 | 5.01 | 5.16 | 5.21 |
| 1988 | 5.65 | 5.54 | 5.59 | 5.60 | 5.41 | 5.72 | 5.73 |
| 1989 | 6.53 | 6.27 | 6.38 | 6.37 | 6.22 | 6.57 | 6.65 |
| 1990 | 6.28 | 6.01 | 6.16 | 6.13 | 6.03 | 6.31 | 6.38 |
| 1991 | 5.26 | 5.34 | 5.49 | 5.40 | 5.27 | 5.25 | 5.22 |

**Table 15**
**Nonperforming Loans as a Percentage of Total Loans**
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 2.22 | 3.04 | 2.81 | 2.79 | 2.41 | 3.23 | 1.88 |
| 1988 | 1.90 | 2.53 | 2.53 | 2.29 | 2.08 | 2.47 | 1.67 |
| 1989 | 1.89 | 2.50 | 2.19 | 1.93 | 1.99 | 2.52 | 1.75 |
| 1990 | 2.43 | 2.31 | 2.16 | 2.05 | 2.14 | 2.46 | 2.57 |
| 1991 | 2.58 | 2.33 | 2.22 | 2.05 | 2.13 | 2.50 | 2.81 |

## Table 16
**Securities Gains (Losses) before Taxes as a Percentage of Total Assets***

*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.03 | 0.01 | 0.02 | 0.02 | 0.03 | 0.05 | 0.03 |
| 1988 | 0.02 | (0.01) | 0.00 | 0.01 | 0.01 | 0.02 | 0.02 |
| 1989 | 0.03 | (0.00) | 0.01 | 0.01 | (0.00) | 0.00 | 0.04 |
| 1990 | 0.02 | 0.00 | (0.00) | (0.01) | (0.01) | 0.01 | 0.03 |
| 1991 | 0.11 | 0.07 | 0.06 | 0.05 | 0.07 | 0.04 | 0.14 |

** 0.00 indicates securities gains (losses) that are less than 0.01 percent of total assets.*

## Table 17
**Noninterest Income as a Percentage of Total Assets**

*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 1.24 | 2.15 | 0.81 | 0.87 | 1.01 | 1.33 | 1.36 |
| 1988 | 1.22 | 1.40 | 0.86 | 1.09 | 1.04 | 1.25 | 1.31 |
| 1989 | 1.18 | 1.50 | 0.85 | 1.05 | 1.07 | 1.35 | 1.23 |
| 1990 | 1.27 | 1.38 | 0.91 | 1.06 | 1.09 | 1.12 | 1.39 |
| 1991 | 1.35 | 2.04 | 0.90 | 1.15 | 1.17 | 1.19 | 1.48 |

## Table 18
**Total Noninterest Expense as a Percentage of Total Assets**

*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 3.61 | 5.11 | 3.59 | 3.45 | 3.53 | 3.83 | 3.58 |
| 1988 | 3.61 | 4.59 | 3.71 | 3.59 | 3.59 | 3.56 | 3.59 |
| 1989 | 3.48 | 4.72 | 3.64 | 3.46 | 3.53 | 3.62 | 3.41 |
| 1990 | 3.54 | 4.79 | 3.69 | 3.58 | 3.48 | 3.71 | 3.49 |
| 1991 | 3.72 | 5.30 | 3.74 | 3.72 | 3.59 | 3.60 | 3.74 |

## Table 19
## Percentage Return on Assets
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.77 | 0.31 | 0.52 | 0.73 | 0.78 | 0.45 | 0.86 |
| 1988 | 0.82 | 0.30 | 0.51 | 0.81 | 0.78 | 0.86 | 0.87 |
| 1989 | 0.67 | 0.20 | 0.64 | 0.89 | 0.85 | 0.55 | 0.62 |
| 1990 | 0.53 | 0.05 | 0.64 | 0.71 | 0.81 | 0.65 | 0.41 |
| 1991 | 0.67 | 0.20 | 0.61 | 0.78 | 0.89 | 0.68 | 0.60 |

## Table 20
## Percentage Return on Equity
*(Insured commercial banks in the Southeast by consolidated assets)*

| Year | All SE Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 11.14 | 2.82 | 5.70 | 8.61 | 10.27 | 6.90 | 13.99 |
| 1988 | 11.60 | 2.80 | 5.48 | 9.41 | 10.18 | 12.85 | 13.71 |
| 1989 | 9.52 | 1.79 | 6.71 | 9.98 | 10.99 | 8.29 | 9.79 |
| 1990 | 7.30 | 0.39 | 6.77 | 8.00 | 10.36 | 7.65 | 6.47 |
| 1991 | 9.04 | 1.76 | 6.40 | 8.70 | 11.33 | 9.77 | 8.80 |

## Table 21
## Adjusted Net Interest Margin as a Percentage of Interest-Earning Assets
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 4.23 | 4.49 | 4.27 | 4.93 | 2.95 | 4.33 | 4.18 |
| 1988 | 4.34 | 4.46 | 4.39 | 4.98 | 3.38 | 4.20 | 4.10 |
| 1989 | 3.92 | 4.15 | 3.84 | 4.74 | 2.89 | 4.00 | 3.66 |
| 1990 | 3.56 | 4.10 | 3.19 | 4.29 | 3.05 | 3.86 | 3.37 |
| 1991 | 3.81 | 4.22 | 3.58 | 4.20 | 3.07 | 4.18 | 3.91 |

**Table 22**
**Tax-Equivalent Interest Revenue as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 10.20 | 10.06 | 10.08 | 11.04 | 9.80 | 10.20 | 9.99 |
| 1988 | 10.64 | 10.61 | 10.47 | 11.20 | 10.54 | 10.33 | 10.59 |
| 1989 | 11.24 | 11.20 | 11.00 | 12.01 | 10.89 | 11.04 | 11.28 |
| 1990 | 10.91 | 10.80 | 10.70 | 11.39 | 10.48 | 10.74 | 11.31 |
| 1991 | 9.97 | 10.06 | 9.83 | 10.51 | 9.34 | 9.93 | 9.97 |

**Table 23**
**Loan-Loss Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 0.81 | 0.44 | 0.77 | 0.73 | 1.59 | 0.60 | 0.65 |
| 1988 | 0.65 | 0.32 | 0.59 | 0.55 | 1.29 | 0.46 | 0.74 |
| 1989 | 0.79 | 0.42 | 0.79 | 0.58 | 1.51 | 0.52 | 0.96 |
| 1990 | 1.07 | 0.47 | 1.22 | 0.98 | 1.23 | 0.63 | 1.35 |
| 1991 | 0.90 | 0.54 | 1.03 | 0.95 | 1.11 | 0.49 | 0.79 |

**Table 24**
**Interest Expense as a Percentage of Interest-Earning Assets**
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 5.17 | 5.13 | 5.03 | 5.38 | 5.26 | 5.26 | 5.16 |
| 1988 | 5.65 | 5.83 | 5.48 | 5.68 | 5.87 | 5.66 | 5.75 |
| 1989 | 6.53 | 6.64 | 6.38 | 6.69 | 6.49 | 6.51 | 6.67 |
| 1990 | 6.28 | 6.23 | 6.29 | 6.12 | 6.20 | 6.25 | 6.59 |
| 1991 | 5.26 | 5.30 | 5.23 | 5.36 | 5.15 | 5.26 | 5.28 |

## Table 25
### Percentage Return on Assets
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 0.77 | 1.08 | 0.75 | 1.13 | −0.07 | 0.87 | 0.89 |
| 1988 | 0.82 | 1.16 | 0.78 | 1.15 | 0.03 | 0.85 | 0.85 |
| 1989 | 0.67 | 1.01 | 0.61 | 1.08 | −0.13 | 0.78 | 0.60 |
| 1990 | 0.53 | 1.03 | 0.28 | 0.93 | 0.20 | 0.71 | 0.42 |
| 1991 | 0.67 | 1.04 | 0.50 | 0.87 | 0.22 | 0.90 | 0.77 |

## Table 26
### Percentage Return on Equity
*(Insured commercial banks in the Southeast by state)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 11.14 | 13.28 | 12.04 | 16.11 | −0.93 | 11.46 | 12.31 |
| 1988 | 11.60 | 14.39 | 12.14 | 15.78 | 0.36 | 10.94 | 11.62 |
| 1989 | 9.52 | 12.56 | 9.54 | 14.46 | −1.86 | 9.88 | 8.23 |
| 1990 | 7.30 | 13.08 | 4.25 | 11.32 | 2.94 | 9.17 | 5.75 |
| 1991 | 9.04 | 13.53 | 7.31 | 10.06 | 3.28 | 11.67 | 10.64 |

## Table 27
### Percentage Return on Assets
### 25th Percentile According to Profitability
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.09 | −0.03 | 0.35 | 0.52 | 0.58 | 0.47 | 0.30 |
| 1988 | 0.83 | 0.20 | 0.53 | 0.64 | 0.70 | 0.56 | 0.71 |
| 1989 | 0.50 | 0.37 | 0.58 | 0.70 | 0.76 | 0.64 | 0.50 |
| 1990 | 0.50 | 0.36 | 0.53 | 0.63 | 0.65 | 0.41 | 0.10 |
| 1991 | 0.55 | 0.46 | 0.56 | 0.68 | 0.65 | 0.54 | 0.22 |

## Table 28
## Percentage Return on Assets
## 50th Percentile According to Profitability
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.09 | 0.67 | 0.84 | 0.92 | 0.96 | 0.94 | 0.86 |
| 1988 | 0.83 | 0.78 | 0.93 | 0.98 | 1.04 | 1.00 | 1.02 |
| 1989 | 0.50 | 0.84 | 0.98 | 1.04 | 1.07 | 1.06 | 0.96 |
| 1990 | 0.50 | 0.82 | 0.93 | 0.98 | 1.01 | 0.98 | 0.74 |
| 1991 | 0.55 | 0.86 | 0.95 | 1.00 | 1.01 | 0.94 | 0.81 |

## Table 29
## Percentage Return on Assets
## 75th Percentile According to Profitability
*(Insured commercial banks by consolidated assets)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 0.09 | 1.09 | 1.18 | 1.25 | 1.24 | 1.20 | 1.08 |
| 1988 | 0.83 | 1.14 | 1.24 | 1.28 | 1.33 | 1.29 | 1.21 |
| 1989 | 0.50 | 1.20 | 1.28 | 1.34 | 1.35 | 1.30 | 1.20 |
| 1990 | 0.50 | 1.16 | 1.23 | 1.26 | 1.28 | 1.30 | 1.12 |
| 1991 | 0.55 | 1.18 | 1.24 | 1.27 | 1.28 | 1.25 | 1.16 |

## Notes

1. Six size categories of commercial banks are analyzed in this study. They are (1) banks with total assets of no more than $25 million, (2) banks with total assets exceeding $25 million and at most $50 million, (3) banks with total assets greater than $50 million and no more than $100 million, (4) banks with total assets exceeding $100 million, up to $500 million, (5) banks with total assets exceeding $500 million and at most $1 billion, and (6) banks with total assets greater than $1 billion.

   Only banks that have been opened to the public for at least one full year are included in this study. The ratios displayed are full-year profitability figures based on beginning-, middle-, and end-of-year balance sheets and income statements. Banks that commence operations during any particular year will be missing beginning-of-year data and perhaps more. See Table A on the following page.

2. A loan-loss provision is a noncash expense item charged to a bank's earnings when expanding the allowance for possible bad debt. These provisions are reported on a bank's income statement. A bank does not set aside funds (cash) in reserve to cover its loan losses, and an increase in the loan-loss account does not directly cause any change in the allocation of a bank's assets.

   An increase in loan-loss provisions reduces the net value of the bank's loans on its accounting records and its net income. Increases in provisions will also have a negative impact on a bank's equity capital as reported in its accounting records (additions to loan-loss provisions are subtracted from bank equity) and may trigger regulatory demands for additional equity. See Wall (1988, 39-41).

3. Noninterest income is net income derived from fee-based banking services, such as corporate cash management, check collection, and consumer annual fees on credit cards, as well as monthly service charges on deposit accounts. Also included are many new activities, such as fees from participations in mutual fund commissions, investment advisor fees in merger and acquisition activities, and securities underwriting fees.

   Noninterest expenses are the fixed operating costs of a bank. They include salaries, rental of equipment, leases of buildings and equipment, deposit insurance costs, and taxes and other related expenses.

   "Consolidated Reports of Income for Insured Commercial Banks" filed by banks with their primary regulators have three noninterest expense components. They are (1) salaries and employee benefits, (2) expenses for premises and fixed assets, and (3) other noninterest expenses. Salaries and employee benefits account for almost half the total, expenses for premises and fixed assets absorb approximately 15 percent, and other noninterest costs equal about 40 percent of the total.

4. In this study *Southeast* refers to the six states entirely or partially within the Sixth Federal Reserve District: Alabama, Florida, Georgia, Louisiana, Mississippi, and Tennessee.

5. The revenue, expense, and profitability figures presented are generally similar to those displayed in prior bank profitability studies published in the *Economic Review* (see Goudreau and King 1991 for the most recent study). The figures may not be identical because the data have been corrected for reporting errors. Additionally, the interest revenue as a percentage of interest-earning assets ratio and adjusted net interest margins may differ from figures reported in previous studies because of corrections in the treatment of tax-exempt interest income.

6. Loan problems worsened in 1990, with the bulk of troubled loans shifting generally from sour commercial real estate lending in the Southwest. The 1990 deterioration was greatest in commercial real estate loans across the nation, although larger banks in the Northeast were hit hardest. The Northeast and other regions also experienced rising delinquencies on commercial and industrial loans.

   See "Commercial Banking Performance" (1990, 1991). Commercial and industrial (C&I) loans are made to corporations, commercial enterprises, or joint ventures, as opposed to loans to consumers. C&I loans can be a source of working capital or used to finance the purchase of manufacturing plants and equipment.

7. In this study, nonperforming loans are defined as loans past due 90 days or more and nonaccrual assets. Total nonperforming loans are expressed as a percentage of total loans.

   A nonaccrual asset is usually a loan that is not earning the contractual rate of interest in the loan agreement owing to financial difficulties of the borrower. Nonaccrual assets are loans for which interest accruals have been suspended because full collection of principal is in doubt or because interest payments have not been made for a sustained period of time.

8. Accordingly, California banks made significant additions to loan-loss provisions during the October-December quarter to account for anticipated losses. See "Commercial Banking Performance" (1991) and "How Banks Are Doing" (1992).

9. Equity-to-assets ratios for banks in the six asset classifications during the 1987-91 period are displayed in Table B. Equity-to-assets ratios, with few exceptions, have risen steadily for each size group during the five years under review. Larger banks maintain equity-to-assets ratios that are considerably lower than smaller competitors.

10. See Table C.

11. See Table D. See "Commercial Banking Performance" (1991) for troubled real estate loan rates for other states and regions.

12. See Table E. Total assets for the smallest banks in Florida and Georgia equaled 26 percent and 28 percent, respectively, of the southeastern total for 1991.

## Table A
## U.S. Commercial Banks, 1991

| Year | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|
| Number of Banks | 2,846 | 3,092 | 2,750 | 2,209 | 257 | 365 |
| Percent of U.S. Banks | 24.7 | 26.8 | 23.9 | 19.2 | 2.2 | 3.2 |
| Total Assets ($ billions) | 44.2 | 108.3 | 188.0 | 444.4 | 173.7 | 2,331.9 |
| Percent of U.S. Total Assets | 1.3 | 3.3 | 5.7 | 13.5 | 5.3 | 70.9 |

## Table B
## Equity-to-Total Assets Ratios
## U.S. Commercial Banks
*(Percent)*

| Year | All Banks | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|---|
| 1987 | 6.06 | 9.37 | 8.59 | 8.21 | 7.39 | 6.77 | 5.27 |
| 1988 | 6.17 | 9.41 | 8.82 | 8.44 | 7.56 | 6.72 | 5.43 |
| 1989 | 6.34 | 9.71 | 8.98 | 8.66 | 7.68 | 6.94 | 5.65 |
| 1990 | 6.36 | 9.95 | 9.06 | 8.73 | 7.80 | 7.39 | 5.64 |
| 1991 | 6.68 | 9.95 | 9.20 | 8.83 | 7.92 | 7.17 | 6.04 |

## Table C
## Southeastern Commercial Banks, 1991

| Year | $0-$25 million | $25-$50 million | $50-$100 million | $100-$500 million | $500 million-$1 billion | $1 billion+ |
|---|---|---|---|---|---|---|
| Number of Banks | 241 | 505 | 431 | 307 | 37 | 50 |
| Percent of S.E. Banks | 15.3 | 32.1 | 27.4 | 19.5 | 2.4 | 3.2 |
| Total Assets ($ billions) | 4.0 | 17.6 | 29.3 | 59.5 | 24.7 | 203.9 |
| Percent of S.E. Total Assets | 1.2 | 5.2 | 8.6 | 17.6 | 7.3 | 60.1 |

## Table D
## Troubled Real Estate Asset Rates*
*(December 31, 1991)*

| Year | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|
| Percent | 2.64 | 6.22 | 4.69 | 11.10 | 3.68 | 5.09 |

*Noncurrent real estate loans plus other real estate owned (OREO) as a percent of total real estate loans plus OREO*

## Table E
## Southeastern Banks with Assets of $25 Million or Less
## Percentage Return on Assets
*(Insured commercial banks by consolidated assets)*

| Year | All SE Banks | Alabama | Florida | Georgia | Louisiana | Mississippi | Tennessee |
|---|---|---|---|---|---|---|---|
| 1987 | 0.31 | 0.90 | −0.92 | 1.32 | −1.49 | 0.64 | 0.78 |
| 1988 | 0.30 | 0.84 | −0.77 | 0.82 | −0.84 | 0.90 | 0.92 |
| 1989 | 0.20 | 0.62 | −1.16 | 0.69 | 0.35 | 0.78 | 0.56 |
| 1990 | 0.05 | 0.59 | −0.94 | 0.33 | 0.43 | 0.56 | 0.19 |
| 1991 | 0.20 | 0.21 | −0.20 | 0.01 | 0.41 | 0.81 | 0.49 |

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# Review Essay

## *Edge City: Life on the New Frontier*

by Joel Garreau.
New York: Doubleday, 1991.
546 pages. $22.50.

**William Roberds**

History contains only a few individuals who have caused as much intellectual suffering as Johann Heinrich von Thünen. It was Thünen, an early nineteenth century Prussian economist, who brought the term "marginal" into the mainstream of economic analysis. As any student of economics can attest, there is no economic concept more venerated by professors and reviled by students than the idea of the "margin." Those students hoping to pass their first course in economics have to endure lectures featuring such narcolepsy-inducing concepts as marginal costs, marginal utility, marginal productivity, and marginal revenue.

Yet the pall cast by Thünen's work extends well beyond the confines of college economics courses into our everyday habits of thought. Thünen's idea of the margin derives from his celebrated model of an urban area. According to this theory, economic forces would cause such an area to have a genuine city only at its core, surrounded by concentric rings of more or less rural areas. The intensity of crop cultivation and density of population would decrease with distance from the central city and would terminate "at the edge of a wild and uncultivated zone," representing the outer margin of civilization. As quaint as Thünen's theory may sound to modern ears, this particular abstraction still shapes our "monocentric" language of urban configurations: We still speak of "central business districts," even though they may be neither central nor businesslike, and "suburbs" whose commercial and manufacturing capacity often outstrips that of the central city. And too often our private decisions and public policy debates are still couched in such Thünenesque terms.

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Perhaps the primary message of Joel Garreau's *Edge City: Life on the New Frontier* is an eloquent plea for its readers to cast off the intellectual cobwebs of Thünen's theory. In 1991 there are too many Gallerias, Silicon Valleys, Perimeter Centers, and other commercial centers (Garreau dubs them "edge cities") located outside of traditional downtown areas for people to speak sensibly in terms of central cities and suburbs. However, the most enjoyable feature of *Edge City* is its unique and readable collection of insights as to why so much of the U.S. population and commerce is now concentrated in edge cities or, in more concrete terms (no pun intended), why in recent years so much of the United States has started to look like Los Angeles.

One major factor contributing to the book's readability is the author's competence as a journalist. Nine of the ten chapters of *Edge City* each deal with a specific U.S. metropolitan area and its various edge-city developments. It is clear that Garreau has amassed a goodly amount of detailed information on these metropolitan areas, but he has managed to frame each area's situation in slightly different terms so that the presentation never becomes boring or redundant. Each chapter presents a fresh perspective on edge cities, offering new insights to both the local and national situation. The case of the Atlanta metro area, for example, is used to illustrate the black middle class's participation in the movement of commerce and population toward the edge cities.

The most important characteristic of Garreau's analysis is the quasi-economic nature of his basic approach. In refreshing contrast to many previous studies, *Edge City* does not begin by presuming that indoor shopping malls and the other characteristic edge-city constructs manifest the Spenglerian decline of Western civilization. Instead, Garreau acknowledges a number of reasons why rational people might prefer to live and work near major shopping malls and other edge-city developments, even though they might also find such developments aesthetically repugnant. He proposes that rational people might, for example, actually prefer shorter commuting times and the (at least perceived) mobility and status of commuting by automobile instead of by bus or train. People might prefer the cheaper housing and lower taxes historically offered by areas outside the central business district. People might prefer the security offered by a brightly lit, glass-elevatored, security-patrolled shopping mall to the relative insecurity of an older downtown shopping district. Garreau's point is that much of the development of edge cities is perhaps best explained as an attack of mass rationality (seeking out edge-city amenities) as opposed to an attack of mass hysteria (escaping the "evils" of downtown).[1]

Having admitted the possibility of rampant rationality in the U.S. population, economists may also admire the analysis in *Edge City* for making a clear distinction between the rationality of individuals and the desirability of market outcomes. To do this Garreau must at least implicitly calculate an economic equilibrium, which he does in Chapter 4. Rational people in the United States, it turns out, do want the convenience, low costs, and security offered by the urban periphery; yet at the same time there has not been a stampede to Dubuque. People want to enjoy the employment, shopping, and amusement opportunities that are typically available only in urban areas. Garreau calculates that a successful major retail mall, for example, needs a quarter-million customers within a fifteen-minute drive. And in most metropolitan areas, the price of land dictates that successful large malls will have to be multistory structures that include parking garages. The presence of such a mall, in turn, leads to other relatively high-density development in the vicinity. According to Garreau, this process is the essential trade-off of edge-city developments: the density of development necessary to bring "urban amenities" to outlying areas tends to undermine the advantages of accessibility and cost that initially brought development to these areas. He reckons that the critical point for most edge cities is reached near or before the ratio of floor space to land area (FAR) is 1.5. Stated differently, it is very difficult to develop edge cities in which the total area of floor space exceeds the total area of the land by more than 50 percent. At densities higher than 1.5 FAR, competition from newer, less densely developed edge cities makes additional growth difficult.

This point is the single most important one of the book, and it bears repeating. For all of our newfound ecological consciousness, most Americans do not like to walk or use public transportation. Garreau reports that the upper limit on walking distances in the United States, outside of airports and the old downtowns, is about 600 feet; any further, and most people will go by car. Faced with the similar choice of living or working in a congested central business district (FAR typically 5.0 or more), in a mature edge city (FAR approaching 1.5), or in a new, less congested edge-city area (FAR $<$ 1.0), the new edge city will almost always win hands down.

Garreau's arguments in favor of this point are tightly spun and backed with illustrative anecdotes and calculations. At the same time, he is careful not to let these arguments degenerate into apologia. Being well aware of the TV-villain image that our society has assigned to commercial real estate developers, he takes great pains not to minimize the negative aspects associated with edge-city developments. Garreau's journalistic abilities again come to the fore in his descriptions of some of the more prominent developers, in which he skillfully manages to depict the people behind the stereotypes.

In fact, *Edge City*'s most obvious shortcoming is that it is a bit too impartial in its assessment of the decentralization currently going on in U.S. metro areas. Granted, as a nation we seem to have strongly mixed views on what is happening, and *Edge City* reflects our wishy-washy state of mind. We are often outspoken in our condemnation of new development and frequently just as outspoken on our right to live in single-family houses on half-acre lots. Although Garreau very aptly shows how this conflict has led to the prevalent edge-city pattern of development, one still wants to ask where all of this is leading. Are we headed toward a new era of Jeffersonian democracy, or does the continued construction of new and ever more remote edge cities amount to an urbanized version of "slash and burn" farming?

Garreau provides us only a few clues to the answers to these questions. First, he points out that edge cities are fairly new and that certainly their form will continue to evolve—for the better, one may hope. After all, he argues, even Venice was chaotic and ugly during its rise to power. Second, Garreau goes out of his way to point out that the form of edge cities is already changing in ways that many people would characterize as improvements. For example, negative reactions to the "freshly bulldozed" look of new office developments has given birth to what he calls the "great-big-oak-trees-right-up-against-the-windows" look that is currently fashionable in office developments, together with "hanging-gardens-of-Babylon" parking garages. And in many edge-city communities (the book considers the case of Pasadena, California), local governments have adopted building codes that try to discourage the pervasive uniformity that often generates negative reactions to new edge-city areas.

Despite such efforts, Garreau's treatment of these issues seems a bit too Panglossian. Having brilliantly drawn the distinction between the reasonable desires of the U.S. middle class (a three-bedroom home on a half-acre lot) and the only partially satisfactory result (edge cities), Garreau does not dig very deeply into the possible economic causes of and remedies for the perceived shortcomings of edge-city areas. An especially glaring weakness is the relative lack of treatment of public finance issues. One wonders, for example, Would the American penchant for suburban living be nearly so strong without the usual disparity in local tax rates between urban and suburban areas? Does the increasingly widespread exaction by local governments of "impact fees" for new developments lead to better-planned and more amenable edge cities, and to what extent do such fees discourage new development? With the possible exception of the chapter on Phoenix, *Edge City* is uncharacteristically mute on such topics.

*Garreau's point is that much of the development of edge cities is perhaps best explained as an attack of mass rationality . . . as opposed to an attack of mass hysteria.*

Similar concerns extend to the arena of government policy at the state and national levels. As an example, one cannot seriously study the housing market as one of the major forces behind the formation of edge cities without seeing the highly visible hand of government intervention. The U.S. housing industry is one of the most regulated, taxed, and subsidized industries in the country. Since its end product is so politically sensitive, it is unrealistic to imagine that the industry will find itself in a laissez-faire environment at any time in the near future. Yet it is hard to accept that a better replacement could not be found for the current unwieldy and often contradictory amalgam of local, state, and national laws, regulations, and policies that attempt to influence the housing market. Unfortunately, Garreau does not share with his readers what must be his well-informed opinions on this subject.

One useful way of viewing such issues is from the perspective advanced by the noted economist Charles M. Tiebout.[2] Tiebout's theory addressed the problem of how best to provide "local public goods"—commodities or services such as roads, water and sewer services, and police protection that are traditionally not priced in competitive markets but are provided by local governments and paid for with tax revenues.

Tiebout reasoned that the presence of mobile households would provide a reasonable approximation to the forces of a competitive market. That is, if people were allowed to "vote with their feet" and to choose freely among different communities with different levels of taxation and investment in local public goods, then people would gravitate to communities that best matched their demand for these kinds of goods.

The analysis in *Edge City* makes clear that "voting with your feet" has become very easy to do in the last decade. Technology and interstate highways have made it easier for people to behave in the way that Tiebout hypothesized. People are no longer voting only with their feet but with their car tires, computer modems, and fax machines. Clearly, by their choice of location, people and companies in this country are voting for a lower level of the types of public goods and services that are traditionally associated with large cities. The urban amenities of public transportation, parks, sidewalks, and the like are not enough to lure people or their employers away from edge cities. As Garreau points out in his chapter on Phoenix, many people have chosen to opt out of the domain of local government entirely by living in private communities. Yet it is not clear that an edge-city pattern of development, offering fewer traditional amenities, necessarily brings with it a correspondingly lower level of investment in local public goods. The diffuse automobile-oriented layout of most edge cities typically requires enormous public investment in roads as well as water and sewer utilities. And despite the success of private developments in Phoenix and elsewhere in the country, it seems doubtful that the full costs of this additional infrastructure can be entirely privatized.

Although hard data are not available to prove the point, the move toward edge cities seems to imply a substitution of one sort of public good for another rather than a fundamental change in the degree of the public's demand for public goods. One line of thinking, consistent with Tiebout's view, is that this substitution could indicate a shift toward a wider selection of public goods. Or it could represent, considering the continual construction of new, more remote edge cities, a movement toward a single, relatively uniform standard for the provision of public goods. Unfortunately, Garreau fails to disclose any clear sense of the direction of what may well be a fundamental shift.

To be sure, *Edge City* is at least partly excused for any shortcomings by Garreau's disclaimer, "I am a reporter, not a social critic." The book provides a finely detailed portrait of an important and often misunderstood change in the way that U.S. urban areas are organized. The phenomenon of edge cities certainly deserves more attention from the mainstream of the economics profession, not to mention other would-be social critics. It may be the case, as Garreau's more optimistic passages seem to imply, that edge cities represent a step toward a better form of social organization. Or edge cities may represent a futile attempt at "city living with country taxes." Certainly this issue bears a closer look.

## Notes

1. In addition to focusing on his main argument, Garreau also considers the effects of the production side of the economy, explaining how recent changes in transportation and communication technology have accelerated the movement to edge cities. The technological innovations of the past twenty years (computer networks, fax machines, and the like) have clearly contributed to the attractiveness of edge cities vis-a-vis traditional downtowns. Again, this rather obvious development has generally received short shrift in analyses of the "new suburbs."
2. Charles M. Tiebout, "A Pure Theory of Local Expenditures," *Journal of Political Economy* 64 (October 1956): 416-24.

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