Federal Reserve Bank of New York

Quarterly Review

Spring 1992 Volume 17 Number 1

Federal Reserve Bank of New York Quarterly Review
Spring 1992 Volume 17 Number 1

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The Supply-Side Consequences of U.S. Fiscal Policy in the 1980s

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In the wake of deteriorating economic performance in the 1970s, a reassessment of the role of government became an increasingly important part of the U.S. policy agenda. Concern that excessive regulation of industry and misdirected federal spending and tax policies were hurting long-run economic performance led to a strong interest in streamlining the role of the public sector. In response, the Carter Administration (1977-80) introduced substantial deregulatory measures in several industries, including airlines, trucking, railroads, energy, and finance. In 1980, President Carter also proposed policy changes aimed at reducing federal spending as a share of GNP and simultaneously providing significant tax incentives for business investment (Council of Economic Advisers, 1981, pp. 9-12).

The first Reagan Administration (1981-84) attached much greater importance to reducing the role of government. In President Reagan's words:

> My first and foremost objective has been to improve the performance of the economy by reducing the role of the Federal Government in all its many dimensions. This involves a commitment to reduce Federal spending and taxing as a share of gross national product. It means a commitment to reduce progressively the size of the Federal deficit. It involves a substantial reform of Federal regulation, eliminating where possible and simplifying it where appropriate. It means eschewing the stop-and-go economic policies of the past which, with their short-term focus, only added to our long-run economic ills. (Council of Economic Advisers, 1982, pp. 4-5).

In the early 1980s, the increased emphasis on reducing the fiscal role of government reflected to some extent the influence of the "supply-side" economists, who felt that shrinking the size of government would aid economic growth.[1] The "supply-siders" viewed tax policy as the centerpiece of fiscal policy and believed that it should be aimed at long-run economic growth rather than short-run stabilization. Reductions in marginal tax rates, they believed, would greatly stimulate long-run growth by increasing the supply of labor and capital and, more generally, by improving the allocation of resources. Consequently, some supply-siders even asserted that the tax cuts would "pay for themselves": a rise in the tax base would mitigate or prevent the fall in tax revenue. Most economists doubted such a "Laffer curve" effect, but they shared the view that changes in U.S. tax policy were needed to remove tax distortions and improve resource allocation. In any event, by the mid-1980s the influence of the supply-siders had subsided but the debate about the role of federal spending and tax policies continued. More recently, the fiscal agenda has been dominated by efforts to deal with the continuing large federal deficits.

Against this background, this article reviews the principal changes in U.S. fiscal policy since the early 1980s and their implications for economic performance. We focus on developments in three broad areas of fiscal policy—budget deficits, expenditures, and taxes—and investigate how these developments have affected the basic determinants of potential growth—saving and capital formation, labor supply, and productivity. At the

[1] See Fullerton (1990) for an overview of supply-side economics in the 1980s, including citations of statements by the supply-siders.

outset, we note that this review covers the supply-side implications of all the major fiscal policy developments rather than focusing on the particular set of policies recommended by the U.S. supply-siders.

The supply-side consequences of fiscal policy changes in the 1980s appear to have been mixed. The persistently large budget deficits have clearly hurt saving, investment, and the long-run growth potential of the economy. Similarly, the decline of public investment in infrastructure over the 1980s has had adverse effects on productivity and potential output. Several important changes in the tax structure, however, appear to have been beneficial in creating incentives to increase the supply of output. Even so, on balance, changes in U.S. fiscal policy since the early 1980s have been detrimental to the growth potential and long-run economic performance of the economy.

Long-run macroeconomic performance and fiscal policy

To provide general background for our review of fiscal policy, Table 1 reports data on five major macroeconomic indicators—output, employment, prices, productivity, and capital stock.[2] Following a weak performance in the early 1970s, output and employment rose rapidly in the second half of the decade. Inflation continued to increase, however. Moreover, despite continuing strong growth of capital stock, both overall and manufacturing productivity growth slipped substantially.

On the whole, these indicators do not suggest a major improvement in economic performance in the 1980s. Output growth for the decade averaged about the same as in the 1970s, but employment growth was significantly weaker. In the second half of the 1980s, both output and employment growth were below the rates of the late 1970s. The inflation performance, however, improved greatly over the 1980s relative to the earlier period. Productivity growth, especially for the manufacturing sector, also showed considerable improvement in the 1980s even as capital stock growth weakened substantially. This slowdown in capital formation implies, ceteris paribus, a significant deterioration in productivity performance in the long run.

Although these broad indicators do not suggest a supply-side "revolution" in the 1980s, it is possible that a fiscal-policy-induced revolution did occur but was obscured by other developments in the economy. To get a clear sense of the supply-side impact of fiscal policy, we must ultimately focus on the growth of potential output—the amount of output that can be produced

[2]For further details, see Akhtar and Harris (1991).

Table 1

Broad Economic Indicators

Annual Percent Change

	Real GNP	Employment	Consumer Prices†	Output per Hour: Nonfarm Business Sector	Output per Hour: Manufacturing Sector‡	Real Net Capital Stock: Total Private	Real Net Capital Stock: Manufacturing	Potential GNP§
Ten-Year Averages								
1960-70	3.9	1.8	2.6	2.4	2.8	4.5	4.7	
1970-80	2.9	2.4	7.2	1.2	1.9	3.8	3.7	
1980-90	2.5	1.7	4.9	0.9	2.9	2.6	1.8	
Five-Year Averages								
1970-75	2.4	1.8	6.6	1.8	3.0	3.9	3.6	
1975-80	3.3	3.0	7.9	0.5	0.8	3.6	3.8	
1980-85	2.4	1.5	5.5	1.3	2.7	2.9	2.0	
1985-90	2.7	1.9	4.3	0.5	3.1	2.2	1.5	
Business Cycle Averages								
1960-73	4.0	2.0	3.1	2.5	3.3	4.4	4.4	3.3‖
1973-80	2.2	2.3	8.3	0.4	0.6	3.6	4.0	2.9
1980-90	2.5	1.7	4.9	0.9	2.9	2.6	1.8	2.5††

†Implicit deflator for personal consumption expenditures.

‡For periods prior to 1977, data published before the 1991 benchmark revision of the National Income and Product Accounts are used.

§Braun's (1990) estimates based on Okun's law and consistent with the natural rate of unemployment.

‖Estimate for 1965-73.

††Estimate for 1980-87.

without upward pressures on inflation. The channels of fiscal effects on potential growth, however, can be quite complex and can operate with long lags, so that the actual performance of the economy in the 1980s may not fully reflect the fiscal actions of that period.

Changes in fiscal policy affect the growth of potential output through saving, investment, the supply and quality of labor, efficiency in the allocation of public sector resources, and incentives for allocative efficiency in the private sector. All three broad areas of fiscal policy—deficits, expenditures, and taxes—may influence saving, although through significantly different channels. Higher budgetary deficits reduce the amount of national saving directly, while expenditure and tax policies may create incentives to increase or reduce private saving. Moreover, by influencing saving, capital costs, and public sector spending on infrastructure, all three broad areas of fiscal policy also affect capital formation.

Normally, deficits do not cause, at least directly, any changes in the supply and quality of the labor force or in the efficiency of resource allocation. Changes in the nature and composition of expenditures, by contrast, may have significant effects on the supply and quality of labor and on efficiency in the allocation of public sector resources. For example, spending on welfare programs affects work incentives, education spending bears on labor quality, and government investment influences private sector productivity. Changes in tax policy also may alter potential output by influencing the supply of labor and allocative efficiency of the private sector. The bulk of these effects result from changes in the rates and coverage of income taxation.

In what follows, we review the implications of developments in deficits, expenditures, and tax policy for the main determinants of potential output. Specifically, the next section looks at budget deficit developments and their implications for saving, capital formation, and potential output. Major changes in the structure of expenditures and taxes and their consequences for potential output are examined in the following two sections. Although our discussion deals primarily with the federal government sector, we have attempted to include state and local government activities where appropriate and possible. Our limited coverage of the state and local government sectors does not appear to be a serious problem for this analysis because recent changes in U.S. expenditures and taxes are dominated by federal activities.

Long-run economic growth consequences of deficits

The federal budget deficit averaged 3.6 percent of GNP in the 1980s, double its level in the 1970s (Table 2). After showing considerable improvement in the late 1970s, the deficit climbed sharply from below 1 percent in 1979 to over 5 percent of GNP in 1983, hovered around 4½ percent through 1986, and then declined gradually to 3 percent in 1990. The structural (that is, cyclically adjusted) deficit also deteriorated substantially to just above 3 percent of potential GDP in the second half of the 1980s from about 2 percent in the second half of the 1970s. With the combined state and local government surplus providing a partial offset, the overall public sector deficit was 2.4 percent of GNP over 1986-90, up from 0.8 percent of GNP over 1976-80. Throughout the period, the trend of the overall public sector deficit was dominated by the trend of the federal deficit, although the combined state and local government surplus, which reflects social insurance fund contributions (mostly pensions for public employees), increased significantly from 1980 to 1984 and declined gradually thereafter.

The federal budget deficits have been financed almost exclusively by borrowings from the private sector. As a result, the generally declining postwar trend of the federal debt relative to GNP was reversed in the early 1980s: federal debt held by the public rose to 45 percent of GNP in 1990 from about 27 percent in 1980.

National saving

The federal budget balance, calculated on a national income accounts basis, measures the direct contribution of the federal government to the pool of national saving. That is, each dollar of deficit represents a dollar of lost national saving. As Table 3 indicates, the federal sector has been an increasing drag on national saving since the early 1970s. More specifically, from the 1970s to the 1980s the worsening federal deficit accounted for, on average, 55 percent of the decline in net national saving as a share of GNP. Using the average deficit over 1961-80 as the benchmark raises the direct contribution of the deficit's share of the saving decline to nearly 70 percent. The portion of the decline in the national saving rate attributable to the public sector as a whole is considerably smaller because the state and local government sector has experienced a budgetary surplus over the 1980s. Including the state and local surpluses, however, probably understates the extent of dissaving by the public sector: these surpluses reflect the growth in pensions for public employees and are conceptually more like private saving than government saving.

In principle, government deficits can also affect private saving through several channels. One such channel, much debated in academic circles, is suggested by the "Ricardian Equivalence" doctrine, which holds that when deficits rise, households increase their saving by an equal amount in order to pay the postponed taxes in

Table 2

Government Budgetary Deficit and Debt

Percent of GNP

	Deficit (−) or Surplus†			Cyclically Adjusted Federal Deficit (−)‡	Government Debt Held by the Public		Deficit (−) or Surplus	
	Federal	State and Local	Total		Federal	Total	Federal Excluding Net Interest Payment	State and Local Excluding Social Insurance Funds
				Ten-Year Averages				
1961-70	−0.4	0.1	−0.3	−1.2	36.7	50.8	0.9	−0.5
1971-80	−1.8	0.8	−1.0	−1.9	27.3	40.3	−0.3	0.0
1981-90	−3.6	1.0	−2.6	−3.0	38.3	51.4	−0.7	−0.1
				Five-Year Averages				
1971-75	−1.8	0.6	−1.2	−1.6	27.0	41.0	−0.5	−0.1
1976-80	−1.8	1.1	−0.8	−2.2	27.6	39.6	−0.2	0.2
1981-85	−4.1	1.2	−2.9	−2.7	33.3	44.6	−1.3	0.0
1986-90	−3.2	0.8	−2.4	−3.2	43.2	58.2	−0.2	−0.3
				Projection				
1991-95	−3.5§			−2.8				

Note: Components may not add to totals because of rounding.

†Calculated on a National Income and Product Accounts basis.

‡Congressional Budget Office estimates on a fiscal year basis, expressed as a percentage of potential GDP.

§Congressional Budget Office projections on a fiscal year basis, expressed as a percentage of GDP.

Table 3

Net Saving and Investment

Percent of GNP

	Net National Savings				International Inflow or Outflow (−) of Saving†	Net External Investment Position‡		Net Private Investment	Depreciation§
	Total	Private	Federal	State and Local		A	B		
					Ten-Year Averages				
1961-70	7.9	8.3	−0.4	0.0	−0.6			7.2	8.4
1971-80	7.0	8.0	−1.8	0.8	−0.2	3.9		7.1	10.0
1981-90	3.5	6.1	−3.6	1.0	1.9	−4.2	1.1	5.2	11.4
					Five-Year Averages				
1971-75	7.3	8.4	−1.8	0.6	−0.4	3.9		7.0	9.3
1976-80	6.8	7.5	−1.8	1.1	−0.0	3.9	11.2	7.2	10.6
1981-85	4.3	7.1	−4.1	1.2	1.2	1.8	7.5	5.5	11.8
1986-90	2.7	5.1	−3.2	0.8	2.5	−10.1	−5.4	5.0	11.0

Note: Components may not add to totals because of rounding. In addition, for selected years in the period 1970-81 total net national saving includes small amounts of net capital grants received by the United States, which are not shown separately.

†Net foreign investment, which equals the saving-investment gap excluding a small statistical discrepancy.

‡Averages of year-end data: the first column, A, uses direct investment on a book value basis; the second column, B, evaluates direct investment on a current cost basis.

§Consumption of fixed capital.

the future.[3] Even in theory this doctrine holds only under some very strong assumptions such as infinite planning horizons and perfect capital markets without liquidity or credit constraints. Moreover, the recent experience of rising deficits and falling private saving is difficult to reconcile with the Ricardian Equivalence doctrine.

Deficits may also affect private saving by pushing up interest rates. The interest elasticity of private saving, however, appears to be quite low and therefore any such effects are likely to be small (see Haliassos and Tobin 1991, pp. 911-12; Smith 1990; and Congressional Budget Office 1989). Indeed, despite substantially higher real interest rates in the 1980s relative to the earlier period, the private saving rate has fallen.

A part of the decline in the national saving rate in the 1980s has been offset by foreign saving inflows to the United States (Table 3). The budget deficit, through upward pressures on interest and exchange rates and through increased consumption spending, has clearly helped to induce foreign saving inflows. But other macroeconomic developments, both domestic and international, have played a large role in the evolution of U.S. external balances during the last ten years or so (Akhtar 1989). The complexity of factors underlying the U.S. external position makes it very difficult to quantify the effects of the budget deficit relative to other determinants of the external position.

In any event, the inflow of foreign saving is a double-edged sword. By offsetting a part of the decline in national saving, it does make more funds available for investment than would otherwise be the case. However, the foreign saving inflow also represents increases in the U.S. external debt, the servicing of which will use up future saving and other productive resources of the economy. In the long run, therefore, the continued inflow of foreign capital places an additional burden on the economy. As reported in Table 3, the U.S. net external position has deteriorated rapidly since the late 1970s. On a current cost basis for direct investment, the nation has moved from a net creditor position of more than 13 percent of GNP in 1980 to a net debtor position of around 7½ percent of GNP in 1990. On a historical cost basis for direct investment, the deterioration is similar, from a net creditor position of 4 percent of GNP to a net debtor position of nearly 13 percent of GNP.

Capital formation and potential output

Capital formation has been weaker in the 1980s than in the earlier period. In particular, the ratio of net investment to GNP fell from about 7 percent in the 1970s to 5 percent in the late 1980s (Table 3). Measures of real capital stock show a similar trend: total private capital stock and especially its manufacturing component have grown at a much slower pace in the last decade than in the earlier period (Table 1).[4]

By reducing national saving, the budget deficit has clearly played a major role in lowering the rate of capital formation. The deficit has affected investment through a number of interrelated channels. First, since the budget deficit must be financed regardless of the level of interest rates, increased government borrowing against the small pool of private saving has exerted upward pressures on interest and exchange rates, depressing investment. Second, the rise in the deficit in the early 1980s stimulated aggregate demand, a development that, on the one hand, may have encouraged more investment in productive capacity and, on the other, may have discouraged investment by putting additional upward pressures on interest rates. Third, persistently large structural budget deficits probably have contributed to expectations of weak future performance for the economy, further dampening the investment climate.

The long-run effects of the budget deficit on capital formation and potential output can be quantified using a broad framework that combines major determinants of economic growth—saving and capital formation, labor force growth, and technological advance—with necessary linkages to the inflow of foreign saving and the net external debt position. In a recent study, Harris and Steindel (1991) used this "neoclassical growth" framework to examine the impact of the decline in overall saving on potential GNP. Here we apply this model to the decline in federal government saving alone, comparing how the economy actually fared in the 1980s with how it would have fared had the federal deficit remained at its 1961-80 average as a share of GNP.

The results are striking. In the 1980s the deficit as a share of GNP averaged 2½ percentage points higher than in the 1961-80 period. This increase in the deficit lowered national saving and investment, a drop that was only partially offset by increased foreign capital inflows. Overall, the deficits cost the nation about 7 percent of its capital stock and 2½ to 3½ percent of its potential output by 1990. By the end of the century, if the deficit remains at its late 1980s share of GNP, the losses will grow to 10 to 11 percent for the capital stock and 4 to 5½ percent for output, ceteris paribus. (Further details of these simulations are provided in Appendix A.)

The Harris-Steindel model also gives a rough estimate of how much of the rise in the net external debt is attributable to the increasing federal deficit. As noted earlier, it is difficult to quantify precisely the link

[3]See Barro (1974). For a wide ranging review of issues and evidence on debt neutrality, see Haliassos and Tobin (1991).

[4]See Englander and Steindel (1989) for a detailed recent analysis of trends in capital formation.

between domestic saving and foreign capital flows. The Harris-Steindel model estimates the link using two simplifying assumptions: first, that the drop in domestic saving directly or indirectly caused foreign capital inflows to increase, replacing one-third of the lost saving; and second, that changes in government saving have the same impact on foreign capital flows as changes in private saving. The results suggest that the increased federal deficit is responsible for more than one-third of the 17 percentage point rise in external debt as a share of GNP over the last decade (and an equal portion of the corresponding 0.7 percent of GNP deterioration in net investment income).

By making somewhat different, but equally plausible, assumptions about certain key parameters, one can show that the effects of the budget deficit on the capital stock, potential output, and external debt may be smaller or larger than the Harris-Steindel model suggests. In particular, using the 1971-80 deficit as the baseline reduces the estimated cost of the 1980s deficits by a third. Furthermore, since the relationship between foreign capital inflow and national saving is not as tight as assumed here, the first set of calculations may overstate the effects of the deficit on external debt. Despite the lack of precision in such estimates, the main point is not controversial: federal budget deficits in the 1980s have had substantial adverse effects on the long-run performance of the economy.

Summary: deficits and potential output

Overall, the federal deficit appears to have been responsible, on a national income accounts basis, for 55 to 70 percent of the decline in net national saving relative to GNP in the 1980s. Contrary to the Ricardian Equivalence doctrine, private saving has not risen to offset this decline in government saving. Furthermore, while foreign saving inflows have increased, replacing some of the lost domestic saving, these inflows add to the nation's external debt and increase the debt service burden of future generations. Estimates from the Harris-Steindel growth model suggest that the federal deficits of the 1980s have already cost the nation about 7 percent of its capital stock and roughly 3 percent of its potential output. If the current level of deficits persists, these losses could almost double by the end of the century.

Expenditure shifts and aggregate supply

This section examines whether the major shifts in the pattern of public sector expenditures over the last decade have reinforced or offset the implications of the budget deficit for long-run performance of the economy. We begin by describing the recent trends in broad categories of federal expenditures. We then look more closely at public spending in four important areas—transfers, capital formation, research and development, and education—and their implications for economic growth.

Table 4

Government Expenditures

Percent of GNP

	Federal Government Expenditures								
	Total	Defense Purchases	Non-defense Purchases	Net Interest Payment on Debt	Grants-in-Aid to State and Local Government	All Other†	Total Government Expenditures	Federal Entitlements and Other Mandatory Spending‡	Federal Nondefense Discretionary Spending‡,§
Ten-Year Averages									
1961-70	19.2	8.3	2.4	1.2	1.8	5.6	28.2	6.0	4.4
1971-80	21.1	5.5	2.4	1.5	3.2	8.6	30.8	9.8	4.9
1981-90	23.4	6.1	2.1	2.9	2.5	9.9	33.0	11.0	4.0
Five-Year Averages									
1971-75	20.8	6.0	2.4	1.3	3.0	8.1	30.9	8.9	4.6
1976-80	21.4	5.0	2.4	1.6	3.3	9.1	30.7	10.7	5.1
1981-85	23.8	6.1	2.2	2.8	2.6	10.1	32.9	11.5	4.4
1986-90	23.1	6.1	2.0	3.1	2.3	9.6	33.0	10.4	3.7

Note: Components may not add to totals because of rounding.

†Includes subsidies net of current surplus of government enterprises, as well as all other federal transfers to private sector.

‡Calculated on a fiscal year basis. Data for 1961 are not included.

§Includes essentially all nondefense purchases and federal grants-in-aid.

Federal government expenditures averaged 23½ percent of GNP over 1981-90, up from about 21 percent in the 1970s (Table 4). By contrast, the combined spending of state and local governments showed virtually no change over that period. Substantially higher interest payments on the rising public debt and increased spending on defense and government transfers to the private sector more than account for the rise in federal government outlays. Offsetting about one-quarter of the overall rise in these spending categories were significant declines in federal nondefense purchases and federal grants-in-aid to state and local governments. In other words, all of the decline occurred in nondefense discretionary spending of the federal government.

Some of these changes in the composition of spending may have significant consequences for the supply side of the economy. In particular, spending on transfer programs such as social security and unemployment benefits bears on labor supply decisions, while outlays for public capital, research and development, and education are important determinants of private sector productivity. By contrast, defense spending probably has limited implications for long-run growth beyond its impact on the deficit. Similarly, interest payments should be viewed as a legacy of past budget deficits and therefore do not warrant separate treatment. With these exceptions in mind, we now turn to the key nondefense expenditure categories.

Government transfers to the private sector

Direct federal government transfers to the private sector increased to an average level of nearly 10 percent of GNP over 1981-90, compared with about 8½ percent of GNP over 1971-80 (Table 5). Federal transfers rose sharply in the early 1980s, reflecting to a considerable extent the effects of the 1980 and 1982 recessions, and dropped to an average of 9½ percent of GNP over 1986-90. State and local government transfers—the bulk of which are funded through federal grants-in-aid to state and local governments—showed only a small gain in the 1980s. The rise in government transfers occurred without a significant concomitant change in the ratio of non-working-age to working-age population (the so-called dependency ratio) and was largely driven by increases in Social Security and medicare benefits. Government spending on welfare programs, which are means-tested, showed no significant change in the 1980s relative to the second half of the 1970s.

The substantial rise in government transfers is likely

Table 5

Government Transfers to Private Sector

Percent of GNP

	Total Government†	Federal					State and Local†	Federal Grants-in-Aid to State and Local Government		Federal Welfare Programs‖
		Total‡	Social Security	Federal Employee Retirement§	Medicare	Unemployment Insurance		Total	Medicaid	
					Ten-Year Averages					
1961-70	6.7	5.2	2.6	0.6	0.5††	0.4	1.4	1.8	0.2††	0.6
1971-80	10.7	8.4	3.9	1.0	1.0	0.6	2.3	3.2	0.5	1.5
1981-90	12.3	9.7	4.5	1.2	1.7	0.4	2.6	2.5	0.6	1.7
					Five-Year Averages					
1971-75	10.1	7.8	3.7	0.9	0.8	0.6	2.3	3.0	0.4	1.4
1976-80	11.3	8.9	4.2	1.1	1.1	0.6	2.4	3.3	0.5	1.7
1981-85	12.4	10.0	4.6	1.2	1.6	0.6	2.5	2.6	0.6	1.7
1986-90	12.2	9.5	4.4	1.1	1.8	0.3	2.7	2.3	0.7	1.7

Note: Data exclude net interest payments on debt. Components may not add to totals because of rounding.

†Includes subsidies.

‡Includes subsidies but excludes federal grants-in-aid to state and local governments.

§Includes railroad retirement.

‖Includes a) three programs—food stamps, supplemental security income, and earned income credit—directly funded and implemented by the federal government and b) spending on Medicaid and "welfare and social services" funded through federal grants-in-aid to state and local governments.

††Based on 1966-70 data.

to have affected labor supply, saving and investment, and the allocation of resources within the public sector. The labor supply effects of government transfers result primarily from Social Security and unemployment insurance benefits. Retirement payments to federal workers could also affect the labor supply, but these payments have shown little change since the mid-1970s.

Social Security coverage increased dramatically in the early 1970s. Benefits were increased sharply in real terms, indexed to inflation, and extended to a broader population. The Social Security reform of 1983 slowed benefit growth by imposing a tax on the benefits of high-income retirees and by phasing in an increase in the retirement age from 65 to 67. Nevertheless, as the elderly proportion of the population expanded in the 1980s, Social Security outlays surged. Along with more generous private pensions, this development probably encouraged earlier retirements, lowering the labor supply.

Empirical studies confirm that more generous Social Security outlays have had adverse effects on labor supply, although the magnitude of the response is in doubt (see, for example, Burkhauser and Quinn 1983). Indeed, as Table 6 indicates, recent trends in labor force participation rates for older workers do suggest a negative impact on the labor force. Participation rates for older men have declined steadily since the late 1960s. Among women, participation rates have risen rapidly for all age groups except women near retirement age.

Some of the adverse effects of higher Social Security benefits on labor supply were probably offset by lower unemployment insurance benefits in the 1980s. Both theoretical and empirical studies have demonstrated a significant negative link between unemployment insurance and work incentives or labor supply (see Hamermesh 1982 and Hum 1980). Perhaps influenced in part by these studies, legislation during the 1980s reduced unemployment insurance benefits and tightened eligibility requirements (for details, see Moorthy 1990). As a result, in 1990, 44 percent of unemployed workers received benefits, down from 53 percent in 1980 and 69 percent in 1975, the peak year for benefits. These changes have lowered overall unemployment insurance payments as a percentage of GNP, thereby boosting labor supply.

Increased transfers in the 1980s may also have affected household saving behavior. Empirical studies suggest that Social Security transfers had a modest depressing effect on private savings (for retirement and precautionary purposes), although the evidence does not appear to be robust (see, for example, Evans 1983, Organization for Economic Cooperation and Development 1985, and Smith 1990). More generally, the propensity to save out of transfers is lower than out of other income, so the change in the mix of income may have put downward pressure on private saving. Overall, the adverse effects of higher transfer payments on private saving, and therefore on investment, are likely to have been small in light of the relatively weak link between Social Security benefits and household saving.

The sharp rise in government transfers in the 1980s may also have caused some "crowding out" of other government spending, including public investment. For example, one apparent victim of the federal budget squeeze has been grants-in-aid to state and local governments. In some ways this loss may encourage growth because it helps contain the expansion of government expenditures and because the grant system often causes inefficient spending choices (Organization for Economic Cooperation and Development 1990, pp. 95-97). Its main effect, however, has been to hurt potential output: the decline in grants has been concen-

Table 6
Labor Force Participation Rates
Percent, Three-Year Averages

	Men			Women		
	16-54	55-64	65 & over	16-54	55-64	65 & over
1968-70	88.3	83.5	27.1	49.3	42.9	9.7
1978-80	88.2	72.7	19.8	62.2	41.5	8.2
1988-90	88.5	67.3	16.5	71.2	44.6	8.3

Table 7
Real Nonmilitary, Nonresidential Public Investment and Capital Stock
Percent of GNP

	Gross Public Investment	Net Capital Stock		
		Public†		Total Private and Public
	Ten-Year Averages			
1961-70	3.7	49.3	4.6	131.2
1971-80	2.5	49.5	1.9	140.6
1981-90	2.1	44.8	1.4	143.4
	Five-Year Averages			
1971-75	2.8	50.9	2.4	140.7
1976-80	2.2	48.0	1.4	140.5
1981-85	2.0	46.7	1.1	146.4
1986-90	2.2	43.0	1.8	140.3

†Figures in the right hand column under this heading are averages of annual percent changes. They include the changes in both the first year and the last year in each period.

trated in "investment" activities such as training, employment, and regional development, whereas the share of grants earmarked for "consumption" activities such as health and income security has increased. This change in the allocation of resources in the public sector has probably lowered economic growth, although it is difficult to measure the extent of the lost output.

Public capital formation

Nonmilitary government investment as a share of GNP has declined substantially since the mid-1970s (Table 7). The bulk of the slowdown reflects lower investments by state and local governments. Nonmilitary capital stock averaged 43 percent of GNP in the second half of the 1980s, down from about 49 percent over 1971-80. The rate of capital formation declined to 2 percent over 1981-90 from 2½ percent over the preceding decade. The decline in public capital formation is broadly spread across various components of public infrastructure—highways and streets, education buildings, water supply, sewer and transit systems, airports and public electric and gas utilities—which together account for more than two-thirds of nonmilitary public capital stock.

Although there is little doubt that the slowdown in public investment has adversely affected potential output, the importance of public capital stock to output has been the subject of some controversy in recent years.[5] This disagreement is driven by differing views of the return to public capital relative to private capital and associated estimates of the elasticity of the annual increase in private output with respect to public capital, estimates that range from a low of 8 percent to a high of 40 percent. The upper end of the elasticity range implies that the marginal product of public capital is several times that of private capital. This assessment is clearly implausible. The lower end of the range implies that the marginal return on public capital is the same as that of private capital.

If we choose a 10 percent estimate for the output elasticity of public capital and the average level of the 1970s as the benchmark, we find that the decline in public capital formation in the 1980s has lowered annual output growth by 0.05 percent. In other words, annual output would have grown that much faster if public capital stock had continued to increase at the higher rate of the 1970s. The implied cumulative loss of output for the whole decade is about ½ percent and will increase over time. Of course, with a higher output elasticity of public capital, the loss of output would be greater: for example, a 20 percent estimate for the elasticity would double the implied output loss for the 1980s. Moreover, these estimates do not take into account the "accelerator" effects of lower output on saving, capital formation, and eventually future potential output. In any event, these estimates indicate that the slowdown in public capital formation in the 1980s has had at least a modest adverse effect on the long-run performance of the economy.

[5]For a discussion of the relevant issues, see Munnell (1990), Hulten (1990), and Rubin (1991).

Government expenditures on research and development

Potential output may also have been hurt by the slowdown in federal nondefense expenditures on research and development (R&D) during the 1980s. R&D expenditures affect potential output by improving technology and thereby increasing total factor productivity, that is, growth in output not directly explained by capital or labor inputs. Federal spending on nondefense R&D declined to 0.4 percent of GNP over 1986-90 from 0.6 percent of GNP over 1976-80 (Table 8). The decline was fully offset, however, by increased federal spending on defense R&D, which climbed from 0.5 percent of GNP to 0.8 percent of GNP over that period.

Increased federal expenditures on defense R&D have probably offset some of the adverse effect of lower nondefense R&D spending on economic growth. Defense R&D activities have been managed with a view to exploiting commercial opportunities. For example, major advances in civil aviation, medical technology, and weather satellites originated from defense-sponsored R&D. Even so, the private sector benefits of nondefense R&D are probably higher than those of

Table 8
Federal Outlays for Research and Development
Percent of GNP

	Total	Defense	Non-defense	Total Private and Public R&D Expenditures†
		Ten-Year Averages		
1961-70	1.9	1.1	0.8	2.8
1971-80	1.2	0.6	0.6	2.2
1981-90	1.2	0.7	0.4	2.7
		Five-Year Averages		
1971-75	1.3	0.7	0.6	2.3
1976-80	1.1	0.5	0.6	2.2
1981-85	1.1	0.7	0.5	2.6
1986-90	1.2	0.8	0.4	2.7

Note: Outlays are measured on a fiscal year basis. Components may not add to totals because of rounding.

†National Science Foundation estimates on a calendar year basis.

defense R&D (see Organization for Economic Cooperation and Development 1990, pp. 89-90). On a net basis, therefore, total federal R&D spending—which has remained unchanged as a share of GNP since the mid-1970s—probably made a smaller contribution to economic growth in the 1980s than in the earlier period.[6]

Education expenditures

Government spending on education-related activities affects the quality of labor and therefore plays a major role in the growth of potential output. Starting from relatively high base levels of real education expenditures, however, marginal changes in government spending on education may not be closely related to changes in the quality of labor or in the underlying educational performance if nonfinancial factors have large effects on education.

Overall government education expenditures declined to 5.5 percent of GNP over 1981-90 from 6.1 percent of GNP over 1971-80 (Table 9). State and local governments carry the main responsibility for education, accounting for more than four-fifths of these expenditures. Despite the decline in the GNP share of government education expenditures, on a real per capita basis for population under thirty years of age, those expenditures actually increased in the 1980s as compared with the earlier period. It seems likely, therefore, that the modest decline in government spending on education as a share of GNP in the 1980s has had only a small impact on potential output growth.

This impression is strongly confirmed by looking at real public school expenditures per pupil and educational achievement over the postwar period. As Table 10 demonstrates, real total spending per student has risen throughout the postwar period and has nearly tripled over the past three decades. More important perhaps, increased spending seems to have accomplished what advocates of higher spending frequently seek: lower pupil-teacher ratios, smaller class sizes, and better educated and more experienced teachers (see Chubb and Hanushek 1990). Yet educational performance has stagnated or possibly dropped. For example, overall achievement at the high school level declined through much of the 1970s, recovered some of the lost ground in the late 1970s and 1980s, and today appears to be, at most, no better than it was two decades ago (Council of Economic Advisers 1990, chap. 5; and Chubb and Hanushek 1990). These findings suggest that increases in educational spending have had only a small impact on educational achievements and have not succeeded in overcoming the broader social problems students bring to school.

Summary: expenditure shifts and potential output

Shifts in the pattern of several important components of government expenditures are likely to have depressed potential output, but the overall effect appears to be relatively modest, perhaps on the order of 1 percent for the 1981-90 period. The decline in the rate of public capital formation in the 1980s seems to have brought potential output about ½ percent below what it would have been if public capital stock had continued to advance at the higher rate of the 1970s; this loss of

[6]Tax law changes also affected private R&D expenditures in the 1980s. The 1981 tax law created incentives for R&D, including a "research and experimental tax credit." These incentives were eliminated in the 1986 tax reform. Hines (1991) argues that the 1986 reform caused a $1.4 to $2.2 billion drop in R&D expenditures.

Table 9
Government Education and Labor Training Expenditures

	Expenditures as Percent of GNP			Real per Capita Expenditures for Population under 30 (1987 Dollars)
	Total†	Federal‡	State and Local§	
Ten-Year Averages				
1961-70	4.8	0.4	4.4	1,443
1971-80	6.1	0.8	5.3	2,094
1981-90	5.5	0.5	5.0	2,162
Five-Year Averages				
1971-75	6.1	0.7	5.4	2,006
1976-80	6.0	0.9	5.2	2,183
1981-85	5.5	0.6	4.9	2,064
1986-90	5.5	0.5	5.0	2,260

Note: Components may not add to totals because of rounding.

†Total government and private spending on education is, of course, larger; in recent years, private educational expenditures have been estimated to be in the range of 1.5 to 2 percent of GNP.

‡Labor training component has usually accounted for less than 30 percent of federal expenditures.

§Labor training component has usually accounted for only about 2 percent or less of state and local government expenditures.

Table 10
Real Public School Expenditures per Pupil
1988 Dollars

	1960	1970	1980	1988
Current expenditures†	1,499	2,488	3,202	4,209
Total expenditures	1,889	2,912	3,592	4,626

Source: Chubb and Hanushek (1990).

†Excludes capital outlays and interest on debt.

output will increase over time. On the whole, increased transfer payments to the private sector also worked to reduce the supply of output, although a part of the adverse effect of higher Social Security payments on labor supply was probably offset by the favorable effect of lower unemployment insurance benefits. Government spending on R&D may have made a smaller contribution to output in the 1980s than in the earlier period, but the difference does not appear to be significant. Finally, the decline in public education expenditures as a share of GNP is likely to have had small adverse consequences for output growth.

The supply-side implications of tax policy

As noted in the introduction, supply-side economics had an important influence on tax policy in the 1980s, especially in the early part of the decade. In particular, supply-siders argued that reducing marginal tax rates would encourage economic growth by creating incentives for reallocating resources. Because of the stimulus to output, many supply-siders believed that the tax cuts would pay for themselves—that is, the rise in the tax base resulting from lower rates would be sufficient to prevent tax revenue losses.

Although most economists disagreed with the view that the tax cuts would pay for themselves, they shared concerns about the tax distortions and adverse incentives created by the then existing tax structure. Some economists also had misgivings about the fairness and complexity of the tax structure. After the early 1980s, narrower supply-side views became less fashionable, but uneasiness about the incentives and other effects of the tax system continued.

Tax trends in the 1960s and 1970s contributed to distortions and perverse incentives, setting the stage for the 1980s "revolution." In the late 1960s and 1970s high inflation combined with an unindexed tax system steadily worsened the incentive effects of the tax structure. As Table 11 suggests, bracket creep pushed the marginal personal tax rate for the median family up from 17 percent in 1965 to 24 percent in 1980. Over the same period the average tax rate remained roughly constant at about 11 percent because of the continual introduction of new credits or deductions.

Inflation had other pernicious effects on the tax structure. Even in noninflationary times, savers and investors were often taxed twice on the same income. Inflation added to this penalty for thrift. For example, in 1965 the median tax payer earned a 1.8 percent real after-tax return on his or her one-year Treasury bond; by 1980, with higher inflation and marginal tax rates, that same tax payer "earned" a negative 4.3 percent real after-tax return.[7] Inflation also encouraged a shift in investment away from business and into home building. Neither the implicit rent nor the capital gains from home ownership were taxed, and as a result, increases in interest rates and inflation raised the value of owner-occupied housing while lowering the value of business fixed investment.[8]

Tax changes in the 1980s were designed to reverse some of these trends. The cornerstones were the Economic Recovery Tax Act (ERTA) of 1981 and the Tax Reform Act (TRA) of 1986. ERTA rolled back marginal personal tax rates and offered new tax breaks to savers and investors. TRA lowered personal tax rates further, broadened the tax base, and attempted to "level the playing field" by taking away a variety of tax breaks. The years between these landmark bills saw several smaller revisions to the tax code that together had important supply-side implications. (For details on the tax laws,

[7]The example uses the tax rates in Table 11 and the actual consumer price index inflation rate (1.6 for 1965 and 13.5 percent for 1980) and bond yields (4.2 for 1965 and 12.0 percent for 1980).

[8]According to estimates by de Leeuw and Ozanne (1981), a permanent 12 percent increase in both interest rates and inflation would raise the value of owner-occupied housing by 22 percent while lowering the value of business fixed investment by 22 percent.

Table 11

Key Tax Rates

	Marginal Personal Rate				Top Bracket		
	One-Half Median	Median	Two times Median	Social Security†	Personal	Capital Gains	Corporate
1965	14	17	22	7.2	70	30‡	48
1980	18	24	43	12.3	70	28	46
1985	14	22	38	14.1	50	20	46
1988	15	15	28	15.3	33	28	34

†Combined employee-employer contribution. The "1988" figure is actually the most recent 1990 rate.

‡1970 rate.

see Appendix B.)

The remainder of this section evaluates the empirical evidence on the supply-side effects of tax changes in the 1980s. Focusing on labor supply, saving, and investment, we review both the impressionistic evidence and the more sophisticated results from the literature. Taken as a whole, the evidence suggests that tax policy changes in the 1980s had only a modestly favorable net impact on the supply-side performance of the U.S. economy.

Labor supply

ERTA, TRA, and the legislation in the intervening years significantly influenced the after-tax return to labor. ERTA lowered marginal personal tax rates over a period of three years. The top rate was immediately cut from 70 percent to 50 percent, and other rates were reduced in three stages to produce a cumulative decline of 23 percent by 1984. Starting in 1985, the rate schedule was indexed to the price level, precluding any subsequent bracket creep. Other provisions that increased the incentive to work included a reduction in the "marriage tax" and lower taxes on various kinds of saving.

The next several tax bills whittled away some of the tax advantages for labor supply offered in ERTA. The most important of these, the 1983 amendment to the Social Security Act, broadened the base of the Social Security payroll tax to include more workers and raised the tax rate. The combined employer-employee rate was raised from 13.4 percent in 1983 to 15.3 percent in 1990.

TRA continued the personal tax rate cuts started under ERTA: by 1988 the law had swept away the old structure of fourteen tax brackets ranging from 11 percent to 50 percent and substituted two brackets of 15 percent and 28 percent.[9] At the same time, the tax base was broadened by restricting individual retirement accounts and disallowing a variety of other deductions. The law partly offset this base broadening by roughly doubling the personal exemption and the standard deduction. Overall, TRA not only cut marginal tax rates substantially, but also was designed to shift a significant part of the tax burden from the personal to the corporate sector.

If supply-side economics has validity, these dramatic cuts in marginal tax rates should have had a significant impact on labor supply, inducing workers to substitute work for leisure. Most important, the tax cuts should have increased the hours and participation rates of married women and secondary earners, who presumably have a relatively flexible work choice. The cuts should also have induced some workers to move into higher paying, more demanding work or to invest more in their human capital. Yet even in theory, the labor response would not be entirely predictable because it would depend, among other things, on the relative strength of the substitution and income effects. On the one hand, lower taxes may induce greater willingness to work because of the higher after-tax return to work. On the other hand, lower taxes mean less work is needed to earn the same after-tax income. The labor supply response also depends on the flexibility of work arrangements and the way the tax cut is "financed."[10]

Impressionistic evidence does not suggest a dramatic labor supply response to the tax cuts. As Table 12

[9]Because of the phasing out of personal exemptions, upper-middle income earners faced a marginal rate of 33 percent. Under the 1990 Budget Accord this tax rate "bubble" was reduced to 31 percent.

[10]For example, if the tax cut is accompanied by an equal cut in consumption-like government expenditure, tax payers may feel that their "income" or command over goods and services is unchanged. In this case, a cut in marginal tax rates will almost surely increase labor supply through the substitution effect. But if the tax cut is financed through base broadening to include fringe benefits that are at least implicitly linked to basic wages, it may not have a significant effect on the marginal return to work.

Table 12

Key Labor Supply Statistics

	Participation Rate		Multiple Job Holders as a Percentage of Employment	Part-Time Workers‡ as a Percentage of Employment	Average Work Week
	Married Women	Secondary Earners†			
1969	41.5§	55.3	3.6	0.8	37.7
1979	49.3	63.4	3.2	1.6	35.7
1985	54.2	65.9	3.9	2.7	34.9
1989	56.5	68.5	4.5	2.1	34.6

†All workers except prime-age males.
‡Part-time because could not find full-time work.
§Because of a definitional change in the series, 1972 data are used.

shows, participation rates for married women—the group that is probably most sensitive to marginal tax rates—increased more in the rising tax years of the 1970s than in the falling tax years of the 1980s.[11] Other labor force indicators give only weak support for the supply-side argument. The portion of people holding second jobs—another group sensitive to tax cuts—did rise sharply in the 1980s. As the fourth column of Table 12 shows, however, a good portion of this increase in dual jobs may have been due to this population's difficulty in finding a single full-time job. Finally, in the 1980s the average work week continued to drop in line with its postwar trend, a further indication that no incentive-induced turnaround had occurred.

Estimates in the empirical literature support a somewhat larger labor supply response to the tax cuts. Perhaps the strongest results come from the 1987 Annual Report of the Council of Economic Advisers. Using a simulation model with assumed parameters, the Council estimated a 3.1 percent increase in the labor supply response to TRA alone. Evans and Kenward (1988) suggest, however, that the Council's model is quite sensitive to changes in parameters. Studies that use actual empirical estimates of the elasticity of labor supply find a smaller response. Hausman and Poterba's (1987) econometric estimates, which build on earlier work by Hausman, suggest that TRA raised the long-run labor supply by 1½ percent, with most of the increase explained by the higher participation rate of married women.[12] Their estimates suggest that ERTA's impact on labor supply was about half that of TRA.[13] Even these estimates may be on the high side: in Bosworth's (1984) survey of the literature, most labor supply elasticity estimates are lower than Hausman's. Overall, empirical evidence suggests a labor supply response to ERTA and TRA combined that is greater than zero but probably less than 2 percent.

[11]A closer look at the work hours of married women across income classes reinforces this impression. In the 1980s women in low income families (the bottom 20 percent for two-parent families with children) increased their work hours by 43 percent despite a 3 percent *fall* in their real hourly wages. By contrast, women in high income families (top 20 percent) worked only 25 percent more hours even as their real hourly wage soared 27 percent. It appears that economic necessity rather than the incentive effects of higher wage rates was the principal determinant of increasing work effort by women in the 1980s. For details see Joint Economic Committee (1992).

[12]The largest effect is for married women who work part time. These women have considerable discretion over whether to work or not, and under TRA they experienced, on average, a dramatic drop in their marginal tax rate from 22.5 percent to 15 percent.

[13]Not only were the marginal rate cuts greater under TRA, but because the law was designed to be revenue neutral, a large offsetting "income effect" from the tax cut was less likely.

Investment

ERTA was the high water mark of efforts to create tax incentives for investment in the United States. It extended the investment tax credit to more short-term assets, allowed firms to use the accelerated cost recovery system for depreciating capital, granted a more generous 175 percent declining balance for structures, and allowed "safe harbor leasing" so companies could take advantage of tax credits even if they had no taxable income. (See Appendix B for further details.)

The tax laws of the next several years first chipped away at the investment tax benefits of ERTA and then, with the passage of TRA in 1986, virtually turned back the clock to the pre-1981 level of tax incentives. The Tax Equity and Fiscal Responsibility Act of 1982 scaled back the benefits of the investment tax credit, canceled further planned accelerations in the depreciation schedule, and put some restrictions on safe harbor leasing. The Deficit Reduction Act of 1984 made the depreciation rules less favorable. Finally, in 1986 TRA attempted to "level the playing field" for investment by eliminating many of the special provisions created under ERTA and earlier legislation. Although TRA cut the maximum corporate tax rate from 46 percent to 34 percent by 1988, this measure was more than offset by the retroactive abolition of the investment tax credit and the elimination of the generous depreciation rules, especially for structures. Whereas TRA had tended to reinforce the labor supply incentives created under ERTA, it dramatically scaled back efforts to promote investment through special incentives.

Tax changes in the 1980s should have had several noticeable effects on aggregate investment. In particular, investment should have reached high levels both as a share of GNP and as a contributor to the recovery from the 1982 recession. Furthermore, since equipment investment first garnered many of the tax breaks introduced in ERTA and then lost them through subsequent legislation, equipment investment should have outpaced previous expansions until 1986 and then should gradually have fallen back to the levels it registered during previous expansions.

In fact, although some measures of business fixed investment were high as a share of GNP in the 1980s, the more important measures were quite low (Table 13). Because investment shifted into shorter lived assets with high rates of depreciation, gross investment was relatively high, especially when measured in real terms (reflecting the sharp drop in the relative price of computers). But gross investment measures exaggerate the extent of capital formation. As the right side of the table shows, net investment and therefore the growth in the capital stock were quite weak in the 1980s.

Chart 1 compares the recovery of equipment and

structures investment following the 1982 recession with two earlier long economic expansions. It shows (1) that investment did not always respond as expected to tax law changes in the 1980s and (2) that, if anything, tax law changes probably hurt investment in the 1982-90 expansion. Equipment investment recovered quickly from the deep 1981-82 recession, but before the passage of TRA, equipment spending had leveled off and fallen behind previous expansions. Surprisingly, after tax advantages for equipment were eliminated in 1986, equipment investment actually recovered from its mid-1980s doldrums. Structures investment languished following TRA. In fact, for the 1982-90 expansion as a whole, structures investment grew only about 10 percent, compared with 40 to 50 percent in previous expansions.

Of course, the broad trends in the aggregate data may reflect the offsetting impact of tax law changes and the impact of other variables on investment. Fortunately, much empirical work has been published on tax policy and investment. Most of the literature uses a relatively simple neoclassical framework with a "cost of capital" variable that takes into account tax credits, depreciation rules, costs of funds from various sources, and the corporate tax rate. In this framework, two aspects of investment behavior complicate the assessment of tax law changes. First, this sector is not only highly cyclical but has also been buffeted by dramatic structural shocks arising from new technology and changes in the composition of output. Second, econometric models generally do not fit the investment data well, particularly for structures, making it difficult to produce "statistically significant" results even when the coefficients are economically large.

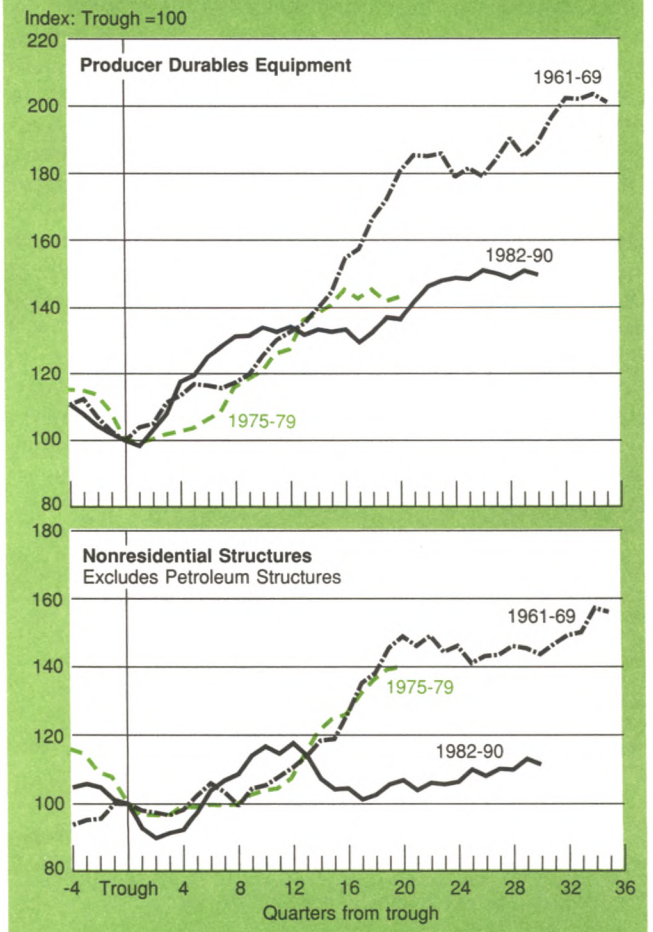
Table 13
Nonresidential Investment as a Share of National Product

	Gross Investment		Net Investment†		Depreciation	
	Nominal	Real	Nominal	Real	Nominal	Real
Ten-Year Averages						
1961-70	10.0	9.6	3.9	3.6	6.4	6.3
1971-80	11.3	10.5	4.1	3.5	7.6	7.3
1981-90	11.8	11.4	3.2	3.0	9.0	8.7
Five-Year Averages						
1971-75	10.7	10.2	3.9	3.5	7.1	7.0
1976-80	11.9	10.8	4.2	3.5	8.2	7.6
1981-85	12.6	11.5	3.7	3.3	9.3	8.6
1986-90	11.0	11.2	2.7	2.8	8.6	8.7

†Percentage of net national product.

A variety of studies in the mid-1980s found that tax policy probably played a small but significant role in the 1982-84 investment recovery. Surveys of the literature by Bosworth (1984) and Chirinko (1986) argue that although there is no clear consensus on the magnitude of tax effects on investment, most studies find that taxes mattered but were not nearly as important as output growth, interest rates, and inflation. (See, for example, Sahling and Akhtar 1985, Brayton and Clark 1985, and Meyer 1984.) In a representative study, Sahling and Akhtar argue that tax changes accounted for about one-fifth of the expansion in business fixed investment over 1982-84.

Chart 1
Business Fixed Investment in Business Cycle Recoveries



Note: The Tax Reform Act became effective in the thirteenth quarter of the 1982-90 recovery.

Most research suggests that the 1981-82 tax stimulus to investment was reversed under TRA. The President's Council of Economic Advisers (1987) optimistically estimates that the law lowered the capital stock by only about ½ percent. Others estimate much larger losses of capital stock. Using a model similar to the Federal Reserve's MPS model, Prakken (1986) finds that TRA would lower the 1995 capital stock by almost 9 percent. Fazzari's (1987) middle-ground findings attribute about a 4 percent decline in the capital stock to TRA.

Several studies have attempted to assess the net impact of tax law changes between 1981 and 1986. As Table 14 shows, Corker et al. (1989) find that the net impact of the tax changes was to raise the cost of capital, especially for equipment. These estimates of the cost of capital lead Corker and his colleagues to conclude that "in the long run, it seems likely that business fixed investment and the corporate capital stock could be lower than [they would have been] if none of these packages had been enacted" (p. 59).

Tax changes in the 1980s had other significant effects on capital formation that cannot easily be captured in cost of capital calculations. ERTA included strong incentives for tax shelters because of its favorable depreciation provisions, safe harbor leasing feature, and generous treatment of passive income losses. These tax incentives, along with relatively easy credit, were a major cause of the boom in apartment and office building and the sharp rise in vacancy rates in the mid-1980s. This process came to an abrupt halt when TRA put strong restrictions on tax shelters. To the extent that TRA diverted funds to capital with higher utilization rates, it had a positive impact on potential output. Thus, most conventional studies using the cost of capital approach have probably overstated both ERTA's favorable effects and TRA's adverse effects on potential output.

Table 14
The Real Cost of Capital
Percent

	1982	1985	1987
Equipment			
Actual	9.7	9.3	9.6
Excluding tax policy changes	10.6	10.0	8.3
Difference	−0.9	−0.7	1.3
Structures			
Actual	7.2	5.8	5.0
Excluding tax policy changes	8.5	6.9	4.5
Difference	−1.3	−1.1	0.5

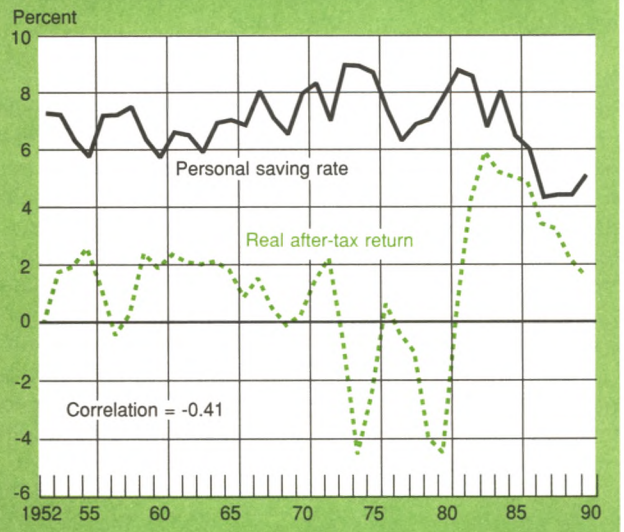
Source: Corker et al. (1989).

Saving

Tax law changes in the 1980s had significant effects on the after-tax return to saving. ERTA not only lowered marginal tax rates but broadened eligibility for individual retirement accounts (IRAs) and other retirement plans. TRA promoted saving by lowering tax rates further and eliminating the deduction for nonmortgage consumer interest, but it discouraged saving by restricting IRAs. Other tax law changes relevant to saving included the temporary cut in the maximum capital gains tax rate from 28 percent to 20 percent in the early 1980s, and the shift in the tax burden from the low-saving household sector to the high-saving corporate sector under TRA.

Impressionistic evidence does not suggest a strong saving response to changes in the after-tax rate of return. Until recently, the private saving rate in the United States was so stable that this empirical regularity became known as "Denison's law." As Chart 2 shows, there does not appear to be a systematic positive relationship between the after-tax real interest rate and the saving rate; in fact, the two variables are negatively correlated. During the early 1980s, saving rates fell despite a combination of very high real interest rates, cuts in marginal tax rates, and generous saving incentives. Blinder (1987) aptly points out that "titanic

Chart 2
The Savings Rate and Real After-Tax Returns



Note: The real after-tax return is i(1-t)-p, where i is the yield on AAA corporate bonds, t is the median income tax rate for a family of four, and p is the twelve-month percent change in the consumer price index excluding food and energy.

increases in rates of return during the 1980s failed to raise private saving. This suggests that the response of saving to the rate of return may not even be positive, much less large" (p. 638).

Most econometric studies find either very small effects of real interest rates on saving or no effect at all (see Smith's 1990 literature survey). Indeed, the estimated elasticity appears to be smaller in more recent studies that use data from the 1980s.

Evidence for a saving response to IRAs is more favorable. Clearly these tax-free accounts alter the composition of saving; the tougher question is how much they "borrow" from other forms of saving by causing shifts out of other assets and by increasing the federal budget deficit. The strongest support for IRAs comes from Venti and Wise (1987), who contend that about half of IRA savings is diverted from consumption. Carroll and Summers (1987) present corroborating evidence, arguing that much of the difference between U.S. and Canadian saving rates is due to more generous saving incentives in Canada. Other studies are less sanguine: Deaton (1987) questions Venti and Wise's conclusions, and Horioka (1986) argues that differences in tax incentives account for little of the difference between Japanese and U.S. saving rates. Furthermore, it is difficult to reconcile the micro evidence on IRAs with one macroeconomic fact: the personal saving rate fell almost continuously during the 1980s, both during years of generous IRA provisions (1982-86) and when IRAs were curtailed. If tax policy encouraged saving in the mid-1980s, the effects must have been quite small relative to other determinants of saving.

Summary: tax policy and potential output

For the 1980s as a whole, tax changes had little net impact on the incentive to save and invest. Tax incentives for investment granted under ERTA were reversed in subsequent legislation. The net impact on capital stock and hence on output growth was probably close to zero. Similarly, IRAs and other tax incentives for saving probably provided only a temporary boost to private saving in the early 1980s. It is hard to argue, moreover, that any such boost was substantial since the personal saving rate fell throughout the period. In any event, tax incentive effects on saving appear to have been too small to have had significant consequences for capital stock and the supply of output.

By contrast, reductions in personal tax rates in the 1980s appear to have made a significant, though modest, contribution to labor supply and potential output. At one extreme, optimistic econometric estimates suggest about a 3 percent labor supply response, mainly in the form of higher participation rates. At the other extreme, the raw data seem to suggest very small effects. In particular, the labor force participation rates of those who should have been most affected—married women, "moonlighters," and secondary workers in general—have not shown a noticeable response to tax changes. Overall, our best guess is that the tax rate reductions during the 1980s most likely increased labor supply by about 2 percent. Since labor represents a two-thirds share of output, the implied contribution of increased labor supply to potential GNP would appear to have been less than 1½ percent.

Conclusion

On the whole, developments in U.S. fiscal policy during the 1980s were unfavorable for the long-run performance of the economy. It appears that large and persistent federal budget deficits have already lowered the level of potential output by roughly 2½ to 3½ percent and, assuming no significant change in fiscal stance, the negative impact will continue to build up over time. Budget deficits have also made a significant contribution to the deterioration in the nation's net external debt position.

Shifts in public expenditures in the 1980s, especially through the reduced share of capital spending and the increased share of transfer expenditures, have put further downward pressures on capital stock and potential output. Thus far, however, adverse effects of expenditure shifts on output appear to have been relatively modest.

Changes in tax policy in the 1980s appear to have made no significant net contribution to capital formation for the decade as a whole. Tax breaks for investment were introduced in the early 1980s but subsequently taken away, leaving a more level playing field with less special incentives for investment. In contrast, tax policy initiatives have spurred labor supply and work effort, although it is very difficult to measure these benefits. Our reading of the available impressionistic and econometric evidence suggests that the favorable effects of reductions in marginal tax rates on potential output appear to have been smaller than the adverse consequences of large and persistent budget deficits.

In the absence of new legislation, a major reversal of the federal deficit trend in the next year or two seems unlikely. Indeed, the federal deficit has mushroomed and, on a national income accounts basis, is expected to exceed 5 percent as a share of GNP in the current fiscal year.[14] Fortunately, a significant part of the increase reflects the temporary effect of the recession.

[14]This deficit estimate excludes the deposit insurance costs of bailing out or closing insolvent thrift institutions and commercial banks. These outlays represent a transfer from one sector to another and do not affect national saving.

With a sustained recovery, the Congressional Budget Office projects that the deficit will fall to about 3 percent of GNP by 1995. This improvement would reduce the deficit to below its 1980s average, although considerable further efforts would be required to bring the budget back into balance. The challenge to policy makers will be to reduce the deficit without undoing the positive supply-side developments of the 1980s.

Appendix A: Deficit Impacts on Potential Output

The estimated effects of the deficit on potential output are based on simulations of a detailed neoclassical growth model. The model links the three key determinants of growth—saving and investment, labor force growth, and technological advance—to economic growth and the external debt position. We use two variations of the model to accommodate differing views about the interaction between investment and technological change: a "traditional" model that treats technology as independent of investment, and a "learning-by-doing" model that assumes that new investment encourages technological innovations. In both versions of the model, an increase in the federal deficit lowers net national saving and investment, although some of the decline in investment is offset by increased foreign capital inflows. With slower growth in the capital stock and higher debt service to foreigners, U.S. income growth falls. In the learning-by-doing model, the slowdown in capital formation also discourages technological change, further weakening income growth. Details of the model are presented in the appendix to Harris and Steindel (1991).

The table shows the important role of the "baseline" assumption in estimating the cost of the budget deficits in the 1980s. The baseline is the standard of comparison for the actual deficit: it shows what the deficit would have been had fiscal policy remained unchanged in the 1980s. The simplest baseline is a zero deficit, implying that fiscal policy in the 1980s is blamed for the entire deficit during that period. Using the traditional model, we find that the deficit accounts for a 3.8 percent drop in potential by 1990; using the learning-by-doing model, we find that the deficit is responsible for a 5.0 percent loss of potential. But these figures probably exaggerate the cost of fiscal policy in the 1980s. The budget was in deficit even at the peak of the business cycle in 1979, and balancing the budget for the decade would have required major new fiscal initiatives. On the other hand, using the 1970s as the baseline appears to understate the cost of fiscal policy in the eighties because the average deficit for that decade was quite high. A reasonable compromise, adopted in the text, is to use the long historical average from 1961 to 1980 as the baseline.

Sensitivity of Output Loss Estimate to Baseline Deficit Assumption
Percent Deviation from Baseline

		Potential Output in 1990	
Baseline Deficit	Deficit	Traditional Model	Learning-by-Doing Model
Zero	3.6	−3.8	−5.0
1961-80 Average	2.5	−2.7	−3.5
1971-80 Average	1.8	−1.8	−2.3

Appendix B: Main Features of Tax Law Changes in the 1980s

The Economic Recovery Tax Act (ERTA), 1981
Personal taxes

- Cut marginal personal tax rates in increments of 5 percent, 10 percent, and 10 percent, producing a total reduction of 23 percent by 1984. Immediately cut the top rate from 70 percent to 50 percent.
- Indexed the rate schedule, the zero bracket amount, and the personal exemption to the price level from 1985 on.
- Extended eligibility for individual retirement accounts (IRAs) to all working households ($4,000 for two-earner couples, $2,250 for one-earner couples). Made both the contribution and the interest earned tax free. Included more generous allowances for Keoghs and "all savers certificates."
- Reduced the "marriage tax": allowed married couples filing jointly to deduct 5 percent in 1982 and 10 percent thereafter of their earnings up to $30,000. Under the previous law, two-earner couples paid higher taxes if they married because their combined income would push them into higher tax brackets.
- Specified that starting in 1985, taxpayers would be allowed to exclude 15 percent of interest income up to $3,000.
- Cut top rate on capital gains from 28 percent to 20 percent.

Appendix B: Main Features of Tax Law Changes in the 1980a *(Continued)*

Business taxes

- Allowed accelerating cost recovery system (ACRS) for depreciating capital, lowering the average write-off period for equipment from 8.6 to 5.0 years, and for industrial plant from 23.8 to 15 years (Council of Economic Advisers 1982, p. 122).
- Reduced the declining balance for equipment from 200 percent to 150 percent, but raised the declining balance for structures from straight-line to 175 percent. Mandated further acceleration for subsequent years.
- Extended the investment tax credit to short-term assets not previously covered.
- Allowed "safe harbor leasing": permitted companies that cannot use all their tax credits to lease equipment from other companies. The latter earn the tax credit and then pass it through to the capital users by charging a low rental rate.

The Tax Equity and Fiscal Responsibility Act (TEFRA), 1982

Personal taxes

- Chipped away at the generous provisions under ERTA: "It added to the individual alternative minimum tax (AMT), increased the floor for deductible medical expenses and casualty losses, [and] taxed more of unemployment benefits" (Fullerton 1990, p. 32).
- Imposed 10 percent withholding on interest and dividends for the first time. (This provision was repealed the following year.)

Business taxes

- Put restrictions on safe harbor leasing.
- Scaled back the value of depreciation allowances by reducing the depreciable base of an asset by 50 percent of the value of the investment tax credit and by eliminating planned further accelerations in depreciation schedules.
- Introduced other minor changes: "reduced deductions for some mineral companies, required capitalization and amortization of construction period interest and property taxes, amended the completed contract method of accounting, accelerated corporate estimated tax payments, limited the use of tax-exempt industrial development bonds, restricted allowable pension contributions and benefits, and amended provisions for foreign income, life insurance companies, and unemployment taxes" (Fullerton 1990, p. 32).

Social Security Act, 1983 Amendment

- Added to and accelerated already planned increases in tax rates: mandated an increase in the combined employer-employee tax rate from 13.4 percent to 15.3 percent during 1983-90, and raised the self-employed rate from 9.35 percent to 15.3 percent.
- Expanded coverage to include all new federal employees and employees of nonprofit corporations.
- Altered tax exemption for benefit payments: made 50 percent of benefits taxable for individuals (couples) with incomes greater than $25,000 ($30,000) per year.

The Deficit Reduction Act (DEFRA), 1984

- Addressed a broad range of arcane details of the tax code, undoing some of the special provisions and loopholes created in the previous twenty years.
- Raised the depreciation lifetime for structures from fifteen to nineteen years.

The Tax Reform Act (TRA), 1986

Personal taxes

- Stipulated that by 1988 two brackets of 15 percent and 28 percent replace fourteen brackets ranging from 11 percent to 50 percent. Because of a phasing out of deductions, upper-middle income earners actually face a 33 percent marginal rate.
- Raised the effective capital gains tax rate to 28 percent.
- Broadened the tax base to include: all long-term capital gains, state and local sales taxes, IRAs for high-income persons with employer-provided plans, nonmortgage consumer interest payments, miscellaneous itemized deductions less than 2 percent of adjusted gross income, net losses from passive investments, and net losses from active real estate investments for high-income earners. (This last category of losses cannot be deducted from ordinary income and must be carried forward and deducted from net income generated by like activities in later years.)
- Partially offset the base broadening by doubling the personal exemption and increasing the standard deduction (by 36 percent for joint returns and 21 percent for single returns). Increased the earned income credit, eliminating the social security tax for low income people.

Business taxes

- Lowered the corporate rate from 46 percent to 40 percent in 1987 and 34 percent thereafter.
- Repealed the investment tax credit, effective January 1986.
- Made depreciation rules less generous: raised the average depreciation life for equipment from 4.6 to 6 years, and for structures from 19 to 31.5 years. Raised the declining balance for equipment from 150 percent to 200 percent, but reduced the declining balance for structures from 175 percent to straight-line.
- Increased the alternative minimum tax.

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Small Time Deposits and the Recent Weakness in M2

by John Wenninger and John Partlan

By most standard measures, monetary policy has eased considerably since the peak in economic activity in the third quarter of 1990. Total reserves and the monetary base have increased quite rapidly (Charts 1 and 2) relative to their growth in past business cycles, and the federal funds rate has declined in a pattern rather similar to the average in past cycles (Chart 3).[1] Despite this apparent easing in monetary policy, however, M2's growth has been unusually weak since about the time of the peak in business activity. By the fourth quarter of 1991, M2's level was 6 percent below the normal cyclical pattern (Chart 4).

The weakness in M2, however, has not been reflected uniformly across its components.[2] As Charts 5 and 6 show, the recent weakness in M2 can be traced to its small time deposit component. Small time deposits are currently about 27 percent below the usual cyclical pattern, while M2 less small time deposits has displayed a fairly typical cyclical pattern.[3]

The first section of this article investigates the developments that have reduced the growth of small time deposits and consequently the growth of M2 over the last two years. We find that the unusually weak growth in M2 and small time deposits appears to stem from both supply and demand considerations. On the supply side, depository lending has been sharply curtailed in what some analysts have called a "credit crunch."[4] As of the fourth quarter of 1991, depository lending had fallen about 11 percent below the typical cyclical pattern (Chart 7).[5] This reduced lending by depository institutions has probably contributed to the weakness in M2 from the supply side because banks have had more freedom to use small time deposits as managed liabilities since the phaseout of the interest rate ceilings on bank deposits imposed by Regulation Q. Thus, with curtailed lending, banks have had less need to pursue small certificates of deposit (CDs) as a source of loanable funds.

In addition to these supply-side developments there has been an apparent decline in the demand for small

[1] In these charts and the ones that follow, the averages over the past four recessions include the 1960-61, 1969-70, 1973-75, and 1981-82 recessions. The 1980 recession was excluded because of the unique circumstances associated with the 1980 credit controls, and the overlap with the data for the 1981-82 recession.

[2] M2 consists of a diverse set of depository liabilities, ranging from very liquid transactions accounts and savings accounts to less liquid small time deposits (less than $100,000) of varying maturities. M2 also contains some nondepository liabilities such as repurchase agreements and money market mutual fund shares. See the appendix for more background on the definition of M2.

[3] In real terms, the cyclical comparisons tell a slightly different story. As of the fourth quarter of 1991, M2's level would be about 3 percent below the pattern of past cycles, while small time deposits

Footnote 3 continued
would be roughly 23 percent below and M2 less small time deposits about 4 percent above.

[4] See Ronald Johnson, "The Bank Credit Crumble," Federal Reserve Bank of New York *Quarterly Review*, Summer 1991, pp. 40-51. Johnson argues that the sharp curtailment in bank lending resulted primarily from a deflation in asset prices and a broad shortage of bank capital.

[5] In this article, we use the terms "bank lending" and "depository lending" interchangeably to mean total lending by depository institutions, both banks and thrift institutions.
In real terms, depository lending in the fourth quarter of 1991 was 7.7 percent below the typical cyclical pattern.

time deposits and M2 as a whole. Consumers have become more willing to switch to instruments not counted in M2 now that the yields on small time deposits have fallen to very low levels. Also from the demand side, the closing of thrift institutions by the Resolution Trust Corporation may have prompted some consumers to move funds out of thrift institutions into mutual funds and market instruments.

In the second section of this article, we consider whether it is possible to construct a more useful monetary aggregate by excluding small time deposits from M2. Our analysis suggests that a monetary aggregate measured as M2 less small time deposits would pose significant problems for monetary targeting. Unlike M2, this aggregate does not seem to have a strong and stable long-run relationship with GDP, a desirable feature for achieving long-run policy objectives through monetary targeting. Moreover, it appears to respond strongly to changes in interest rates, making the Fed-

Chart 1
Total Reserves

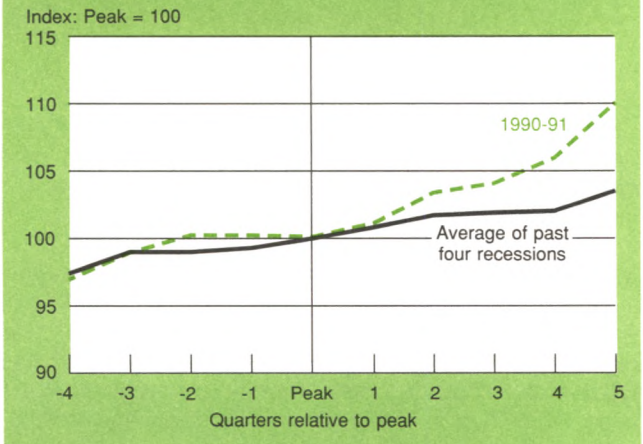


Chart 2
Monetary Base

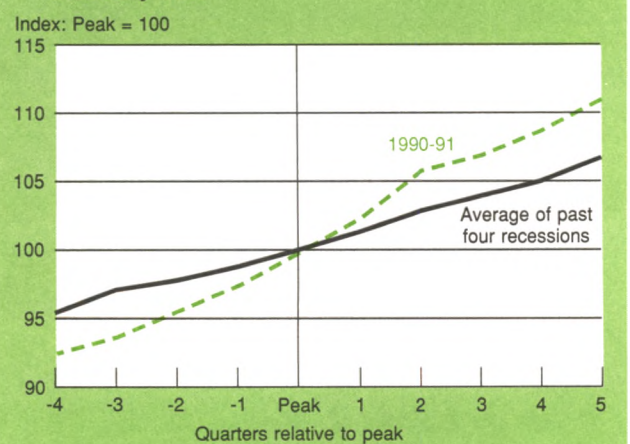


Chart 3
Federal Funds Rate

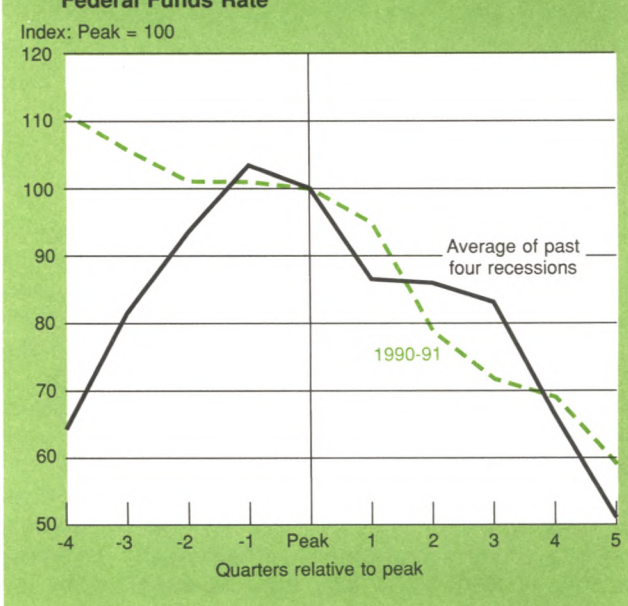
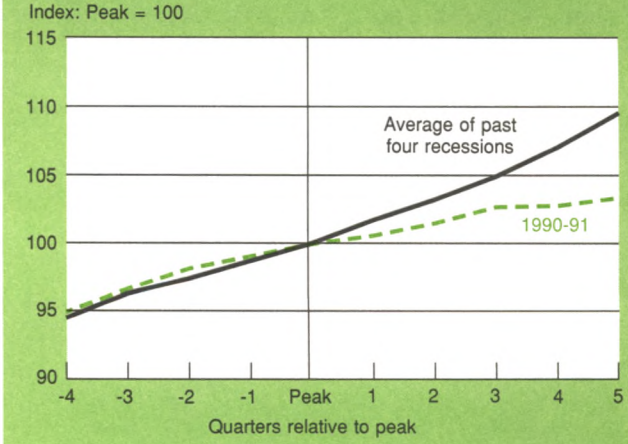


Chart 4
M2



eral Reserve's task of setting targets in the shorter run more difficult. It is possible, however, that if small time deposits continue to complicate the interpretation of M2, the question of how to define M2 will come up again.

Recent weakness in small time deposits

This section reviews the supply-side and demand-side factors that have lowered the growth of small time deposits and M2. The section ends with a discussion of the likely interaction of the supply and demand considerations and a brief look at the policy implications.

Supply-side considerations

The recent sluggishness in bank lending probably stems from the weakness in economic activity and from some reduction in the willingness of banks to lend. Therefore, both of these developments have probably also contributed to the unusual weakness in M2 and small time deposits. Although sorting out the relative importance of the two developments is difficult, the wider spread between the prime rate and the federal funds rate over the last two years does suggest that the "credit crunch" could be playing a significant role (Chart 8).[6] Indeed, if the slowdown in bank lending came exclusively from a reduced demand for bank loans in a weak economy, we would expect banks to be lowering, not raising, the prime rate (and other lending rates) relative to market rates to attract additional borrowers.[7]

Chart 5

Small Time Deposits

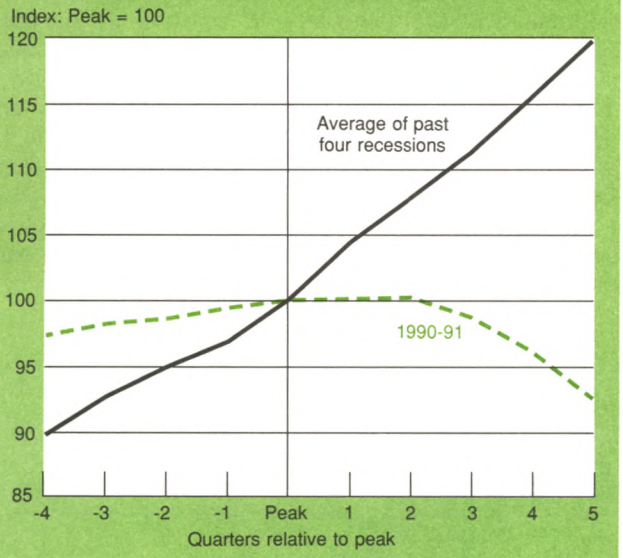


Chart 6

M2 less Small Time Deposits

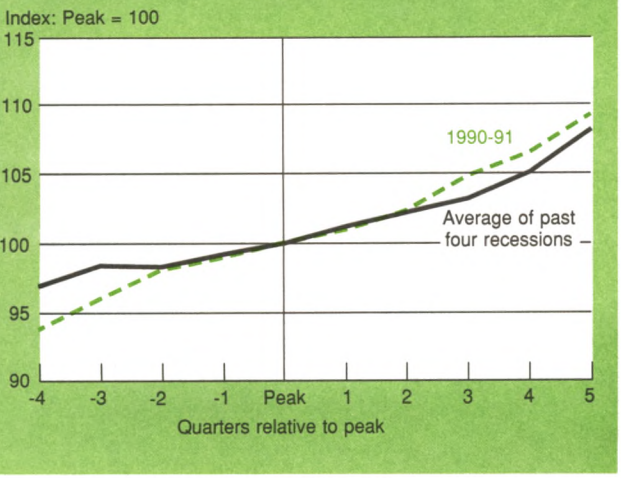
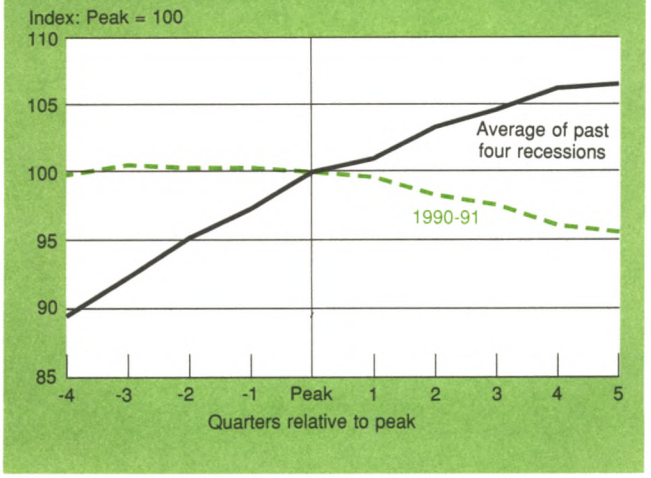


Chart 7

Depository Lending



[6]Spreads comparable to the current ones also occurred in the 1982 recession. Although that period is not generally viewed as a classic "credit crunch" episode, the financial markets were subjected to great uncertainty stemming from the collapse of Drysdale, the Penn Square failure, and the rescheduling of the debts of Brazil, Mexico, and other countries. Had these debts not been rescheduled, the adequacy of the capital of some large U.S. banks would have been in doubt. Some analysts have characterized this period as approaching a credit crunch. For more detail, see Albert Wojnilower, "Private Credit Demand, Supply, and Crunches—How Different are the 1980s?" *American Economic Review*, Papers and Proceedings, May 1985, pp. 351-56.

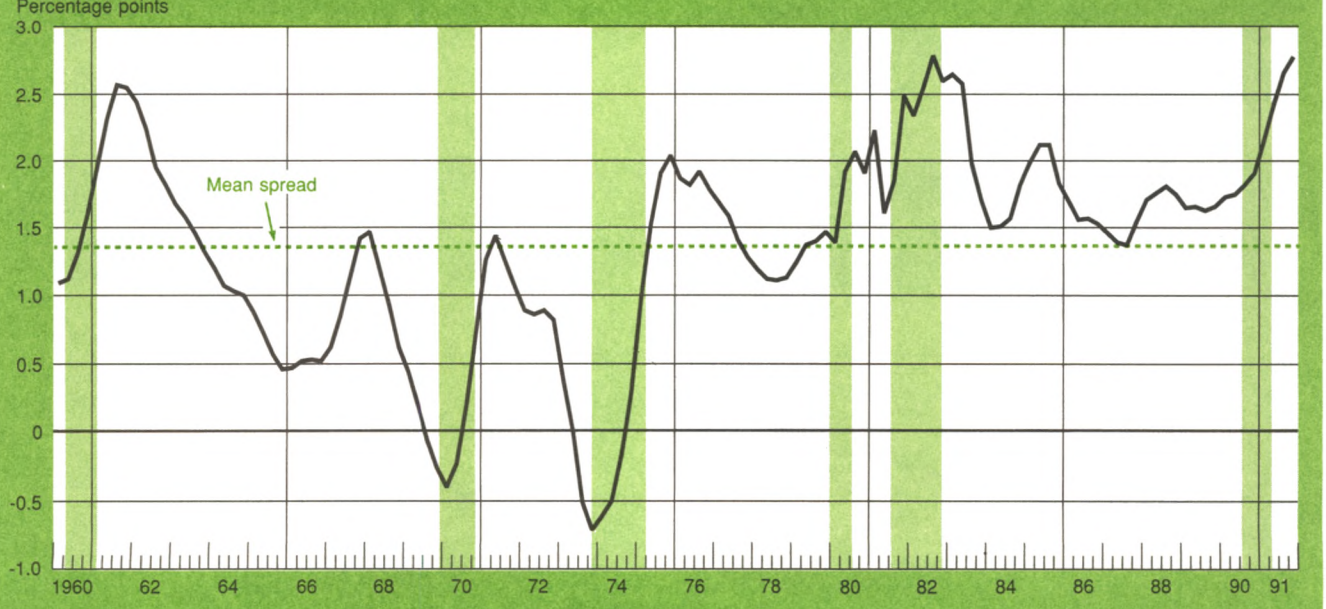
[7]It is not the purpose of this article to document the existence or the severity of the credit crunch over the past two years. Others

In contrast, when a credit crunch is an important supply-side consideration, we would expect to see high lending rates relative to market rates as well as weakness in bank lending on the asset side, and slow growth in managed deposits on the liability side. In addition, all other things equal, the rates paid on these managed deposits should look low relative to market rates as banks bid less aggressively for these deposits. Thus far, however, there has been little evidence of unusually low deposit rates relative to market rates. When bank deposit rates are compared with the rates on Treasury securities of similar maturities, significant changes from the past relationships are not readily apparent (perhaps because banks make some of the adjustment by reducing advertising and promotions). For example, the spread between the six-month consumer CD rate and the six-month Treasury bill rate has been quite stable in recent years (Chart 9). This spread had shown somewhat greater volatility in the late 1970s and early 1980s when, partly as a result of the change in the Federal Reserve's operating procedures, interest rates in general were more volatile. Moreover, as explained below, the rates banks offer on small CDs may not prove to be unusually low relative to the rates on market instruments, even when bank funding needs are reduced by sluggish loan growth, if the demand to hold these CDs is weakening at the same time.

In any case, it is not surprising that the weakness in bank lending would be reflected in M2 primarily through its small time deposit component. Since the phaseout of Regulation Q (from the late 1970s through the early 1980s), banks appear to be using small time deposits more actively as managed liabilities. The elimination of interest rate ceilings on deposits (except for demand deposits) has given banks the ability to manage the attractiveness of all their various M2 liabilities by adjusting rate and nonrate terms over the longer run. It is reasonable to expect that such adjustments throughout the whole range of these liabilities would eventually reflect a persistent weakness in loan demand and/or a

Footnote 7 continued
have undertaken that work (see footnotes 4 and 11). Rather, we are focusing on the implications of the credit crunch for M2 and small time deposits. In addition, a simple interest rate spread chart such as Chart 8 could not give much insight into the severity of a credit crunch because banks could also adjust the nonprice terms on their loans or simply ration credit at some posted rate.

Chart 8
Prime Rate less Federal Funds Rate
Four-Quarter Moving Average



Notes: Shaded areas indicate recession periods designated by the National Bureau of Economic Research. For purposes of illustration the trough of the 1990-91 recession is assumed to be April 1991.

reduced willingness of banks to lend.

Still, banks are likely to act more quickly to adjust the quantities of small time deposits than the liquid transactions components of M2. Banks actively manage small time deposits as money market conditions change to avoid the large undesired inflows or outflows that would occur if the offering rates on these deposits moved significantly out of line with market rates or the rates offered by banks' competitors. Indeed, the first step in deregulating small time deposits was to link the interest rates on these deposits to market rates, creating the perception for consumers that these are market-rate accounts. Now that banks are free to offer any rate they choose on small time deposits, consumers have become careful CD rate-shoppers, not only in their local markets but also in the national brokered CD market, and banks can raise funds by offering somewhat higher rates than the rates paid by competitors or on market instruments.

In contrast, consumers are usually slow to move their transactions or savings accounts to another bank for a slightly higher rate of return, and nonprice considerations such as convenience and service are also more important. In addition, banks have marketed these accounts more as accounts for which various services are part of the return, and the interest rates paid change less frequently. Hence, banks do not need to be as active in managing these liabilities, nor can they use these deposits to raise funds in large amounts in the short run. The response by consumers to any change in the terms is likely to be very gradual and not very predictable for purposes of short-run liability management.[8] In general, when banks fund their asset-liability management strategy in the wholesale money market, they tend to take transactions deposits as given. Over time, however, banks will adjust the rates and other terms on these accounts if they feel the rates have moved out of line with market conditions and their own portfolio considerations.[9]

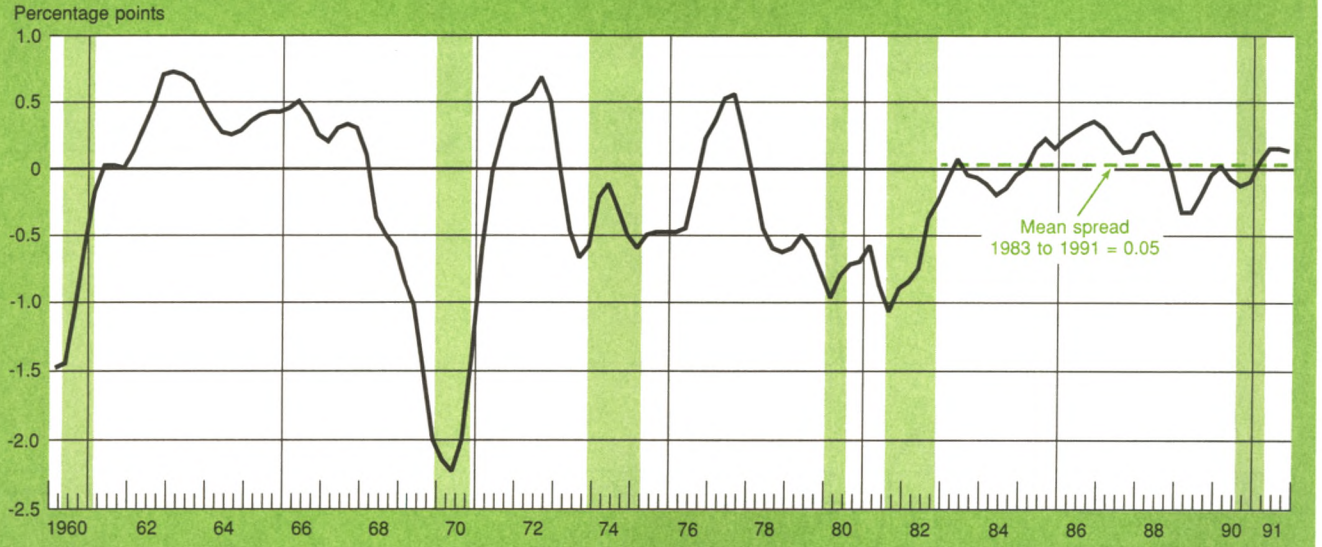
[8]Although consumers do not change the location of their transactions accounts for small differences in yield, they do economize on such balances if attractive alternatives become available. As a result, consumers often transfer some of their liquid balances to small time deposits as banks increase the interest rate on small time deposits more quickly than the rates on the more liquid accounts. The implications of this behavior for monetary targeting are discussed in the next section.

[9]For more detail see Richard G. Davis, Leon Korobow, and John Wenninger, "Bankers on Pricing Consumer Deposits," Federal Reserve Bank of New York *Quarterly Review*, Winter 1986-87, pp. 6-13. For an econometric evaluation of how banks change deposit rates in response to changes in market rates, see John Wenninger, "Responsiveness of Interest Rate Spreads and Deposit Flows to Changes in Market Rates," Federal Reserve Bank of New York *Quarterly Review*, Autumn 1986, pp. 1-10.

Chart 9

Six-Month Consumer CD Rate less Six-Month Treasury Bill Rate

Four-Quarter Moving Average



Notes: Shaded areas indicate recession periods designated by the National Bureau of Economic Research. For purposes of illustration the trough of the 1990-91 recession is assumed to be April 1991.

Charts 10 and 11 contain some empirical evidence suggesting that banks have used small time deposits more extensively as managed liabilities since the phaseout of Regulation Q. The interest rates paid on small time deposits during the last thirteen years have become more highly correlated with rates paid on large time deposits (a traditional managed liability). In addition, the growth rates of the quantities outstanding of large and small time deposits have become much more highly correlated since Regulation Q was phased out, increasing from almost zero to about 75 percent. Over the last two years, the rates paid on small time deposits

Chart 10

Interest Rates on Small and Large Time Deposits

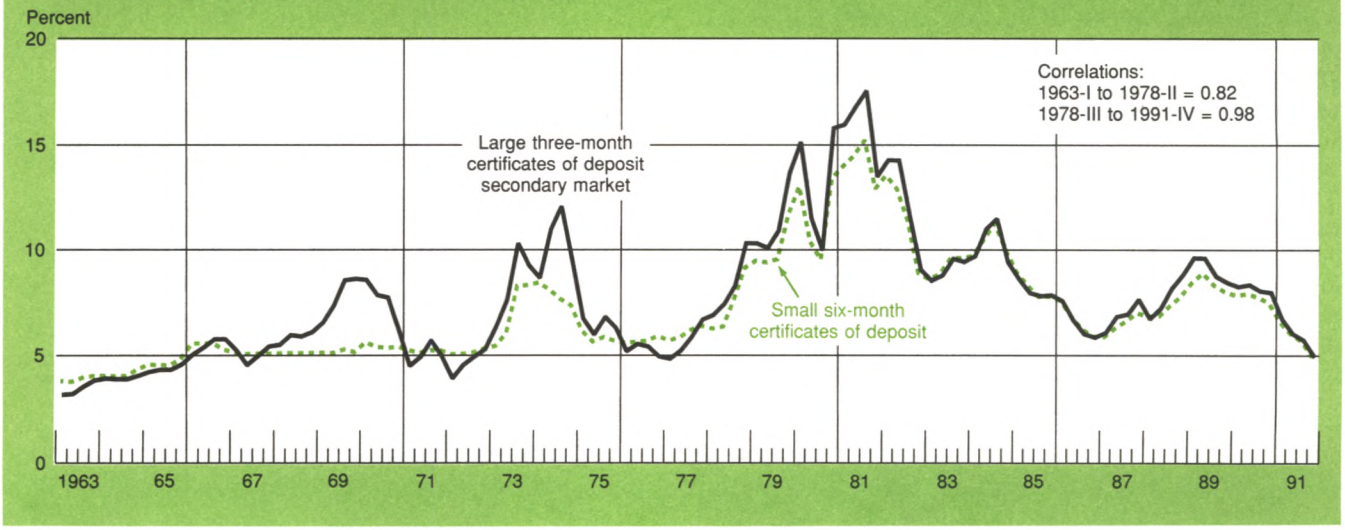
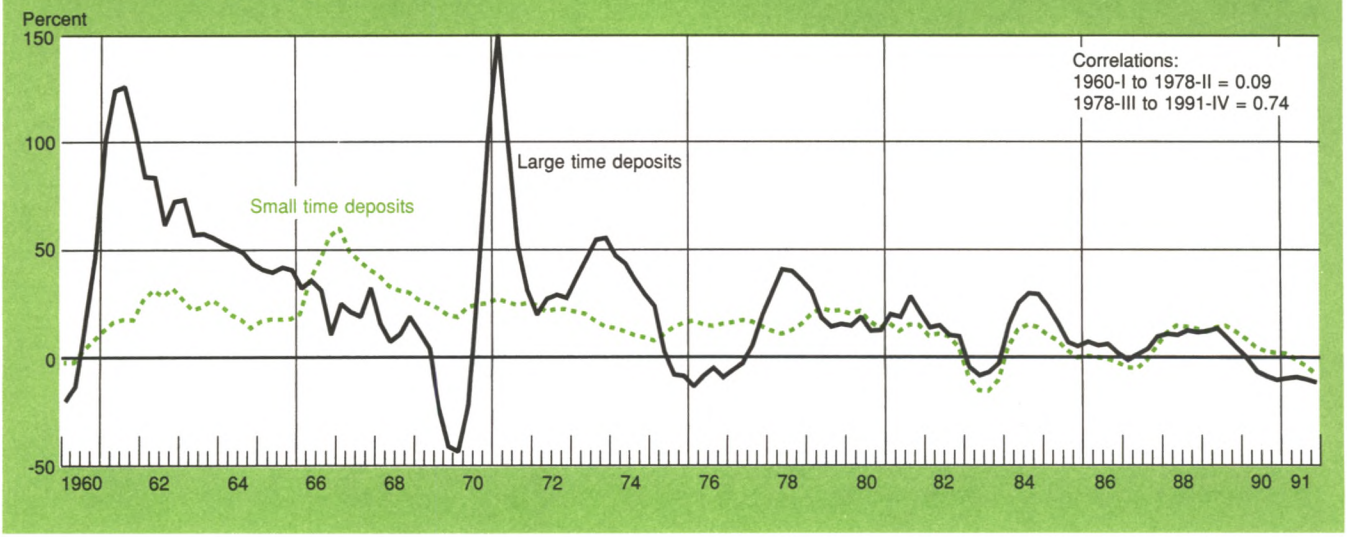


Chart 11

Growth of Small and Large Time Deposits

Change from Four Quarters Earlier



have continued to follow the rates paid on large time deposits quite closely, and the growth rates of the quantities outstanding have shown a comparable slowing. Hence, both large and small time deposits appear to be reflecting the general weakness in bank lending.

Although the evidence shows stronger correlations in recent years between the interest rates paid on small and large time deposits and on the quantities outstanding of these liabilities, the markets for these two types of deposits are, of course, quite different. The market for large CDs is both highly sophisticated and quite competitive. Thus, a bank offering rates much below the going market rate will essentially not be able to raise any funds, whereas a rate much above the market rate will result in a large inflow of these deposits. Consequently, in the large CD market, major banks must offer a rate close to the market rate when they bid for funds, controlling instead the *quantity* of funding they obtain.

In contrast, the market for small, consumer-oriented CDs, while clearly sensitive to the rates offered by a bank, does allow somewhat more pricing freedom than does the market for large CDs because consumers do not respond as quickly and strongly as professional money managers. However, while banks do have some leeway in pricing in this market, they usually accept all the deposits that are supplied by consumers at the posted rates. Consequently, they can control the funds they get from this source only imperfectly by adjusting the posted rates up or down relative to money market rates and the rates offered by other institutions.

Even though banks manage these two types of liabilities somewhat differently, both types have reflected the weakness in bank lending. Hence, it would appear that banks use small time deposits as "managed liabilities" to a sufficiently large degree that M2 could be affected from the supply side during this period of weak bank lending.

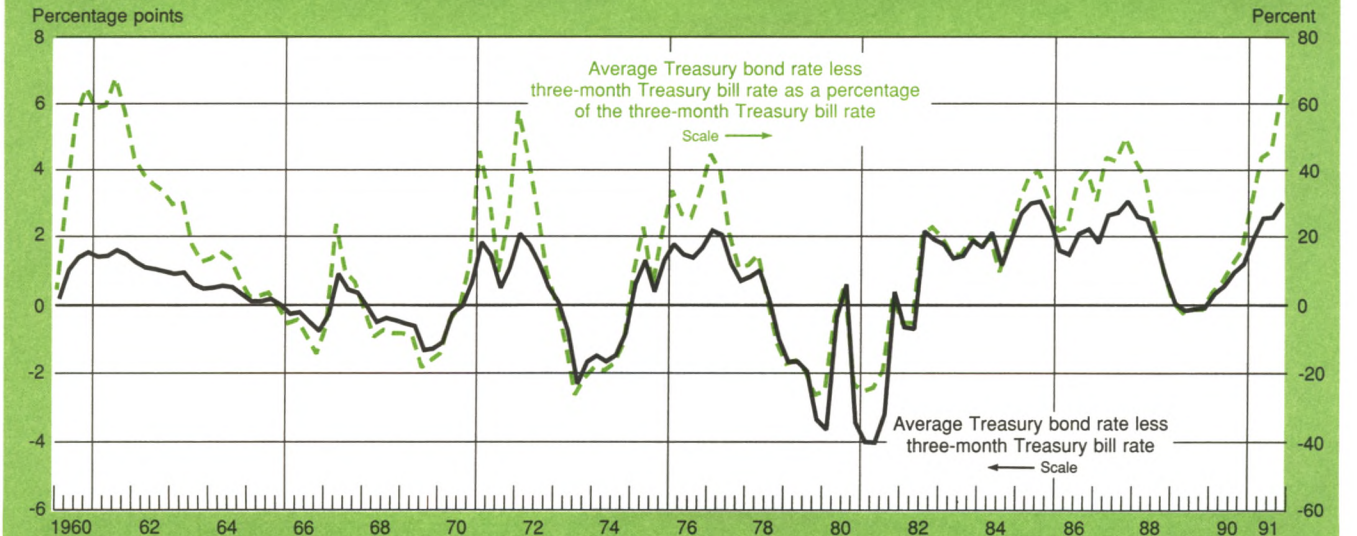
Demand-side considerations

Small time deposits have probably also been unusually weak because the public's demand for them as investment outlets has fallen. Even though small time deposit rates have declined roughly in step with the drop in market rates, the absolute size of the decline has been a shock to many consumers, particularly those who rely heavily on interest income to finance their spending. Some of these consumers have moved their money to investments outside M2 in a search for higher yields. Indeed, with some banks and thrifts actively promoting families of mutual funds at their branches, switching from time deposits or other depository liabilities into a broad range of mutual funds has been made quite simple for consumers willing to take on some risk in exchange for greater yield.

At the same time, former depositors in institutions closed or taken over by bank regulators have had to

Chart 12

Treasury Yield Curve: Absolute and Relative Spreads



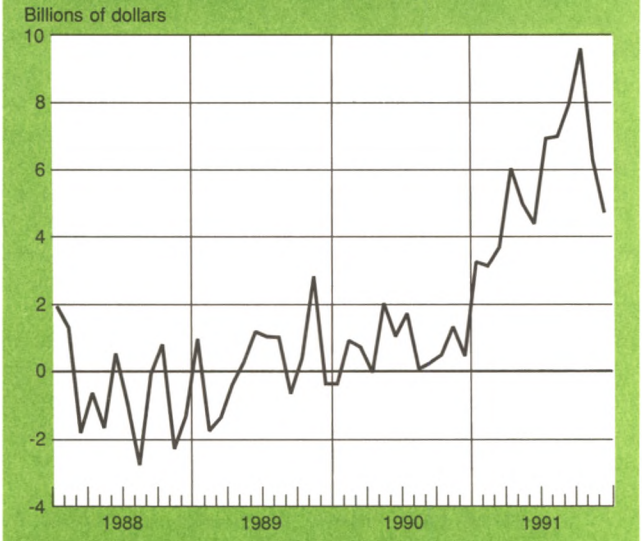
reconsider their investments in a low-rate environment. It seems likely that at least some of these depositors would move their funds outside M2, especially those more sophisticated individuals who were attracted to small time deposits at these weak institutions by interest rates that were above market rates in the local deposit market or in the brokered CD market. In most cases, the acquiring bank or the regulatory agency would be unwilling to continue paying above-market rates.

Coinciding with these other demand-side developments, a sharp steepening of the yield curve has prompted some consumers to examine whether they should sacrifice some liquidity by moving from small time deposits into long-term instruments to gain some additional yield. As Chart 12 indicates, the gain in yield in percentage terms could be quite large. Moving money into longer term instruments has been made somewhat easier in recent years by the greater availability of alternatives such as bond and stock mutual funds of various kinds, and these funds have grown quite rapidly over the past year or so (Charts 13 and 14). In addition, smaller investors probably now view direct investment in bonds more favorably than they would have the last time such strong inducements to find higher yield alternatives were present.

The available econometric evidence suggests that these demand side factors, when added together, could be quite important in explaining the recent weakness in M2. Simulations of conventional demand equations for M2, which do not allow for the full range of alternatives to holding small time deposits, produce very large negative errors. For example, as shown in Chart 15, an equation estimated by Moore, Porter, and Small overpredicted M2 by nearly $200 billion, or 5.6 percent, by

Chart 13

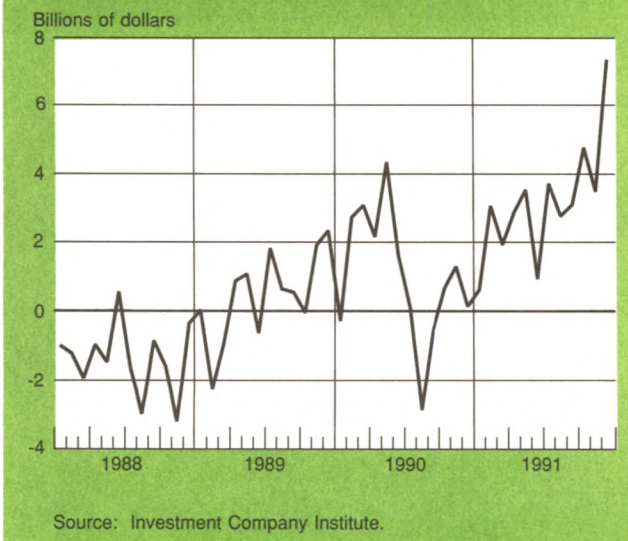
Monthly Net Sales of Bond Mutual Funds



Source: Investment Company Institute.

Chart 14

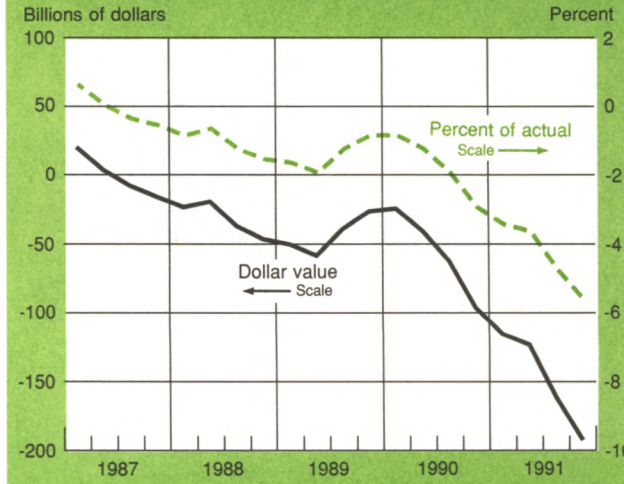
Monthly Net Sales of Stock Mutual Funds



Source: Investment Company Institute.

Chart 15

Cumulative Errors from M2 Demand Equation



Box: Graphical Analysis of Supply and Demand Shifts

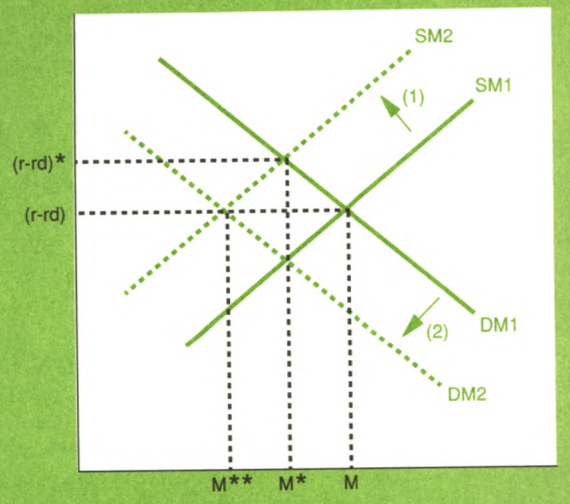
The M2 equation, used to calculate the errors in Chart 15, incorporates a measure of the opportunity cost of holding M2 balances, that is, the spread between a short-term market rate and a weighted average of the rates paid on the components of M2.† The chart in this box, incorporating this spread concept, illustrates how negative shifts in the supply of and demand for M2 may have interacted recently to produce what appears to be a large error in the demand equation. This chart also demonstrates why deposit rates, for the most part, have not appeared unusually weak relative to market rates during this period of reduced bank lending. In the chart, SM1 and DM1, respectively, are the initial positions of the supply of and the demand for money. Initially, M is the equilibrium level of money balances held and (r-rd) is the spread between the market rate (r) and the weighted average deposit rate (rd).

Assume that there is a reduction in the supply of money (SM1 to SM2) resulting from a credit crunch as well as weaker loan demand. To reduce the liability side of their balance sheets, banks offer lower rates on deposits, a response that increases the spread between the market rate and the deposit rate to (r-rd)* and reduces the level of money balances to M*. Because this supply shift represents a movement along the initial demand curve, it should not create any errors in the estimated demand function for money.

However, suppose the demand for M2 also shifts for the reasons cited earlier: very low deposit rates, the greater acceptance of mutual funds by consumers, the closing of many thrift institutions by the Resolution Trust Corporation, and the steep yield curve. As a result, the shift in the demand for money from DM1 to DM2 will reduce money balances even further (to M**). This shift will also tend to move the rate spread back toward the original level as banks are forced to bid somewhat more aggressively to offset outflows larger than desired.

To see how the supply and demand shifts interact, assume that the rate spread returns to its original position (r-rd). When this rate spread is viewed in the context of the original demand function (estimated prior to the shifts in the supply and demand functions), we observe a large error (M**-M), partially due to the supply shift along the initial demand function (DM1) and partially due to the demand shift along the second supply function (SM2). Hence, both supply and demand considerations are leading to the observed error in the initial demand function because the demand function shifts along a reduced supply function.

Impact of Money Supply and Demand Shifts on Money Balances and Interest Rate Spreads



SM1 = initial supply of money
DM1 = initial demand for money
M = initial quantity of money balances
(r-rd) = initial spread between the market rate(r) and the deposit rate(rd)
SM1 to SM2 = reduction in the supply of money created by drop in loan demand and "credit crunch"
M* = level of money balances after supply shift (M*<M)
(r-rd)* = rate spread after supply shift (r-rd)*>(r-rd)
DM1 to DM2 = reduction in the demand for money resulting from greater acceptance of mutual funds and other factors
M** = level of money balances after supply and demand shifts (M**<M*<M)
(r-rd) = level of rate spread after supply and demand shifts (r-rd)<(r-rd)*

† This approach to measuring the opportunity cost does have some problems. First, only the short-term Treasury bill rate is used as an alternative to M2 deposits. Clearly, longer term rates might be important as well, particularly when the yield curve is more steeply sloped. Second, this opportunity cost

† *continued*
measure cannot capture more subtle changes in bank behavior such as increased advertising and promotion. Finally, although the deposit rates are the most common rates paid by surveyed institutions, they may be different from the rates paid to raise funds in the brokered CD market or the rates paid to larger customers.

Box: Graphical Analysis of Supply and Demand Shifts *(Continued)*

Small time deposits probably played an important role in both the demand and supply shifts outlined above. As noted in the text, these deposits are probably the component of M2 most vulnerable to demand shifts because consumers have become more willing to shift funds to alternative instruments outside M2. On the supply side, small time deposits can also have significant impacts on M2 because banks use them at least somewhat as managed liabilities.

the fourth quarter of 1991.[10] Most likely, a large part of this error is due to the omission of these alternatives, especially at a time when consumer attitudes about alternative investments may have changed appreciably (see box for more detail).

Interaction of supply and demand forces and the policy implications

The preceding discussion suggests that reductions in both the supply of and the demand for small time deposits have slowed M2 growth. This combination of supply and demand forces probably explains, in part, why bank deposit rates have not appeared unusually low relative to market rates as a result of weak bank lending. Normally, we would expect banks to respond to weakness in lending by lowering deposit rates relative to money market rates, and perhaps by reducing advertising and promotions as well. But if consumers have been reducing their demand for these deposits at the same time, banks may have been forced to keep deposit rates more in line with market rates to avoid a larger than desired decline in these deposits. The box illustrates this point with supply and demand curves. It also shows how supply and demand forces may have interacted to produce the large error in the M2 demand equation noted above.

How should the weakness in M2 over the past two years be interpreted for policy purposes? A decrease in the supply of money stemming from declining loan demand and a reduced willingness on the part of banks to lend would be consistent with weakness in economic activity, particularly if those consumers and firms relying on bank credit could not find readily available alternatives when the banks reduced their lending.[11] But a decline in the demand for money caused by the greater acceptance of close money substitutes would not necessarily depress economic activity further. The lower level of money balances resulting from the demand shift could finance the same level of spending through an increase in velocity. If, however, the shift out of insured small time deposits into uninsured holdings of stocks and bonds (directly or indirectly through mutual funds) made consumers feel less secure or less liquid, their spending might be somewhat constrained.

Not only has the recent weakness in small time deposits made it difficult to interpret M2 for policy purposes, but it has also raised the question whether M2 is still defined correctly. In the next section, we consider whether excluding small time deposits from M2 would yield a monetary aggregate better suited for policy purposes.

Redefining M2 to exclude small time deposits

For those readers unfamiliar with the logic behind the current definitions of money, the appendix reviews how the current definitions of money were developed in the early 1980s. The monetary aggregates were redefined at that time to include similar deposits at the same level of aggregation without regard to whether the deposits were the liabilities of commercial banks or of thrift institutions. For example, under the revised definitions, all checking accounts, whether at banks or thrift institutions, are included in M1. In contrast, the preceding definitions had sharply distinguished the liabilities of banks from the liabilities of thrift institutions.

[10]The M2 equation used in this exercise was taken from George Moore, Richard Porter, and David Small, "Modeling the Disaggregated Demands for M2 and M1: The U.S. Experience in the 1980s," *Financial Sectors in Open Economies: Empirical Analysis and Policy Issues*, Board of Governors of the Federal Reserve System, 1990, pp. 21-105, Table 11.

[11]For more background, see Ben Bernanke and Cara Lown, "The Credit Crunch," *Brookings Paper on Economic Activity*, 2:1991, pp. 205-27; and Ben Bernanke and Alan Blinder, "Credit, Money, and Aggregate Demand," *American Economic Review*, May 1988, pp. 435-39. In the Bernanke-Blinder model, a reduction in the willingness of banks to lend shifts the IS curve leftward, reducing output. Hence, the monetary policy response in this model would be better if the Federal Reserve took into account not only developments with respect to money but also bank loans.

Because small time deposits are used by banks at least partially as managed liabilities, some analysts have proposed excluding small time deposits from the current definition of M2.[12] These analysts have also argued that in theory the liquid components of M2 (demand deposits, NOW accounts, savings accounts, and money market deposit accounts) should not be aggregated with less liquid time deposits at the M2 level. Consumers are likely to view these liquid accounts as being more readily available for transaction purposes than the less liquid time deposits. A final consideration, outlined in the first section, is that shifts in the demand for small time deposits may also destabilize the demand for M2 if holders of these deposits become more aggressive over time in looking for alternatives outside of M2.

The case that an M2 aggregate defined to exclude small time deposits might be more suitable for policy purposes than the current M2 aggregate rests on four arguments: (1) the redefined aggregate would probably be better insulated from shocks to bank lending in the short run, (2) it would be conceptually cleaner at a theoretical level, (3) it would be more demand-determined because it would not contain a large amount of managed liabilities, and (4) instability in the demand for small time deposits would not translate into instability in the demand for M2.

Other considerations, however, suggest that a redefined M2 might not be better suited for policy purposes than the current definition of M2 over the longer run. Chart 16 shows that consumers tend to move funds between the liquid components of M2 (M2 less small time deposits) and small time deposits. The growth rates of these two components of M2 have developed a strong negative correlation since 1978, when the phase-out of Regulation Q began. Consumers tend to move funds between time deposits and the liquid components of M2 in response to the interest rate spreads that develop when banks quickly adjust the rates on time deposits as market rates change (as would be expected with a managed liability) but only gradually move the rates on the liquid components of M2.[13]

This behavior by banks also suggests that the demand for the liquid assets in M2, like the demand for M1, has a larger interest rate elasticity in the current deregulated financial system than it had under the earlier regulations. When the maximum rates on consumer deposits were set by Regulation Q, the spreads

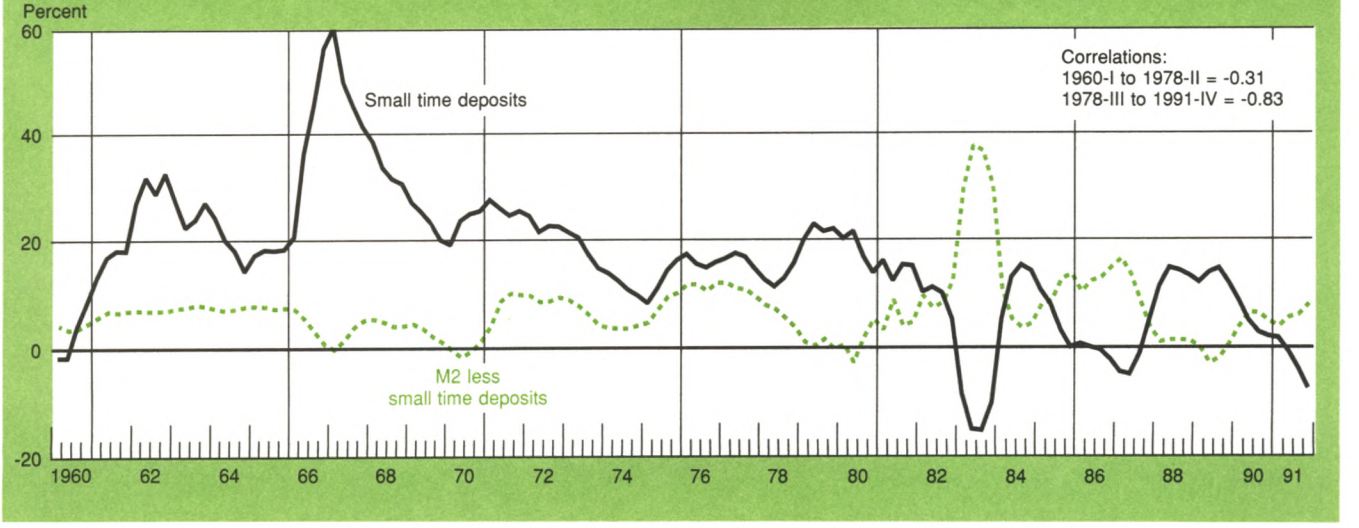
[12]The case for removing small time deposits from M2 can be found in Brian Motley, "Should M2 be Redefined," Federal Reserve Bank of San Francisco *Economic Review*, Winter 1988, pp. 33-51. Also see the Federal Reserve Bank of Cleveland's *Economic Trends*, December 1991, pp. 4-5; and William Poole, "Choosing a Monetary Aggregate: Another Look," report prepared for the Shadow Open Market Committee for its September 29-30, 1991 meeting. Other analysts have argued at times that institutional money market mutual funds, a highly liquid component of M3 but not of M2, should be included in M2.

[13]See John Wenninger, "Responsiveness of Interest Rate Spreads."

Chart 16

Growth of Small Time Deposits and of M2 less Small Time Deposits

Change from Four Quarters Earlier



between the rates offered on M1 balances, or on M2 less small time deposits, and the rates paid on small time deposits tended not to change as market rates changed. Hence, while consumers had incentives to switch funds between deposits and market instruments when market rates changed, no such incentives were created to prompt consumers to move money between time deposits and M1 or M2 less small time deposits.

In a deregulated banking system, however, the spreads between the rates offered on time deposits and the liquid components of M2 also change when market rates change, making both M1 and M2 less small time deposits more interest sensitive. Consumers can now choose small time deposits as well as market instruments as alternatives to their more liquid deposits, the rates on which do not respond strongly and quickly to changes in market rates. Indeed, for many consumers it is probably easier to use time deposits at their banks to manage their money than it is to use market instruments. As a result, M2 less small time deposits, if used for policy, would probably have caused many of the same problems encountered with M1 in recent years, problems that stemmed in large part from M1's larger interest rate elasticity in a deregulated banking system.[14]

This conclusion is supported by Chart 17, which contains the growth rates of M1 and M2 less small time deposits. Except for a brief period in the early 1980s when the introduction of money market deposit accounts attracted a large amount of money into M2 less small time deposits, the growth rates of M1 and M2 less small time deposits have moved together quite closely since the phaseout of Regulation Q began. The growth rates have also been of about the same order of magnitude, including the 1985-87 period when the Federal Open Market Committee stopped setting targets for M1 because of its unusually rapid growth as interest rates fell in response to lower rates of inflation. Hence, it is not clear that M2 less small time deposits would have worked any better for policy purposes than M1 during the 1980s. The longer run similarities between the growth rates of M1 and M2 less small time deposits make it difficult to create a strong case to redefine M2 because of the unusual weakness displayed by M2 over this most recent business cycle.

Chart 18 contains some additional information that would argue against redefining M2 to exclude small time deposits on the basis of the recent weakness in M2.[15] The chart shows that M2 has been the only monetary aggregate to maintain a stable long-run relationship with GDP (stable growth rate of velocity over the long run), a desirable property from the perspective

[14]Econometric evidence that the demand for M2 less small time deposits probably has a large enough interest rate elasticity to cause problems for monetary targeting is also found in Brian Motley, "Should M2 be Redefined?"

[15]This chart was adapted from one contained in an article by Susan Black and William Gavin, "Monetary Policy and the M2 Target," Federal Reserve Bank of Cleveland *Economic Commentary*, December 1, 1989.

Chart 17

Growth of M1 and of M2 less Small Time Deposits

Change from Four Quarters Earlier

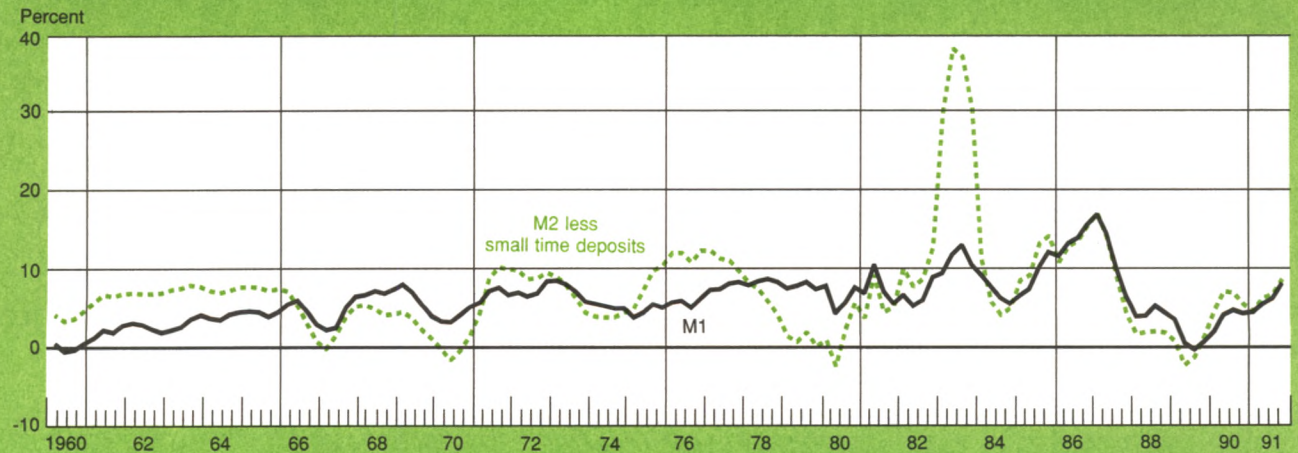
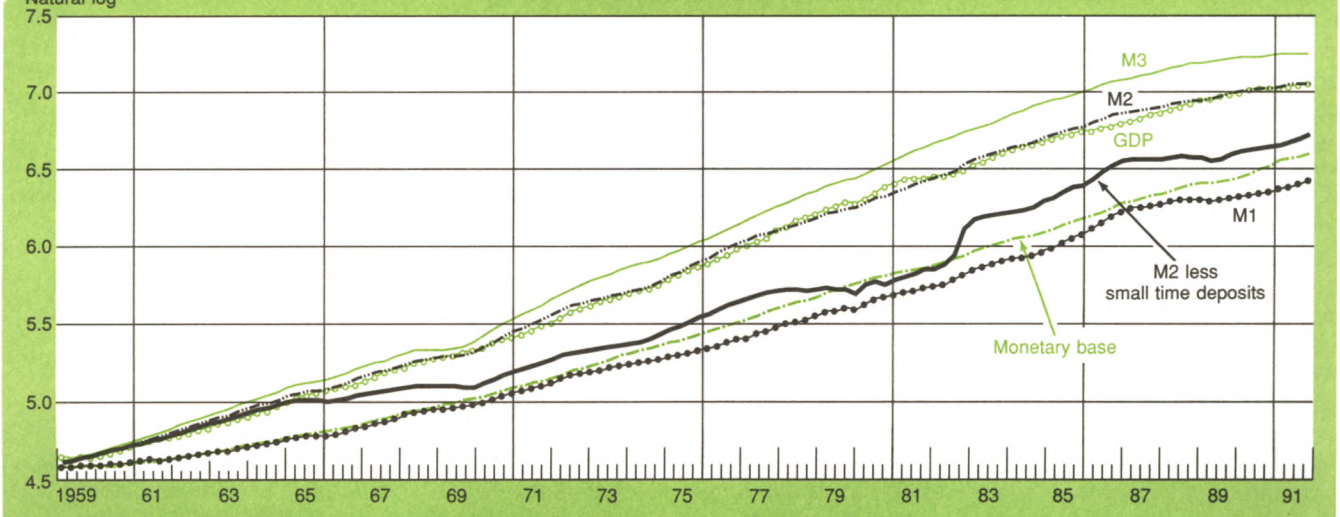


Chart 18

Nominal GDP and the Monetary Aggregates



Note: The various monetary aggregates and GDP are normalized to 100 in the first quarter of 1959.

of setting monetary targets over time to sustain non-inflationary growth in economic activity. M1, M2 less small time deposits, M3, and the monetary base have *not* maintained stable relationships with GDP over the long run (their velocity growth has varied over time). Other analysts, using more sophisticated econometric techniques, have also found M2 to have a stable long-run relationship with GDP.[16] In more technical terms, M2 is cointegrated with GDP.

The statistics in the table also illustrate this point. For the entire period, as well as the first and second halves of the period, M2 has grown at virtually the same rate as nominal GDP. The other monetary aggregates have displayed relationships with GDP that differ from the first half of the period to the second half. Because of its stable relationship with GDP over time (stable growth in velocity over the long run), M2 has received considerable support as a long-run anchor through which monetary policy can control inflation.[17]

GDP Growth less Money Growth

Change from Four Quarters Earlier

	Monetary Base	M1	M2 less Small Time Deposits	M2	M3
Averages					
1960 to 1991	1.5	2.1	1.1	0.0	−0.7
1960 to 1975	2.5	3.1	2.1	−0.2	−1.2
1976 to 1991	0.5	1.1	0.0	0.1	−0.2
Standard deviations					
1960 to 1991	3.0	3.7	6.8	2.8	2.8
1960 to 1975	1.8	1.6	3.1	2.4	2.8
1976 to 1991	3.6	4.7	9.0	3.2	2.7

In sum, it appears that the small time deposit component of M2 has five somewhat unique features that pose definitional problems. First, small time deposits are not as liquid as the other components of M2, raising the theoretical question whether small time deposits should

[16]See Robert F. Engle and C.W.J. Granger, "Cointegration and Error Correction: Representation, Estimation and Testing," *Econometrica*, vol. 55 (March 1987), pp. 251-76; and Stephen M. Miller, "Monetary Dynamics: An Application of Cointegration and Error Correction Modeling," *Journal of Money, Credit, and Banking*, vol. 23 (May 1991), pp. 139-54.

[17]See Jeffrey Hallman, Richard Porter, and David Small, "Is The Price

Footnote 17 continued
Level Tied to the M2 Monetary Aggregate in the Long Run?" *American Economic Review*, vol. 81, no. 4 (September 1991), pp. 841-58; Robert L. Hetzel, "M2 and Monetary Policy," Federal Reserve Bank of Richmond *Economic Review*, September-October 1989, pp. 14-29; and Yash P. Mehra, "An Error Correction Model of U.S. M2 Demand," Federal Reserve Bank of Richmond *Economic Review*, May-June 1991, pp. 3-12.

be aggregated with the other components of M2. Second, small time deposits are used by banks as managed liabilities, a practice that may create short-run instability in the supply of M2 when large shocks to the bank lending function occur. Third, small time deposits in a deregulated banking system are used by consumers to manage their liquidity as interest rate spreads change. This practice creates larger interest rate elasticities for the demand for M1 and the demand for M2 less small time deposits. Fourth, instability in the demand for small time deposits may translate into instability in the demand for M2 as consumers give greater acceptance to instruments outside M2 such as bond and equity funds. Fifth, the small time deposit component of M2 seems to be necessary to maintain M2's stable long-run relationship with GDP (because when market rates change, the shifting of funds between liquid deposits—M2 less small time deposits—and less liquid time deposits is largely internalized in M2 but not in the narrower aggregates).

Taken together, these five features of small time deposits do not make a strong case that M2 should be redefined at this time to exclude small time deposits. To be sure, if small time deposits continue to create shifts in the supply of and demand for M2 that destabilize significantly the short-run relationship between M2, GDP, and interest rates, further consideration might be given to redefining M2. At present, however, not enough observations are available to know how large a problem this instability will prove to be. If it turns out to be only an occasional problem associated with extreme circumstances (a credit crunch, greater use of instruments outside M2 in a low-rate environment), M2 may still prove a better long-term policy guide. And even if it were eventually decided to exclude small time deposits from M2, the resulting monetary aggregate, while correcting for some of the difficulties with the current M2 definition noted above, would create new policy problems. In contrast to M2, M2 less small time deposits does not share a stable long-run relationship with GDP. In addition, M2 less small time deposits appears to respond strongly to changes in market rates, making it difficult to set targets in the shorter run.

Conclusions

The small time deposit component of M2 has been a source of instability in the supply of and demand for M2, particularly in the short run. Nevertheless, this short-run instability need not imply that M2 should be redefined to exclude small time deposits. More experience with small time deposits in a deregulated financial system will be necessary before this issue can be resolved.

Appendix: Development of the Current Definitions of Money

The monetary aggregates were last redefined in the early 1980s, following the review of a set of proposals put out in the late 1970s.† In revising the monetary aggregates, the Federal Reserve Board staff was responding in part to a blurring of the functional distinction between demand deposits and certain types of savings accounts, and between comparable types of deposits at commercial banks and thrift institutions.

Before the 1980 redefinition of the monetary aggregates, M1 was defined as currency plus demand deposits at commercial banks. M2 was also restricted to commercial bank liabilities. To arrive at M2, time and savings balances (except large negotiable CDs) at banks were added to M1. M3 was obtained by adding time and savings balances at thrift institutions to M2. M4, another commercial bank aggregate, was calculated by adding large negotiable CDs to M2. Finally, an M5 aggregate was created by adding negotiable CDs to M3.

In proposing new definitions for the monetary aggregates, the Board staff took as its guiding principle the notion that monetary assets should be grouped by their liquidity (or availability for use in making transactions) and not by the type of institution (banks versus thrifts). Hence, in 1979 the Board staff proposed a new definition of M1 that included the old components of M1 plus NOW accounts (checking accounts paying the same rate of interest as savings accounts), credit union share drafts, demand deposits at thrift institutions, and savings accounts subject to automatic transfer. This proposed aggregate consisted of the most liquid bank and thrift liabilities.

For the redefined M2, the Board staff proposed adding savings balances at all financial institutions. Savings balances are highly liquid, but not checkable, and

†Thomas D. Simpson, "A Proposal for Redefining the Monetary Aggregates," *Federal Reserve Bulletin*, January 1979, pp. 13-42; and Thomas D. Simpson, "The Redefined Monetary Aggregates," *Federal Reserve Bulletin*, February 1980, pp. 97-114.

Appendix: Development of the Current Definitions of Money *(Continued)*

seemed to be the logical next step in moving from the narrow definition of money to broader definitions.[‡]

For M3 the Board staff recommended that all time and savings deposits, including negotiable CDs, be added to M1. This aggregate was designed to capture the total volume of deposits at all depository institutions (commercial banks and thrift institutions). The Board staff also considered including repurchase agreements (RPs) in M3, or possibly in a narrower aggregate, because of evidence suggesting that corporations were using RPs to reduce the level of demand deposits. The staff concluded that the data on RPs were not as reliable as those on the other components and decided not to include RPs in the proposed definitions.

A little over a year later, the Board staff, after reviewing the comments received on the proposed definitions, released the new definitions of the monetary aggregates. The new definitions included five measures of money, which varied somewhat from the three definitions proposed a year earlier.

The Board staff presented two definitions of M1, M1A and M1B. M1B would include NOW and automatic transfer accounts, M1A would not. During the transition to nationwide NOW accounts it appeared likely that consumers would shift balances from both demand deposits (transactions balances) and savings accounts (liquid deposits) into the newly available NOW accounts. Hence, M1B would be likely to overstate the growth of transactions balances and M1A to understate these balances during the transition period. Making both series available would make it easier for analysts to judge the underlying growth of transactions balances.[§]

The new definition of M2 was considerably different from the proposed definition, which had added to M1 only liquid savings accounts at banks and thrifts. The new measure added to M1 not only savings deposits but also overnight RPs, overnight Eurodollars, small denomination time deposits, and money market mutual fund shares. Overnight RPs, Eurodollars, and money market mutual fund shares were judged to be liquid assets that were probably close substitutes for liquid bank deposits. Small time deposits (those issued in denominations of less than $100,000) were included, not because they displayed liquidity similar to the other components, but because the market rates banks and thrifts had recently been allowed to pay on six-month and two-and-a-half-year time deposits would make them very attractive alternatives to savings balances. As a result, the staff concluded that it would be better to internalize any shifts of funds between savings and small time deposits within the M2 aggregate.

To obtain M3, the Board staff added term RPs and large denomination time deposits to M2. These components were viewed as large-dollar instruments that were likely to be close substitutes for one another in most portfolios. A measure of total liquid assets, L, was also defined. It added to M3 the nonbank holdings of bankers' acceptances, commercial paper, savings bonds, short-term U.S. Treasury obligations, and other Eurodollar deposits of U.S. residents. The Federal Open Market Committee, however, has not set targets for L as it has for M1, M2, and M3.

The definitions originally proposed had made sharp liquidity distinctions as they moved from the narrow to the broad aggregates. In addition, these definitions had been limited to the deposit liabilities of depository institutions. The new definitions, by combining time and savings deposits at the same level of aggregation, eased these liquidity distinctions somewhat and grouped together those types of deposits that were likely to be close substitutes. In addition, by including RPs and money market mutual fund shares, the aggregates from the level of M2 on up went beyond the depository liabilities of depository institutions.

[‡]The Board staff also proposed M1+, that is, M1 plus savings balances at commercial banks only. This proposal was based on some evidence (higher turnover rates) that these balances at banks were used more for making transactions than were savings deposits at thrifts.

[§]For a period of time, the Board staff also made available a shift-adjusted M1 series in which M1B's growth was lowered to adjust for flows into NOW accounts from savings accounts.

Changes in Monetary Policy Effectiveness: Evidence from Large Macroeconometric Models

by Patricia C. Mosser

Since the mid-1970s, large institutional, regulatory, and technological changes in financial markets and intermediaries have significantly altered the nature and extent of monetary policy's influence on the real economy. Several recent studies have reported on these effects.[1] The common theme in these studies is that the ways in which monetary policy is transmitted to housing, business investment, trade, and perhaps consumption have changed substantially in the last fifteen years. There is less agreement, however, on whether the economy overall has become more or less sensitive to monetary policy.

Several researchers have identified small changes, both increases and decreases, in the size of aggregate demand responses to monetary policy. This finding is not surprising since these studies typically show offsetting effects in different sectors. For example, housing investment is probably less sensitive to monetary policy because of the removal of interest rate ceilings and the subsequent decline in disintermediation, but business investment may be more sensitive because of increased corporate leverage.

[1]For a summary of recent studies, see Paul Bennett, "The Influence of Financial Changes on Interest Rates and Monetary Policy: A Review of Recent Evidence," Federal Reserve Bank of New York *Quarterly Review*, Summer 1990. In addition, see Barry Bosworth, "Institutional Change and the Efficacy of Monetary Policy," *Brookings Papers on Economic Activity*, 1:1989, pp. 77-110; Benjamin Friedman, "Changing Effects of Monetary Policy on Real Economic Activity," *Monetary Policy Issues in the 1990s*, Federal Reserve Bank of Kansas City, 1989; and Eileen Mauskopf, "The Transmission Channels of Monetary Policy: How Have They Changed?" *Federal Reserve Bulletin*, December 1990. See Patricia Mosser, "Large Model Comparisons of Monetary Policy Sensitivity," Federal Reserve Bank of New York, Research Paper no. 9207, April 1992, for a more complete reference list.

This article evaluates changes in the aggregate effectiveness of monetary policy and changes in transmission mechanisms by examining how traditional large-scale macroeconometric models have changed in the last ten to fifteen years. Because these large-scale models are designed to measure the important structural interrelationships among economic variables and across different sectors of the economy, they give a fairly complete accounting of the complex transmission mechanisms of monetary policy. For example, they measure the effects of policy changes as conveyed through money markets to other financial markets and intermediaries, and finally to spending by households and businesses. Thus, large models can be used to analyze the impact of policy changes on many sectors of the economy simultaneously.

Using large-scale models to evaluate the impact of policy changes does have some drawbacks. In particular, it is possible that changes over time in policy sensitivity as measured by these models reflect improvements in the model builders' knowledge of how the economy works and not changes in the actual economy. In addition, how these models measure policy sensitivity depends on the particular monetary policies used over the period the models were estimated. For example, if investment responds only to large changes in interest rates, a model estimated over a period of stable interest rates will understate the impact of a sharp change in monetary policy. Consequently, large models' evaluation of the impact of new policies may be inaccurate. Nonetheless, because these large models do summarize many of the important statistical relationships between macroeconomic variables, and because they

are regularly reevaluated, changes over time in the link between policy and the real economy should be reflected in changes in their structures.

The article explores changes in policy linkages in two ways. First, it reports monetary policy experiments ("black-box" experiments) that use both past and present versions of several large macroeconometric models to measure the responses of real GNP, inflation, and financial variables to changes in monetary policy. Second, the article looks at changes in model structure over time. Since large-scale models were respecified and reestimated several times during the institutional and regulatory changes of the last decade and a half, examining their evolution can give insights into some of the ways in which monetary policy's influence on the economy has changed. In large models, these evolutionary changes include restructuring of links between financial variables and the real economy in some sectors, changes in the estimated interest rate and wealth sensitivities in other sectors, and changes in estimation procedures.

The article is organized as follows. The first section discusses different ways of measuring sensitivity to monetary policy and the strengths and weaknesses of the large-model approach. The second section documents how monetary policy's overall influence on the real economy has changed in the past decade, as measured by current and past dynamic money multipliers for several different models. The next section uses the Data Resources Inc. (DRI) Model to illustrate some examples of structural changes in these large models since the early 1980s.[2] The discussion focuses on what, if any, implications these changes have had for this model's estimate of the sensitivity of final demand to monetary policy, particularly interest rate sensitivity. Finally, simulation exercises, again using DRI, examine the outcomes of identical policy shocks across different historical versions of the model.

Measuring changes in policy effectiveness using large-scale models

Changes in output sensitivity to monetary policy can be measured in different ways. Reduced form estimation is one possible approach. For example, a 1989 study uses vector autoregressions to summarize the dynamic relationship between interest rates and real output. It concludes that real GNP is slightly less sensitive to federal funds rate changes now than a decade ago.[3] Unfortunately, this approach cannot address policy changes directly since not all interest rate fluctuations are policy induced, nor are interest rates necessarily the only way policy changes are transmitted to the real economy.

An alternative strategy is to use large models. Most large-scale macroeconometric models contain a number of transmission channels from monetary policy to the real economy. The most direct linkage is through interest rates. In most models, monetary policy shocks are implemented by changes in bank reserve positions (open market operations), which affect the supply of bank reserves and the federal funds rate. In turn, changes in interbank lending rates feed through to other short-term interest rates and eventually to long-term interest rates as well. Both short- and long-term interest rates directly affect the models' predictions of several components of final demand, particularly investment.

In addition to incorporating interest rate channels, many large models allow for monetary policy to directly affect bank lending policy. Bank lending in turn may have a direct impact on household and business spending (independent of the interest rate changes), particularly if credit rationing is common. Changes in household and business wealth, which help to determine consumption and investment in some models, are another policy channel. Finally, most models now allow for policy-induced changes in international interest rate spreads to cause actual or incipient capital flows that affect exchange rates and, ultimately, the trade balance.

One example of the large model approach is a recent Federal Reserve Board study that measured changes in policy effectiveness by testing for changes in parameter values before and after 1980 in final demand equations from the Federal Reserve Board/MPS model.[4] The main conclusion of that study was that except for the housing and trade sectors, the regulatory and institutional changes of the 1980s had little or no impact on the policy sensitivity of final demand. Unlike the reduced-form approach, the MPS model study measured changes in a broad range of transmission mechanisms: short-term and long-term interest rates, wealth effects, and the exchange rate. The tests focused largely on single equation estimates, however, with little or no dynamic feedback effects from goods markets to financial markets and with no inflation or price level effects. In addition, the same equation structure with the same

[2]The study focuses on the DRI model, both because of its accessibility as a commercial model and because of the detail available on the 1980-81 version, the time period of most interest in this study. Joyce Yanchar, Mark Lasky, and David Wyss of DRI provided helpful information on the structure and estimation of the current DRI model as well as the historical tracking simulation used in the exercises below.

[3]See George Kahn, "The Changing Interest Sensitivity of the U.S. Economy," Federal Reserve Bank of Kansas City *Economic Review*, November 1989.

[4]See Mauskopf, "The Transmission Channels."

explanatory variables was imposed on regressions estimated both before and after 1980.

Like the Board study, this article adopts a large-model strategy for assessing changes in policy sensitivity. It differs from the earlier study, however, in that it evaluates changes in policy sensitivity by comparing the current structures of large models (including MPS) and their dynamic simulation multipliers with those used before the institutional changes of the last ten to fifteen years. This procedure has several advantages. First, by using dynamic simulations, it allows for full feedback and multiplier effects between financial variables, real output, and inflation. Second, these comparisons do not impose current model or economic structure on history, since presumably model builders would not have chosen the same specification in the 1970s (that is, the same explanatory variables, lag lengths, and so forth) as they are using today. Such "endogenous" specification changes in the last decade cannot be captured by reestimating current equations, but are available by comparing old and new equation structures and by comparing current model simulations to historical ones. Finally, using a large macroeconometric model with a detailed financial sector means that monetary policy effects can be measured relative to more than one policy lever: for example, did a 100 basis point decrease in the federal funds rate or a 2 percent increase in bank reserves have the same impact on output in models of the mid- to late 1970s as it has in current versions of these models?

Despite these advantages, large-scale macro models have disadvantages in evaluating policy experiments. One problem, known as the Lucas critique, focuses on the expectational effects of changes in policy.[5] Changes in monetary policy affect the real economy both directly, through interest rates and the like, and indirectly, by changing people's expectations of the future state of the economy. Most large-scale macroeconometric models, however, do not completely capture the expectational effects of a policy change. Thus they may not accurately reflect the outcome of policy experiments such as a cut in the federal funds rate or higher money growth.

In practice, this problem appears to be important for large changes in monetary policy regimes but less important in evaluating the effects of relatively small policy changes within a particular policy regime such as interest rate targeting or reserves targeting.[6] Thus large regime changes may cause traditional macroeconometric models to produce inaccurate predictions and may eventually lead model builders to restructure and reestimate their large models. In fact, it seems likely that the large shifts in both monetary policy procedures and in financial structures and institutions that took place at the end of the 1970s represent just such a large regime change, one for which the Lucas critique *should* matter and for which the specifications and parameters of macroeconometric models *should* have changed. If this is the case, a comparison of identical (small) policy experiments done with different historical versions of these models will be useful in determining whether the overall response of the economy to shocks has changed as well.

[5]See Robert Lucas, "Econometric Policy Evaluation: A Critique," *Carnegie-Rochester Conference Series on Public Policy*, 1976, pp. 19-42. A counterargument can be found in Christopher Sims, "Policy Analysis with Econometric Models," *Brookings Papers on Economic Activity*, 1:1982, pp. 101-52.

[6]The phrase "small policy changes" refers to changes in policy variables that are of the same size and duration as actual policy changes during the model estimation period. Policy regimes may be thought of as large institutional changes in financial markets or in monetary policy procedures. See Christopher Sims, "Are Forecasting Models Usable for Policy Analysis?" Federal Reserve Bank of Minneapolis *Quarterly Review*, Winter 1986.

Changes over time in policy multipliers of large-scale models

Ideally one would measure the change in the overall sensitivity of the real economy to monetary policy by introducing identical monetary policy shocks to current and past versions of macroeconometric models. Unfortunately, because of data revisions and changes in software and hardware, macroeconometric models of the mid- and late 1970s are difficult (if not impossible) to simulate. However, policy multipliers summarizing the impact of policy on real output are available in print for several models.

One broad-ranging comparison of policy multipliers reports GNP/reserves multipliers for the mid-1970s versions of several models.[7] Recently, policy multipliers have been recalculated for newer versions of the models.[8] These recent-vintage models date from the late 1980s and 1990, and hereafter will be referred to as the "1990" models. Since this article is concerned with historical comparisons, it considers only models used in both sources: the Bureau of Economic Analysis Model (BEA); the Data Resources Inc. Model (DRI), the Federal Reserve Board/MPS Model, and the Wharton Econometric Forecasting Associates Model (WEFA).

[7]See Gary Fromm and Lawrence R. Klein, "The NBER/NSF Model Comparison Seminar: An Analysis of Results," chap. 18 in Lawrence R. Klein and E. Burmeister, eds., *Econometric Model Performance* (Philadelphia: University of Pennsylvania Press, 1976).

[8]F. Gerald Adams and Lawrence R. Klein, "Performance of Quarterly Econometric Models of the United States: A New Round of Model Comparisons," chap. 2 in Lawrence R. Klein, ed., *Comparative Performance of U.S. Econometric Models* (New York: Oxford University Press, 1991). This chapter also contains brief descriptions of the 1990 versions of the models used in this article.

Table 1 summarizes the policy multipliers for the mid-1970s versions of the four models listed above. Baselines were historical tracking simulations starting in 1961, 1962, or 1965. Historical tracking simulations are model solutions over the estimation sample period in which residual add-factors are adjusted to force the model to replicate historical data exactly. For each model, the monetary policy shock was an increase of $0.5 billion or 2.6 percent in nonborrowed reserves.[9]

The top half of Table 1 presents GNP/reserves multipliers: the percent change in real (1958 dollars) GNP (from the baseline) as a proportion of the percent change in reserves. Multipliers for all the models, except MPS, peak at two or three years. The MPS model has positive (and growing) long-run money effects, WEFA has a positive but declining multiplier in the long run, BEA is neutral, and DRI gives a lower real output path in the long run.

The bottom half of Table 1 gives similar calculations for price level/reserves multipliers. Except for WEFA (which shows a decline in prices in the short run), the models have price level effects that are positive but generally quite small, with prices rising significantly only after several years. Long-run price level multipliers are well below 1 for all the models.

Table 2 gives policy multipliers for the 1990 versions of the same models. Although these multipliers are also reported in elasticities, comparisons with Table 1 results are complicated because the 1990 multipliers are stated in terms of M1 rather than reserves. Here, simulations begin in the first quarter of 1975, with a gradual adjustment to a 3 percent higher path for M1. Specifically, M1 was raised 0.1 percent in the first quarter of the simulation, 0.7 percent in the second, 1.9 percent in the third, 2.8 percent in the fourth, and 3.0 percent in the fifth and all subsequent quarters.

As in the earlier exercise, the GNP multipliers for most models (WEFA is the exception) peak after three years. The size of the 1990 multipliers, however, is at least twice that of the mid-1970s multipliers. As in Table 1,

[9]The ratio of nonborrowed reserves to M1 was approximately 0.13 between 1962 and 1965. If this average ratio is assumed to hold for changes in reserves as well as levels, then the increase in nonborrowed reserves translates to an approximate $4.0 billion increase in M1.

Table 1
Reserves Multipliers for 1975-Vintage Macroeconometric Models

Quarters after Shock	Models: BEA	DRI	MPS	WEFA
		Real GNP		
1	0.0	0.011	0.011	0.043
2	0.0	0.018	0.035	0.080
4	0.007	0.155	0.113	0.143
8	0.014	0.293	0.284	0.219
12	0.023	0.220	0.410	0.268
40	0.0	−0.149	0.501†	0.081
		Implicit Deflator		
1	0.0	0.0	0.004	−0.003
2	0.0	0.004	0.004	−0.006
4	0.0	0.008	0.014	−0.013
8	0.003	0.018	0.101	−0.012
12	0.003	0.047	0.166	−0.012
40	0.052	0.160	0.623†	0.033

Notes: Reserves multipliers were calculated as the percent deviation in real GNP or the deflator, divided by percent deviation in nonborrowed reserves. Multipliers were converted from dollar-level changes—ΔGNP/Δ (nonborrowed reserves), and Δ(GNP in 1958 dollars)/Δ (nonborrowed reserves)—reported in Fromm and Klein, "The NBER/NSF Model Comparison," p. 405. The increase in nonborrowed reserves was $0.5 billion or approximately 3 percent. To calculate multipliers in percentages, historical values of real and nominal GNP, available in 1975 (the year the simulations were run), were used as base values. Implicit deflator multipliers (base year 1958) were calculated as the difference between nominal and real GNP percent deviations.

Historical tracking simulations were used as base cases, and monetary shocks were introduced in the first quarter of 1961 for DRI, 1965 for WEFA, and 1962 for all others.

†Figures for the MPS model are twenty-four quarters after the shock.

Table 2
Money Multipliers for 1990-Vintage Macroeconometric Models

Quarters after Shock	Models: BEA	DRI	MPS	WEFA
		Real GNP		
1	0.07	−0.14	0.14	0.50
2	0.08	0.0	0.16	0.44
4	0.11	0.17	0.29	0.27
8	0.18	0.84	0.77	0.36
12	0.19	1.28	1.00	0.39
40	−0.34	−0.95	0.21	0.41
		Implicit Deflator		
1	0.0	0.0	0.0	0.14
2	0.0	−0.03	0.0	−0.04
4	0.0	−0.03	0.02	0.01
8	0.05	0.09	0.22	0.12
12	0.10	0.43	0.74	0.20
40	0.52	2.46	0.52	0.57

Notes: M1 multipliers are calculated as the percent deviation in real GNP or the deflator, divided by the percent deviation in M1. M1 was increased by 0.14 percent in the first quarter of the simulations, 0.73 percent in the second, 1.88 percent in the third, 2.8 percent in the fourth, and 3.0 percent in the fifth and all subsequent quarters. All simulations used historical tracking simulations as baselines, and policy shocks were introduced in the first quarter of 1975.

the DRI and MPS models have the largest real output increases after eight to twelve quarters.

Similarly, while the price level multipliers are near zero for the first year (as in the earlier study), after two to three years they are five to ten times as large as those reported in Table 1. This difference certainly reflects the more volatile U.S. inflation experience since the mid-1970s and the significant changes made in modeling output and inflation linkages in response to this experience.

Taken at face value, Tables 1 and 2 make a striking case that both the real economy and inflation have become much more sensitive to monetary policy in the last fifteen years, at least as measured by these models. In comparison with the very small changes in policy sensitivity measured by previous studies, however, the large jump in multipliers from Table 1 to Table 2 seems extreme, and perhaps it should be viewed with some skepticism.

One reason for caution in interpreting Tables 1 and 2 is that the policy experiments in the two cases are not strictly comparable. The 1976 study reports the response of GNP to changes in reserves, while the later study focuses on the response of GNP to shifts in M1. If there were a simple, stable relationship between reserves and M1, this difference would not pose problems in comparing the medium-term and long-term multipliers. (Note, however, that even with a stable M1/reserves relationship, the slower response of M1 to policy changes might cause a problem in comparing the short-term multipliers.) Unfortunately, the institutional and regulatory changes of the last fifteen years suggest that the M1/reserves relationship has not been stable.

The link between reserves and M1 has been affected by, among other things, reserve requirements that changed substantially over the periods when these simulations were conducted. Reserve requirements have generally fallen, and consequently the M1/reserves multiplier has risen. Even after one adjusts for reserve requirement changes, the M1/reserves ratio shows a steady rise over the last thirty years: from 11 in 1962, to about 13½ in 1975, to more than 17 in 1991.[10]

Comparing reserves changes to M1 changes over time is further complicated by the instability and changing interest sensitivity of M1 demand.[11] The removal of deposit rate ceilings increased the interest sensitivity of M1 in the 1980s. Furthermore, the phasing out of reserve requirements on nontransaction M2 deposits has made bank reserves almost entirely a function of the deposits portion of M1. Thus, as checkable deposits have become more interest sensitive, so have reserves. Finally, as a practical matter, analysis is complicated by several changes in the definition of M1 since the earlier study was done.

Although the cumulative effect of these changes makes it difficult to compare the multipliers in Tables 1 and 2 precisely, the greater interest sensitivity of M1 demand suggests that GNP should have become *less,* rather than more, sensitive to changes in the money stock in recent years. If the demand functions for reserves and M1 are more interest sensitive in the later period, then a reserves injection will lower short-term rates less in the later models than in the earlier ones. In turn, if real output responds to monetary policy largely through interest rates, then smaller rather than larger output multipliers would result. Obviously, then, greater money demand elasticity cannot account for the results in Tables 1 and 2 and in fact works in the opposite direction.[12]

This finding only reinforces the surprising conclusions from Table 2: the very large change in the size of the multipliers indicates that monetary policy in recent-vintage macro models has much larger effects on the economy than in earlier models. Several explanations for this result are possible. The differences between earlier and later versions of the models could reflect changes in the structure of the actual economy and its linkages to monetary policy. These could include changes in sensitivity of final demand to interest rates, financial wealth, and other policy-influenced variables in the last decade, as well as changes in financial markets and institutions that have altered the channels of monetary policy to the real economy. The shifts in money demand documented above are one example.

However, the increases in the model multipliers from Table 1 to Table 2 are so large, particularly in comparison with other findings, that they must certainly also reflect improvements in model building in the last fifteen years. Some of these innovations include major changes in the modeling of inflation, particularly the Phillips curve, and in the specification of aggregate supply. In addition, nearly all the models incorporate more extensive links between the real economy and the financial sector in their recent vintages. For example, previously exogenous sectors such as exchange rates

[10]This rise is due, in part, to a positive long-term trend in the ratio of currency to checkable deposits.

[11]For example, see John P. Judd and John L. Scadding, "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, vol. 20 (1982), pp. 991-1023; and Robert Hetzel and Yash Mehra, "The Behavior of Monetary Demand in the 1980s," *Journal of Money, Credit, and Banking*, vol. 21 (November 1989).

[12]Across-model comparisons of M2 or interest rate changes would probably be preferable, given the problems with M1. Unfortunately, M2 multipliers for these large models are not available in print, and simulations comparing interest rate changes are available only for the 1990 versions of the models.

and foreign trade, or state and local government purchases, are now often modeled with direct and indirect interest rate effects. Finally, improved estimation techniques and statistical tests, including some innovations in time-series econometrics, may have contributed to the changes in the simulation multipliers.

How much of the measured increase in sensitivity in these large models is due to structural changes in the actual economy's response to policy, however, and how much is due to new modeling procedures or improved estimation is unclear. For example, it is likely that the changes in exchange rate sensitivity measured by the models stem from a mixture of both factors. In the late 1970s, actual exchange rates certainly responded to monetary policy, but for modeling purposes they were treated as exogenous because model builders did not have enough data on the post-1973 flexible exchange rate system to measure the effects. At the same time, actual exchange rates have probably become more interest rate sensitive in the last decade as capital markets have become more internationally integrated.

In practice it is not possible to differentiate completely between model changes that reflect "true" changes in the economy and those that result from model builders' better understanding of how the economy works. Nevertheless, the results in Tables 1 and 2, although extreme, do suggest that large macroeconometric models estimate a larger influence of policy on the real economy and the price level today than fifteen years ago. Because these results are quite different from the findings of other authors, it is useful to look more closely at the structure of these large models, particularly the linkages from monetary policy to the real economy, and to examine how these linkages have changed in the last decade. Doing so may help clarify whether the larger money multipliers in Table 2 reflect changes in the actual economy or just in model builders' measures of it.

A structural comparison: 1981 and 1990 versions of the DRI model

Although comparing all of the structural changes in all of the macro models in Tables 1 and 2 would be difficult, if not impossible, an idea of the direction and size of structural changes in macro modeling may be inferred from comparing the current 1990 version of the DRI model with the 1981 version, described in detail by Eckstein in *The DRI Model of the U.S. Economy*.[13] The 1981 DRI model was, for the most part, estimated using data before the upheavals in monetary policy and financial structure in the 1980s. Thus, if structural model specifications have changed substantially in the last ten years, comparing final demand equations and financial sector equations across the two vintages should yield some information on how monetary policy channels have changed.

For the final demand equations, structural changes generally come from three sources: changes in the estimated sensitivity of final demand to interest rates, either short-term or long-term; changes in the response of final demand to financial wealth and/or credit constraints; and changes in estimated coefficients due to changes in the modeling of dynamic relationships. In addition, changes in the ways both exchange rates and the term structure of interest rates are modeled have affected policy transmission as well.

Table 3 compares 1981 and 1990 DRI equations for final demand components that depend directly on financial variables and thus are sensitive to monetary policy. Consumption, investment, and trade are modeled in some detail by DRI, but the basics of the equations for individual components are similar. Thus only single component equations for consumer durables (furniture), housing (single family starts), business investment (equipment), inventory investment (manufacturing), and exports (capital goods except autos) are highlighted.

In the equation for consumer expenditures on furniture and household equipment, income and interest rate elasticities have changed very little from 1981 to 1990, but the effects of consumer sentiment and net worth show clear changes. While the direct interest rate sensitivity fell slightly in the 1990 model, indirect interest rate effects may have been larger because the elasticity of consumer sentiment nearly tripled. Historically, this survey has been very sensitive to interest rate changes, and short-term interest rates are important explanatory variables in the DRI model specification of sentiment. The large expansion of consumer installment debt during the 1980s and the accompanying vulnerability of highly leveraged debtors to interest rate changes may help to explain why indirect interest rate effects conveyed through consumer sentiment have increased.

At the same time, household net worth appears to have a substantially smaller effect on furniture purchases in 1990 than in 1981. This decrease in the wealth elasticity may also reflect how the increased use of consumer credit lines has "disconnected" durables purchases from household financial wealth. Thus, while the sentiment effect indicates that monetary policy may have a larger impact on consumer durables today than ten years ago, the insensitivity to financial wealth suggests the opposite. Model simulations in the next section should help clarify which of these effects is more important.

Table 3 also compares equations for business invest-

[13] Otto Eckstein, *The DRI Model of the U.S. Economy* (New York: McGraw-Hill, 1983).

ment in producers' durable equipment. In 1981, DRI estimated a single equation for equipment. By 1990, rapidly expanding computer and office equipment investment, combined with huge relative price changes, led DRI to model equipment investment in three component equations: office equipment, autos, and all other investment. The 1981 equation was a stock adjustment model that defined the desired stock level in terms of the inverse of the real rental price of capital (the cost of capital divided by the price of investment goods) and real output. The equation also included a debt service variable designed to capture capital market imperfections associated with liquidity constraints and credit rationing. In contrast, the 1990 equation for nonauto/nonoffice equipment has no stock adjustment mechanism or credit rationing effects, and investment depends only on very long lags in output and the rental price.

In the face of such large specification changes, direct measurement of changes in monetary policy effects is virtually impossible. Nevertheless, the changes in specification are important in and of themselves. The exclusion of the debt-to-cash-flow measure in the later version of the model suggests that financial market deregulation and innovation made this tightness measure less important as an independent transmission channel. Financial market changes such as the introduction of junk bonds, the increased use of loan commitments, and the growth of the commercial paper market have increased access to credit markets, making firms' plans—and probably their cash flows as well—more sensitive to market interest rates. Thus monetary policy effects on investment may now be adequately captured purely by the rental price. This change does not necessarily mean that the impact of policy changes is smaller, just that interest rates (through the rental price) are now the most important channel to investment.

The 1990 equations for housing starts are also simpler than their 1981 counterparts. Housing specifications are now stock adjustment equations in which affordability measures and consumer sentiment determine the desired stock. In contrast, the 1981 equation included a rationing variable for mortgages (the real value of new commitments) and the ratio of houses sold to those offered, a variable that measured short-term building supply constraints. The introduction of variable rate mortgages and removal of interest rate ceilings allowed these disintermediation variables to be dropped. Although the effect of these changes on the long-run sensitivity of housing to policy is unclear (the simulations below will address this issue), the removal of credit constraints suggests that the short-run policy impact on housing has become smaller.

Current DRI specifications for manufacturing inventory investment equations incorporate interest rate effects (and thus monetary policy linkages) that were completely absent in 1981. The 1981 equations were traditional stock adjustment specifications that assigned no role to real interest rates. In contrast, the 1990 equations model the inventory-to-expected-sales ratio directly as a function of unexpected sales and real

Table 3
DRI Final Demand Equations, 1981 versus 1990

Consumer Expenditure—Furniture and Household Equipment (Logs)

	1981	1990
Income elasticity†	0.914	1.006 (4)
Interest rate	−0.011 (2)	−0.010
Consumer sentiment	0.06 (2)	0.187 (4)
Net worth elasticity	0.393	0.084

Producers' Durable Equipment (Levels)

	1981 (Total)	1990 (Nonauto, Noncomputer)
Δ(output/real rental price)	0.006 (5)	0.144 (14)
Debt/cash flow	−11.87 (6)	N.A.

Single Family Housing Starts

	1981 (Levels)	1990 (Starts/Stock)
Sold/offer ratio	0.143	N.A.
Sales price/cost	0.005	N.A.
Housing stock	−30.61	N.A.
New mortgage commitments	0.011 (5)	N.A.
Electricity prices	−0.144	N.A.
Consumer sentiment	N.A.	0.355
Affordability	N.A.	−3.45

Manufacturing Inventory Investment

	1981 (Levels)	1990 (Inventory/ Sales Ratio)
Real rate	N.A.	−0.0003
Labor costs	N.A.	−0.1071
Sales surprise	N.A.	−0.162 (2)
Expected sales	N.A.	1.0 (implicit)
Sales	−0.048	N.A.
Lagged sales	0.079	N.A.

Exports of Capital Goods Excluding Autos (Logs)

	1981	1990 (Excluding Computers)
Foreign demand	1.232 (4)	1.222 (13)
Relative price	−0.836 (6)	−1.389 (11)

Notes: Numbers in parentheses are length of lags in specifications. DRI commonly uses polynomial distributed lags to increase the number of degrees of freedom in estimation.
†Long-run permanent income elasticities.

factor costs, including unit labor costs and real interest rates. This change may be due to more sophisticated inventory management techniques, to a threshold effect of higher levels of real rates, or to econometric issues such as the larger variation in real rates in the 1980s.

The trade sector of the 1990 DRI model is more sensitive to monetary policy than its 1981 counterpart largely because the dollar exchange rate is now endogenous, whereas it was completely exogenous in the 1981 model. In the current formulation, spreads between U.S. and world real interest rates directly affect the exchange rate and thus the relative prices of exports and imports. For example, a 100 basis point increase in the spread between U.S. and foreign real long-term rates will raise the dollar by 6 percent over six quarters, an effect that was nonexistent in the earlier model. In addition, estimated relative price elasticities are slightly larger in the 1990 model (Table 3). The combination of a policy-sensitive exchange rate and greater sensitivity of trade to relative price changes suggests that DRI's trade sector should be more sensitive to monetary policy shocks in 1990. Because of the amount of export and import detail in the DRI model, the aggregate importance of these changes for policy sensitivity can best be seen in simulations in the next section.

Substantial changes have also been made to the financial sector of the DRI model, particularly the modeling of interest rates. Short-term interest rate equations in the earlier model had a high degree of simultaneity, each equation depending on rates of close substitutes as well as on bank reserves. In addition, the 1981 model used a segmented markets rather than a term structure approach to determining equilibrium long-term rates. As a result, long rates responded only indirectly to short rates but directly to supply and demand conditions in individual asset markets. In contrast, the 1990 model has a more recursive structure for short rates, and long rates are tied to short rates through term structure equations. The cumulative effect of these changes is that in the 1990 model, short rates are somewhat less sensitive to reserves changes, but long rates are more sensitive.

The switch from a segmented markets structure to term structure specification is unique to the DRI model. Nearly all other large macro models, including those examined earlier in this article, used a term structure approach to modeling long-term interest rates in both the late 1970s and the 1990 versions. Still, estimates using the most recent MPS model also show that long rates during the 1980s were more responsive to short rates than they had previously been.[14]

[14]See Mauskopf, "The Transmission Channels."

The changes in interest rate modeling are an important component in the way DRI has changed links from monetary policy to real investment over time. In the later model (with long rates modeled using the term structure), monetary policy affects investment through the rental price. By contrast, in the earlier model (with segmented markets for long-term rates), monetary policy affected investment through both the cost of capital and cash flow.

In summary, inventories and trade equations appear to be more directly sensitive to interest rates in the 1990 DRI model than they were ten years earlier. The overall effects of monetary policy on consumption and particularly investment are less clear because of changes in the modeling of interest rate linkages and changes in financial markets and financial intermediaries. Monetary policy simulations are needed to disentangle these different effects.

Monetary policy simulations using the DRI model

This section examines how the responses of final demand components to monetary policy shocks in the DRI model have changed over the last decade. In particular, the simulations reported below are designed to measure only the effect of the specification changes of the last decade. To this end, simulations of 1981-vintage and 1990-vintage models using identical policy shocks and spanning identical time periods are compared. The use of identical time periods ensures that initial conditions such as wealth and debt levels do not affect the results. Changes due solely to initial conditions are analyzed in the appendix by simulating the current DRI model over different periods.

Eckstein reports results from a 1981 DRI model simulation in which monetary policy was tightened by a cut in nonborrowed reserves starting in the second quarter of 1975. A summary of his findings is reported in Table 4 as the "1981 simulation." An identical reserves shock experiment using the 1990 DRI model was performed and is reported in Table 4 as the "1990a simulation." Since both of these exercises were conducted from historical bases starting in 1975, comparing them should provide the most direct evidence of model changes over the last decade.[15]

Table 4 shows that the short-run (less than one year) and the long-run (sixteen quarters) responses of real GNP to a cut in reserves are different in the two models. However, the intermediate (eight quarters) effect of tight money on output is very similar—approximately a 4 percent decline in real GNP—in both cases. Policy

[15]Of course, simulating a 1990-vintage model from 1975 to 1979 will not give an accurate picture of how monetary policy influenced the economy in 1975. But the point of these exercises is to compare current policy effects with past ones.

shocks have a smaller immediate impact in the 1990 model, largely because of smaller initial declines in investment and in state and local government purchases. Beyond four quarters, the models give approximately the same output change, but after four years, real output is 0.5 percent stronger using the 1990 model.

Part of the reason for the later downturn and quicker upturn in the 1990 model is evident in the response of equilibrium short-term interest rates, particularly on federal funds, to changes in the nonborrowed reserves. In both experiments, nonborrowed reserves were decreased by 5.8 percent.[16] In the later model, the federal funds rate rose by at most 357 basis points, while in the earlier case, rates peaked more than 100 basis points higher. In the 1981 model exercise, the federal funds rate was still nearly 250 basis points above the base after four years, whereas in the 1990 model, short-term interest rates had already returned to baseline levels.

There are several explanations for the difference in short-term rate responses. It may be due in part to revisions in monetary aggregates, including reserves, since the 1981 simulations were run. If this is the case, a 6 percent cut in reserves may be a milder policy contraction in the current model than in the 1981 model and thus result in smaller interest rate changes. Probably more important is the fact that DRI model structure reflects changes in money demand sensitivity to interest rates and changes in reserve requirements. As noted earlier, the cumulative effect of such changes is that the demand for M1 and reserves is more interest sensitive today than ten years ago. Thus, all other things equal, a decrease in the supply of reserves by the Fed will raise the federal funds rate less today than in 1981.

In light of the substantially different interest rate responses across the two models, an additional "tight money" simulation is reported in Table 4. In "simulation 1990b," the path of the federal funds rate is matched to that reported in the 1981 simulations, and nonborrowed reserves are adjusted appropriately to achieve that path. Because reserves are more interest sensitive in the 1990 model, a sustained tight money policy—defined by the level of the nominal federal funds rate—involves a much more drastic cut in reserves in the 1990 model than in the 1981 model. After four years, the reduction in nonborrowed reserves necessary to keep the funds rate at levels consistent with the 1981 experiment is two and a half times larger in the 1990 model.

Not surprisingly, targeting the federal funds rate rather than reserves gives a very different output path in

Table 4
Monetary Policy Tightening: Comparison of 1981 and 1990 DRI Model Simulations
Percent Deviation from Base Case

	Quarters after Shock				
	1	4	8	12	16
1981 simulation					
Nonborrowed reserves	−5.8	−5.8	−5.8	−5.5	−5.0
Federal funds rate	3.46	4.64	3.64	2.75	2.35
AAA corporate rate	0.28	0.01	−0.54	−0.70	−0.61
Real GNP	−0.9	−3.1	−4.2	−3.2	−2.0
Consumption	−0.7	−2.3	−3.2	−2.3	−1.5
Residential construction	−3.7	−16.4	−20.6	−14.7	−8.6
Business fixed investment	−1.0	−4.1	−6.6	−5.7	−3.5
State and local purchases	−1.1	−2.0	−2.5	−2.6	−2.4
Net exports†	N.A.	N.A.	0.3	N.A	N.A.
1990a simulation					
Nonborrowed reserves	−5.8	−5.8	−5.8	−5.5	−5.0
Federal funds rate	3.04	3.57	1.44	−0.06	−0.76
AAA corporate rate	1.14	2.31	1.52	0.46	−0.20
Real GNP	−0.1	−2.7	−4.3	−3.0	−1.5
Consumption	−0.6	−1.4	−2.4	−1.8	−1.0
Residential construction	−2.6	−23.4	−18.7	−3.2	4.2
Business fixed investment	0.0	−3.6	−11.8	−12.8	−8.0
State and local purchases	0.0	−0.1	−0.7	−1.3	−1.3
Net exports†	0.0	0.3	0.3	−0.1	−0.2
1990b simulation					
Nonborrowed reserves	−6.6	−6.4	−8.9	−11.1	−13.6
Federal funds rate	3.46	4.64	3.64	2.75	2.36
AAA corporate rate	1.30	2.70	2.81	2.38	2.14
Real GNP	−0.1	−2.6	−5.5	−5.9	−5.8
Consumption	−0.7	−1.3	−3.0	−3.4	−3.2
Residential construction	−3.0	−22.8	−28.4	−19.7	−14.1
Business fixed investment	0.0	−3.4	−13.2	−19.1	−18.6
State and local purchases	0.0	−0.1	−0.8	−1.7	−2.2
Net exports†	0.0	0.3	0.5	0.0	−0.2

Notes: The 1981 simulation results are reproduced from Otto Eckstein, *The DRI Model*, p. 88. The baseline simulation used for 1990a and 1990b is a historical tracking simulation for the 1990 DRI model starting in the second quarter of 1975. Simulations 1981 and 1990a impose a permanent decrease in nonborrowed reserves starting the second quarter of 1975. In the 1990b simulation, the federal funds rate path is matched to that in the 1981 simulation by adjusting nonborrowed reserves appropriately. Federal funds and AAA corporate interest rates are reported as percentage point deviations from baseline.

†Differences for net exports are reported as a percentage of real GNP. The figure from the 1981 simulation was rebased from 1972 to 1982 dollars to adjust for the large change in the relative valuation of imports between 1972 and 1982.

[16]The decrease in nonborrowed reserves reported in Eckstein was $2.0 billion in all quarters. This corresponded to reductions of 5.8 percent in 1975 and 1976, approximately 5.5 percent in 1977, and 5.0 percent in 1978. Because of data revisions and changes in coverage, a 5.8 percent cut in nonborrowed reserves in 1975 corresponds to only a $1.5 billion decrease in the current data series.

the 1990 model. For the first year, the downturn in real GNP under interest rate targeting (1990b) is similar to that under reserves targeting (1990a). But after four years, the higher rates push real GNP down nearly 6 percent, while GNP drops only 1.5 percent under reserves targeting.

In comparison with the 1981 simulation, the 1990b simulation (like 1990a) produces a somewhat milder downturn in real output in the short run. This observation is consistent with findings from other studies that the lag between a change in monetary policy and its impact on the real economy has lengthened. After two years, however, output declines in the 1990b simulation are substantially larger than those in the 1981 exercise, despite the identical paths for the federal funds rate. This finding suggests that real final demand is, in the longer term, more sensitive to nominal short-term interest rates in the 1990 model.

Whether policy changes are measured by reserves or interest rates, simulations show that the composition of final demand responses to policy is very different in the two model vintages. As expected, residential structures are, in the very short run, down more sharply in the 1981 simulation than in the 1990 simulations. Thereafter, housing falls farther in the 1990 simulations, but with a quicker and stronger recovery when reserves are targeted. Increased sensitivity of housing to short rates due to adjustable rate mortgages appears to explain the steeper downturn in the 1990 model, and the sharp recovery in the 1990a simulation stems from a quicker turnaround in short rates. When monetary policy is standardized on short-term interest rates, the 1990 model gives a downturn in housing that is both deeper and longer (after the first quarter) than that found in the 1981 model, in part because term structure relationships hold up long-term rates.

Even with a milder path for interest rates (1990a), the drop in business fixed investment is later, and substantially larger and longer, than in the 1981 model. The longer policy lag is attributable to the removal of debt service and credit constraint variables, while the larger long-term response is due to a much stronger reaction of long-term interest rates, and thus of the cost of capital, to short rates in the 1990 model. The increase in long-term rates is larger and the downturn in business fixed investment is even deeper when short-term rates are matched to the 1981 simulation path.

The closer term structure links between long and short rates seen in the 1990 simulations may be related to lower inflation risks in the late 1980s (which would make long rates more predictable from short rates). Nevertheless, the change in the DRI specification, and thus in the policy response, seems to be extreme in comparison with the other macroeconometric models discussed above. Roughly speaking, the 1990 DRI model substitutes a monetary transmission mechanism that operates through the term structure of interest rates for the credit/cash constraint mechanism that

Table 5

Monetary Policy Tightening with Exogenous Exchange Rate: Comparison of 1981 and 1990 DRI Simulations

Percent Deviation from Base Case

	Quarters after Shock				
	1	4	8	12	16
1981 simulation					
Nonborrowed reserves	−5.8	−5.8	−5.8	−5.5	−5.0
Federal funds rate	3.46	4.64	3.64	2.75	2.35
AAA corporate rate	0.28	0.01	−0.54	−0.70	−0.61
Real GNP	−0.9	−3.1	−4.2	−3.2	−2.0
Consumption	−0.7	−2.3	−3.2	−2.3	−1.5
Residential construction	−3.7	−16.4	−20.6	−14.7	−8.6
Business fixed investment	−1.0	−4.1	−6.6	−5.7	−3.5
State and local purchases	−1.1	−2.0	−2.5	−2.6	−2.4
Net exports†	N.A.	N.A.	0.3	N.A.	N.A.
1990a simulation					
Nonborrowed reserves	−5.8	−5.8	−5.8	−5.5	−5.0
Federal funds rate	3.04	3.62	1.64	0.37	0.01
AAA corporate rate	1.15	2.23	1.60	0.60	0.06
Real GNP	−0.1	−2.6	−3.8	−2.1	−0.5
Consumption	0.0	−1.4	−2.5	−1.8	−0.9
Residential construction	−2.6	−23.6	−19.1	−3.7	2.5
Business fixed investment	0.0	−3.6	−11.6	−12.2	−7.3
State and local purchases	0.0	−0.1	−0.7	−1.2	−1.1
Net exports†	0.0	0.6	1.2	0.9	−0.4
1990b simulation					
Nonborrowed reserves	−6.5	−6.8	−8.2	−9.8	−11.8
Federal funds rate	3.46	4.64	3.64	2.75	2.36
AAA corporate rate	1.30	2.56	3.64	2.75	1.97
Real GNP	−0.1	−2.3	−5.1	−4.9	−3.7
Consumption	0.0	−1.2	−3.1	−3.5	−3.0
Residential construction	−3.0	−20.7	−30.0	−21.1	−12.6
Business fixed investment	0.0	−3.2	−12.5	−18.4	−17.4
State and local purchases	0.0	−0.1	−0.8	−1.6	−2.0
Net exports†	0.0	0.5	1.5	1.9	1.7

Notes: The 1981 simulation results are reproduced from Otto Eckstein, *The DRI Model*, p. 88. The baseline simulation used for 1990a and 1990b is a historical tracking simulation for the 1990 DRI model starting in the second quarter of 1975. Simulations 1981 and 1990a impose a permanent decrease in nonborrowed reserves starting the second quarter of 1975. In the 1990b simulation, the federal funds rate path is matched to that in the 1981 simulation by adjusting nonborrowed reserves appropriately. Federal funds and AAA corporate interest rates are reported as percentage point deviations from baseline.

†Differences for net exports are reported as a percentage of real GNP. The figure from the 1981 simulation was rebased from 1972 to 1982 dollars to adjust for the large change in the relative valuation of imports between 1972 and 1982.

existed in the 1981 model. In fact, if the path of long-term rates from the earlier simulation is imposed on the 1990 model, the impact of tight policy on business investment and the rest of the economy is substantially smaller than that measured in the 1981 simulation.[17]

A comparison of the trade balance reactions across the models is more complicated, in part because of changes in exchange rate modeling, but also because of income effects. In the 1990 model, tighter monetary policy has a direct negative effect on the trade balance: higher U.S. interest rates lead to capital inflows and a stronger dollar, eventually producing a decline in net exports. In both models, however, tight money also produces lower income, and thus lower U.S. demand for imports. This outcome pushes the trade balance in the opposite (positive) direction for the first two years. Furthermore, the income effect appears to be somewhat larger in the 1990 model.

To convey an idea of the size of the changes in income and exchange rate effects in the later model, Table 5 presents simulations for the 1990 model while keeping the exchange rate exogenous, as it was in 1981. Without the exchange rate mechanism, real net exports have an even larger and more persistent positive effect on real GNP in the 1990 simulation than in the 1981 simulation.[18] A comparison of Tables 4 and 5 reveals that tighter monetary policy, operating through the trade balance in the 1990 model, does have a depressing effect on the economy—an effect missing from the 1981 model.

The other components of real output show less dramatic changes in policy responses. In the short run, consumption is actually less sensitive to policy in the 1990 model than in the 1981 model, particularly when reserves are used to measure policy changes. This finding also holds for the first two years of the interest rate targeting exercise, but thereafter consumer spending declines are much larger, probably because of the stronger consumer sentiment effects. State and local government purchases are somewhat more responsive to rates in the 1981 model, and federal government purchases, by assumption, are identical.

Unfortunately, a comparison of inflation responses to monetary policy is not possible because inflation changes for the 1981 DRI simulation were not recorded. However, if the comparisons of inflation multipliers reported earlier are indicative, inflation responses are probably larger in the 1990 model than in the 1981 model. If tight money prompts a larger decline in inflation in the 1990 model, then this result could partially explain the lower path of short-term nominal interest rates in the 1990 reserves targeting simulation.

Overall, if one defines sensitivity to monetary policy in terms of the responses of real output to nominal short-term rates (that is, the federal funds rate), then the estimated sensitivities embodied in the DRI model are somewhat smaller in the short run, but substantially larger in the longer term, than they were ten years ago. But if policy is measured in terms of changes in high-powered money, then the overall sensitivity—in the one- to three-year horizon—has changed very little.

What is behind the divergence in the two policy measures? One factor, certainly, is the change in the relationship between reserves, money, and short-term interest rates. As noted earlier, the larger interest elasticities in M1 and reserves can explain why a decrease in reserves causes a smaller increase in short-term interest rates in 1990 and, similarly, why a larger increase in reserves is necessary to "hit" the same federal funds rate level.

A second explanation for the divergence between the reserves targeting and interest rate targeting exercises is that the sensitivity of aggregate demand to nominal short-term interest rates in the DRI model appears to have increased in the last ten years. Larger interest rate effects, particularly after several quarters, are consistent with the finding that equilibrium output declines more in the 1990 simulations when policy changes are measured in terms of short-term interest rates.

The short-term interest rate sensitivity of real demand might be greater today than a decade ago for several reasons. Financial deregulation and innovation have increased the number of economic agents directly affected by market interest rate changes and made it much easier for firms and consumers to substitute among different financial assets—both in borrowing and lending. These effects help to explain the stronger term structure relationships and the stronger response of final demand to market interest rates, particularly short-term rates. The tighter links between interest rates and the dollar have probably made net exports more sensitive to interest rates as well.

Although changes in the interest rate sensitivity of both money and final demand are not the only explanations for the results in Table 4, their effects can easily be explained by the textbook Keynesian macroeconomic model, ISLM. Although ISLM is a very simple macro model, the underlying structures of most

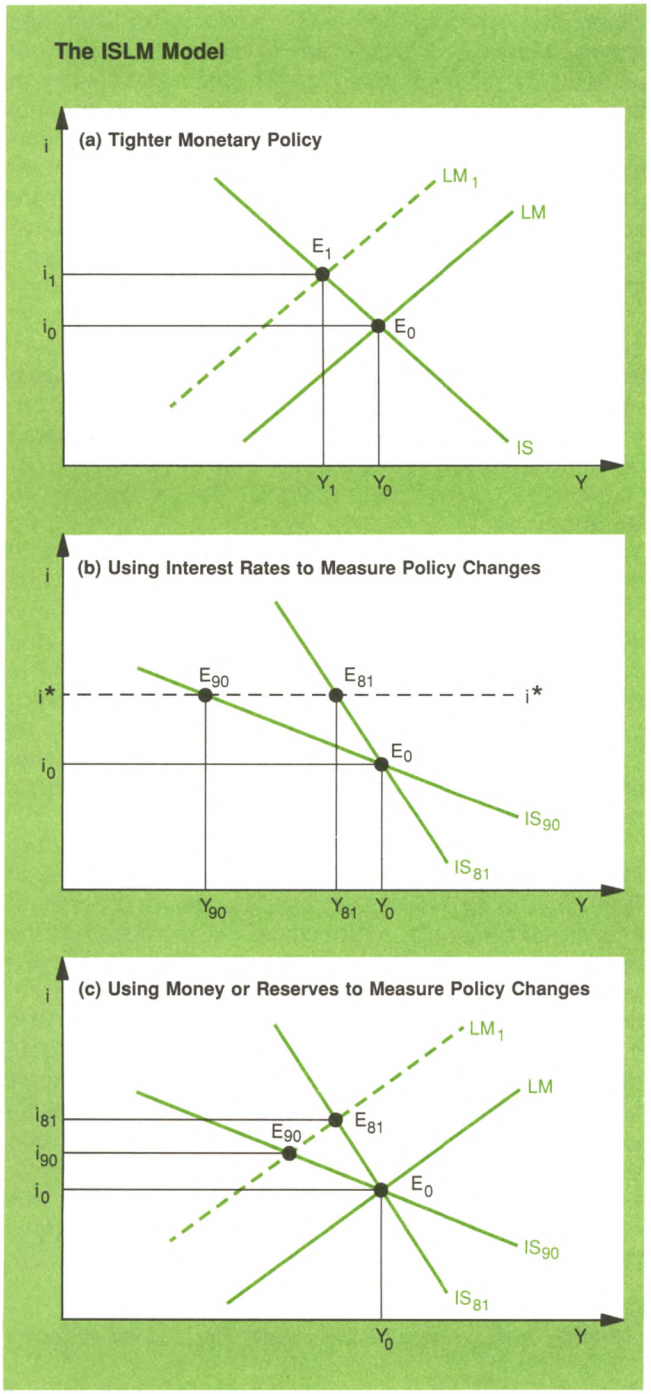
[17]This finding was reached by simulating the 1990 DRI model, targeting first reserves and then the federal funds rate while forcing long-term interest rates to match the paths reported in Eckstein. These model simulations were somewhat unstable, and so are not reported. But output, particularly business investment, was unambiguously higher when the lower long-term rate pattern was used.

[18]In fact, part of the large income effect may reflect the substantial increase in the relative size of the trade sector between 1981 and 1990. The large increase in the import share of GNP means that import income effects will be more important for real output in the 1990 model.

large-scale models derive from it (particularly the money and final demand equations). Consequently, using ISLM to illustrate some of the changes in the large models is not as far-fetched as it might seem.

The ISLM model (see diagram) describes combinations of real output (Y) and interest rates (i) that give equilibrium in both the market for money, as embodied in the LM curve, and the market for goods, represented by the IS curve, simultaneously. The IS curve slopes down because increases in interest rates reduce the output of goods, while the LM curve slopes up because higher interest rates require higher output to maintain money market equilibrium. Tighter monetary policy, which decreases the supply of money and raises interest rates (shifting the LM curve up and to the left in panel a), reduces the equilibrium real output level (Y_0 to Y_1) and raises the equilibrium interest rate (i_0 to i_1).

The ISLM Model



If final demand becomes more interest sensitive, a given increase in interest rates will produce a larger decline in equilibrium output. As a result, the IS curve becomes flatter (IS_{90} in panel b). Thus when tighter monetary policy is measured by interest rate changes (from i_0 to i*), a flatter IS curve produces a larger drop in real output (Y_{90} as against Y_{81}). This real output result corresponds to the real GNP changes from simulations 1981 and 1990b in Table 4. Similarly, when compared with a steep IS curve, a flat IS curve requires a larger change in the reserves stock to induce a particular change in equilibrium interest rates. Again, this result is consistent with the findings in Table 4.

Alternatively, a decrease in the supply of money or reserves, which shifts the LM curve to the left as in panel c, will produce a smaller increase in interest rates when the IS curve is flatter (i_{90} as against i_{81}). This is the pattern seen in Table 4 when monetary policy tightness is measured by changes in reserves (simulations 1981 and 1990a). In addition, this effect is reinforced by the increase in interest sensitivity of M1 and reserves demand, suggesting that the LM curve (when defined in terms of M1) has also become flatter in the past decade.[19]

While ISLM analysis can help us to understand some of the changes in monetary policy transmission in the last decade, the model's simple structure cannot address other important changes. These include changes in inflation responses, the term structure of interest rates, and credit rationing.

A change in the inflation response to policy might help explain the smaller short-term interest rate increases in the 1990a simulation. If inflation falls more rapidly in response to tight money in 1990, then a smaller jump in short-term rates in 1990 might yield the same real interest rate response as in 1981. If it is real rather than nominal rates that affect final demand, then

[19] In fact, the combination of both a flatter IS curve (more final demand sensitivity to interest rates) and a flatter LM curve (more money demand sensitivity to interest rates) can be used to explain why, when reserves are targeted, changes in equilibrium interest rates are smaller in the 1990 model but changes in real GNP are about the same as in the 1981 model.

output responses to monetary policy could be quite similar. Furthermore, matching nominal interest rate paths, as in the 1981 and 1990b simulations, would yield higher real rates in the 1990b simulation and thus lead to larger output declines. Unfortunately, no inflation comparisons are available in the 1981 study, so this hypothesis cannot be checked. The changes reported in Tables 1 and 2 suggest that inflation responses are larger and more rapid in later models, and the DRI specifications of investment, net exports, and consumption do depend on real interest rates. Together these points suggest that larger real interest rate changes in the 1990 model may be one reason for larger output responses.

Tighter links between long-term and short-term interest rates are another change in monetary policy transmission. Large-scale models include a wealth of interest rate detail, with short-term rates closely tied to monetary policy, while long-term rates are modeled (usually) using the term structure. Since final demand components respond to changes in both long and short rates, increased sensitivity of long rates to short rates will change the policy sensitivity of final demand— even if the direct interest elasticities in final demand equations are unchanged.[20]

Finally, one of the most important changes in the monetary policy transmission mechanism has been the weakening of nonprice credit rationing. This development has accompanied the financial deregulation and innovations of the last ten years. Nearly all the studies mentioned above as well as the changes in the DRI equations for investment and housing indicate that the transmission of monetary policy shocks to the real economy through credit constraints has become less important, and in some cases has disappeared entirely, in the last decade. The reduction in credit constraints suggests that monetary policy should have a smaller impact on real output, at least in the very short run. This is precisely what happens in the 1990 simulations in Table 4: real output declines are smaller than those in the 1981 model for the first year of tight money. Thereafter, however, greater sensitivity to nominal interest rates in the 1990 model appears to offset (or more than offset in the 1990b simulation) any reduction of rationing effects.[21]

[20]Similarly, several recent studies (see footnote 1) suggest that the real economy, particularly housing, may be responding more strongly to short-term interest rates in the 1980s but less strongly to long rates. The simulations in Table 4 are consistent with this hypothesis: in the reserves targeting simulation (1990a), short rates rose less while long rates rose more than in the 1981 exercise, but output fell by about the same amount.

[21]In an ISLM framework, credit rationing and disintermediation brought on by tight monetary policy would be reflected in a left shift in the IS curve (in conjunction with the LM curve shift). The decline of credit rationing combined with increased interest rate sensitivity suggests that a flatter IS curve has been substituted for such credit-induced shifts.

In summary, policy simulations using DRI's 1990 model show real output, in the medium term, to be substantially more sensitive to monetary policy when nominal short-term rates serve as policy guides but very similar to 1981 model results when reserves are policy targets. A corollary to this conclusion is that movements in nominal short-term rates arising from changes in reserves are smaller and shorter lived than ten years ago. Still, policy lags in the model are longer and output responses to policy are somewhat smaller in the very short run. In addition, the details of final demand sensitivity to policy have changed considerably. Housing (over one year), business investment (from two to four years), and net exports are more sensitive to policy, while consumption is more sensitive to nominal interest rates only in the longer run. Finally, although a simple ISLM model framework incorporating increased interest rate sensitivity of both final demand and bank reserves can account for some of the differences in policy simulations, other factors such as a tighter link between monetary policy and inflation, stronger term structure relationships, and less credit rationing are important as well.

Conclusions

This article has explored changes in the sensitivity of the real economy to monetary policy over the last decade in the context of several macroeconometric models. In contrast to the findings of other studies, the bulk of the evidence presented here suggests that the real economy is at least as sensitive to monetary policy today as it was ten to fifteen years ago. In fact, some exercises show that policy has substantially larger effects on output currently. The lags in policy effects, however, are probably longer.

In the most extreme result, money multipliers drawn from published historical simulations are much larger in 1990 than in 1975 for most of the widely used macroeconometric models. The substantial increases in the multipliers suggest major changes in the transmission mechanisms in these large models. Equation specifications from one model (DRI) confirm that innovations in financial regulations and institutions have changed both the transmission mechanisms by which policy affects final demand and the size of policy effects. This finding is particularly clear for the investment and trade sectors.

Finally, the article shows that more detailed estimates of the economy's sensitivity to monetary policy depend crucially on how the policy change is measured:

through reserves shocks or through interest rate shocks. Simulation exercises comparing the 1981 and 1990 DRI models suggest that tight monetary policy, as measured in reserves growth, has approximately the same effect on output in 1990 as in 1981. Simulations that use interest rates to measure policy tightness require much larger reserves withdrawals and produce much stronger medium- and long-run effects of monetary policy in 1990 than in 1981. These results, interpreted using the simple ISLM model, suggest a flatter IS curve and perhaps a flatter LM curve (defined in terms of M1) currently. The models also highlight other important changes in policy transmission in the last decade, including stronger inflation effects, stronger links between long-term and short-term interest rates, and the removal of credit rationing effects.

Appendix: The Importance of Initial Conditions

The simulation results in Tables 4 and 5 measure how changes in the DRI model structure have altered its measurement of monetary policy effectiveness. To isolate the specification changes, the 1981 and 1990 simulations were conducted over identical time periods, but using different DRI model versions (in other words, using different equations). Although this approach captures changes in equation specifications well, it does not necessarily account for all the possible ways that real economy responses to monetary policy within large models have changed.

For example, it is still possible that the economy could respond differently to monetary shocks in 1991 than a decade earlier if initial conditions had changed significantly while the structure of the economy remained unchanged. In the standard ISLM macroeconomic model, initial conditions such as wealth levels, the degree of both private and public debt leverage, regulatory stance, and fiscal and monetary policy structure might affect the link between monetary policy and aggregate output without (drastically) changing the equations that determine the IS and LM curves. Similarly, the underlying core inflation rate and movements in supply-related variables such as relative energy prices are substantially different today than ten years ago. Certainly these factors could influence the dynamic behavior of equilibrium output and prices, and thus alter the impact of monetary policy, without directly changing the structure of consumption functions, investment functions, and so forth.

One way to measure the importance of such initial conditions is to use a single macroeconometric model to conduct simulation experiments before and after the structural changes of the 1980s. Tables A1 and A2 report the results of such an experiment using the 1990 DRI model, with policy shocks introduced in 1979 and 1991.

Simulations in Table A1 involve a 5 percent increase in nonborrowed reserves beginning in the fourth quarter of 1979 (simulation 1979a) and the second quarter of 1991 (1991a). In Table A2, reserves are also augmented, but by an amount sufficient to cut the nominal federal funds rate by 100 basis points (simulations 1979b and 1991b).

Comparisons of the "a" simulations show that when reserves are increased by 5 percent permanently, the short-run responses of output are virtually identical. By contrast, the composition of output, particularly investment, differs somewhat. Residential structures rise more sharply in the historical simulation, but these gains are offset by smaller increases in business fixed investment.

Comparison of the federal funds targeting simulations, 1979b and 1991b, also shows similar short-run paths for real output. Again, larger increases in residential investment and smaller increases for nonresidential investment occur in the earlier period. Although the effects are small, the results support the view that initial conditions such as debt leverage ratios increase business investment sensitivity to policy.

Initial conditions appear to have a very small impact on the short-run multipliers, but more significant differences do appear in the longer run. In the 5 percent reserves simulations ("a" simulations), real output is slightly higher in the 1991 simulation after three years, and after ten years remains ½ percent above the baseline. In contrast, the 1979a simulation has GNP just below baseline levels in the long run. The stronger GNP response in the 1991a simulation occurs in spite of relatively higher paths for nominal and *real* interest rates. Notably, both consumption and business fixed investment, sectors where current debt levels are considered to be extraordinarily high, are more responsive to easy monetary policy in the 1991 simulation than in history.

Differences in current and historical responses to interest rate changes induced by reserve changes are shown in Table A2. For the first two years, the increase in nominal reserves necessary to maintain a federal funds rate cut of 100 basis points is about the same in the two simulations. Thereafter, interest rate targeting in the 1991b simulation requires larger and larger injections, until reserves are 50 percent larger after ten years. This extra liquidity translates into substantially higher paths for all components of real output (and for prices) in the long run. In one sense, then, final demand components behave in a way that is more interest rate sensitive in

Appendix: The Importance of Initial Conditions *(Continued)*

1991 than in 1979. The ex post *real* fed funds rate, measured as fed funds less actual inflation, is down nearly 140 basis points after four years in both simulations. But after ten years the real rate is down nearly 200 basis points in 1991b as compared with 130 basis points in 1979b. This finding explains some of the extra output gain in the 1991 simulation.

These simulations point to the general conclusion that changes in wealth, debt, and other factors affecting the position of aggregate demand and supply in the last decade have changed the short-run impacts of monetary policy very little. Long-run responses to persistently loose money, however, are quite different now than in the late 1970s.

Table A1

Monetary Policy Easing
The Effects of a 5 Percent Increase in Reserves:
A Comparison of Simulations of the 1990 DRI Model
Percent Deviation from Base Case

	Quarters after Shock					
	1	4	8	12	16	40
1979a						
Nonborrowed reserves	5.0	5.0	5.0	5.0	5.0	5.0
Federal funds rate	−2.53	−2.90	−1.48	−0.45	−0.25	−0.21
Cost of debt	−0.75	−1.01	−0.72	−0.28	−0.14	−0.22
Cost of equity	−0.34	−1.02	−0.65	0.10	0.53	0.21
Inflation	0.0	0.3	0.8	0.8	0.8	0.0
Price level	0.0	0.1	0.7	1.6	2.4	3.8
Real GNP	0.1	2.2	3.4	2.1	0.8	−0.1
Consumption	0.0	1.1	1.9	1.2	0.4	−0.5
Residential construction	1.9	23.8	27.3	6.2	−4.2	0.4
Business fixed investment	0.0	2.6	7.9	8.9	4.0	1.6
Net exports	−37.9	−14.0	−7.4	9.0	54.0	†
1991a						
Nonborrowed reserves	5.0	5.0	5.0	5.0	5.0	5.0
Federal funds rate	−2.37	−3.11	−1.30	−0.06	0.17	0.37
Cost of debt	−0.81	−1.27	−0.79	−0.19	−0.05	0.00
Cost of equity	−0.18	−0.75	−0.56	0.09	0.55	0.31
Inflation	0.0	0.3	0.8	0.8	0.7	0.2
Price level	0.0	0.1	0.7	1.5	2.2	4.4
Real GNP	0.1	2.2	3.7	2.3	1.4	0.5
Consumption	0.0	1.3	1.9	1.1	0.4	−0.3
Residential construction	1.4	14.9	13.8	1.2	−3.4	−0.8
Business fixed investment	0.0	3.8	10.4	7.9	3.1	2.1
Net exports	−5.5	−13.6	−7.2	29.6	70.6	84.7

Notes: Nominal nonborrowed reserves were increased by 5.0 percent permanently. Changes in the federal funds rate and costs of debt and equity are stated in percentage points. Corporate costs of debt and equity are after tax. The debt cost is the after-tax, new-issue, high-grade corporate bond yield. The equity cost is an expected-inflation-adjusted ratio of dividends to stock prices for the Standard & Poor's 500. The change in net exports is expressed as a percentage of the change in real GNP that quarter.

†The change in real output was virtually zero.

Appendix: The Importance of Initial Conditions *(Continued)*

Table A2

Monetary Policy Easing
The Effects of Lowering the Federal Funds Rate: Comparison of Simulations of the 1990 DRI Model

Percent Deviation from Base Case

	Quarters after Shock					
	1	4	8	12	16	40
1979b						
Nonborrowed reserves	1.9	1.4	2.2	3.1	3.7	6.5
Federal funds rate	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00
Cost of debt	−0.30	−0.34	−0.39	−0.38	−0.38	−0.54
Cost of equity	−0.14	−0.34	−0.38	−0.35	−0.08	0.23
Inflation	0.0	0.1	0.3	0.4	0.4	0.3
Price level	0.0	0.0	0.2	0.5	0.9	3.2
Real GNP	0.0	0.7	1.2	1.3	1.2	0.8
Consumption	0.0	0.3	0.7	0.7	0.6	0.1
Residential construction	0.8	7.2	9.8	9.9	4.5	2.8
Business fixed investment	0.0	0.8	2.5	4.0	3.8	3.5
Net exports	−33.1	−13.9	−21.2	−3.2	1.9	23.4
1991b						
Nonborrowed reserves	2.1	1.3	2.3	3.3	4.1	9.9
Federal funds rate	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00
Cost of debt	−0.34	−0.41	−0.46	−0.47	−0.49	−0.59
Cost of equity	−0.08	−0.25	−0.28	−0.23	−0.13	0.40
Inflation	0.0	0.1	0.2	0.3	0.4	0.9
Price level	0.0	0.0	0.2	0.5	0.9	4.7
Real GNP	0.0	0.7	1.3	1.5	1.7	2.7
Consumption	0.0	0.4	0.7	0.8	0.8	1.0
Residential construction	0.6	4.6	5.8	4.8	4.2	3.7
Business fixed investment	0.0	1.2	3.3	4.0	4.2	6.3
Net exports	0.9	−14.3	−6.8	7.1	15.8	30.1

Notes: Nonborrowed reserves were adjusted by the amount necessary to achieve a 1 percentage point drop in the federal funds rate. The federal funds rate and costs of debt and equity are reported as changes in percentage points. Corporate costs of debt and equity are after tax. The debt cost is the after-tax, new-issue, high-grade corporate bond yield. The equity cost is an expected-inflation-adjusted ratio of dividends to stock prices for the Standard & Poor's 500. The change in net exports is expressed as a percentage of the change in real GNP in that quarter.

Foreign Bank Credit to U.S. Corporations: The Implications of Offshore Loans

by Robert N. McCauley and Rama Seth

International financial transactions have grown in recent years far faster than has our ability to understand their significance for national economies. A case in point is the rise in bank loans from banks outside the United States to U.S. businesses. The rapid growth of such loans bears on issues ranging from the extent of the corporate debt buildup in the United States in the late 1980s, to the progress of securities markets in displacing intermediated corporate credit, to the loss of market share in U.S. commercial lending by U.S.-owned banks.

This article argues that offshore bank loans to U.S. businesses in the 1980s surged as foreign banks availed themselves of an opportunity to avoid the cost of U.S. regulation, namely, the reserve cost of booking loans in the United States. The slowdown in the growth of offshore loans after the Federal Reserve removed the relevant reserve requirements in 1990 is consistent with this explanation.

In addition, the article points to three implications of the rapid pile-up of offshore credit to U.S. businesses:

- The accumulation of debt by U.S. firms was even more rapid than was generally thought in the late 1980s, and the recent drop in bank lending far less striking.
- More of the corporate funding was supplied by banks, including foreign banks, and less by the securities markets than is generally thought. In other words, the usual reckoning of banks' loss of corporate business to the securities markets in the 1980s overstates the case.
- Finally, the overwhelmingly foreign ownership of the banks responsible for the offshore lending means that the foreign bank share of the U.S. commercial lending market is higher than the frequently cited 30 percent figure, which is based on loans booked in the United States. Instead, foreign banks have won a market share for themselves closer to 45 percent, putting commercial lending ahead of chemicals and automaking in the foreign command of the U.S. market.

The buildup of credit to U.S. firms from offshore

The Bank for International Settlements aggregates data on crossborder loans provided by twenty-five banking authorities from industrial countries and offshore banking centers.[1] These data show a very rapid rise in bank loans to U.S. borrowers other than banks: from about $50 billion in 1983 to $278 billion in 1991 (Chart 1). Although publicly available information does not reveal where all the loans are booked, it is clear that the fastest growth has occurred in offshore centers, particularly in the Cayman Islands, and in "other industrial countries," which include Japan.

Those borrowing in the United States from banks abroad comprise not only commercial and industrial firms but also bank holding companies and their nonbank affiliates, securities firms, real estate companies, finance companies, and others. An estimate of the share of commercial and industrial loans in the offshore claims on U.S. nonbanks can be derived from the loans' share on the balance sheet of foreign banks' branches and agencies in the United States. This share is esti-

[1]See Bank for International Settlements, Monetary and Economic Department, *Guide to the BIS Statistics on International Banking* (Basle: Bank for International Settlements, February 1988).

mated to have remained steady at about 60 percent, at least since 1989.[2]

Estimated loans to commercial and industrial companies booked offshore rose from $37 billion in 1983 to $174 billion by the end of 1991 (Chart 2, solid line). These sums are more than double the offshore loans captured in the Treasury International Capital (TIC) reporting system and reflected in the flow of funds data on aggregate corporate indebtedness published by the Board of Governors of the Federal Reserve System (Chart 2, broken line). Note that in one case the lender reports and in the other case the borrower reports.[3] The flow of funds data were capturing about fifty cents of every dollar of estimated offshore loans during 1984-88, after which time they captured even less—only about forty cents of every dollar by 1991.

In the mid-1980s, the Treasury's concern about the accuracy and completeness of the balance of payments data on U.S. corporate borrowing from abroad led it to put in place a new reporting form. In introducing the new form, the Treasury wrote, "information drawn from Treasury interviews with a number of major banks and nonbank firms has indicated that large amounts of offshore loans to U.S. nonbank residents are not being properly reported on the TIC forms. In large part, underreporting of foreign loans may arise because the nonbank borrower is unsure where the loan is actually booked. This confusion is particularly likely in instances where a U.S. firm is granted a loan from a foreign source but all loan servicing transactions are handled by a bank or other intermediary in the United States."[4] The result of the new reporting form was a jump in mid-1986 in the outstanding loans recorded by the Treasury (Chart 2, broken line). Nevertheless, the data reported to the Bank for International Settlements suggest to us that the U.S. data are still undercounting the offshore loans.

Foreign banks have made the bulk of the offshore loans to U.S. commercial and industrial firms. U.S.

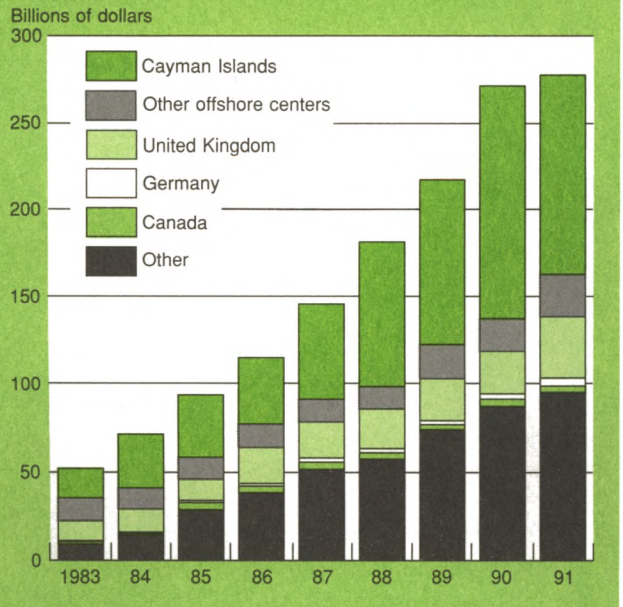
[2]See notes to Table 1 for method of estimation. For at least one component of offshore loans to nonbanks, the 60 percent share is an underestimate. Commercial and industrial loans were 85 percent of loans to U.S. nonbanks made by foreign branches of U.S.-owned banks in 1990.

[3]Some of the problems with balance of payments data on nonbank flows are noted in "Final Report of the Working Party on the Measurement of International Capital Flows," International Monetary Fund, Washington, D.C., February 3, 1992. (See footnote 1 on p. 125.)

[4]Letter "To All Nonbank Business Enterprises Reporting on Treasury International Capital C-Series Forms" from Gary A. Lee, Manager, Treasury International Capital Reporting System, Office of Data Management, Department of Treasury, May 1, 1986.

Chart 1

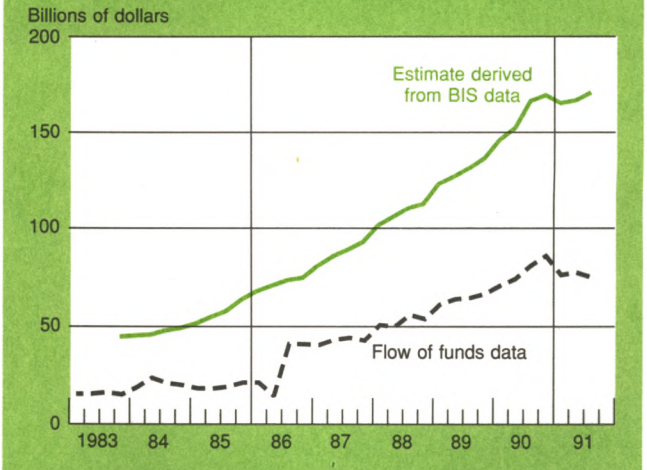
Claims on U.S. Nonbanks by Banks in the BIS Reporting Area



Sources: Bank for International Settlements, *International Banking and Financial Market Developments*; *Statistical Supplement to the Monthly Reports of the Deutsche Bundesbank*; *Bank of Canada Review*; Bank of England; national sources.

Chart 2

U.S. Commercial and Industrial Loans Booked Offshore



Sources: Board of Governors of the Federal Reserve System, Flow of Funds; sources in Table 1.

banks' branches held only $22 billion in such loans at the end of 1991, while foreign banks held an estimated $152 billion. Some of these loans are to U.S. affiliates of home country corporations. At least in the case of Japanese banks, however, such loans are not large enough to explain even their onshore loans.[5] We examine the reason for foreign banks' predominance below. First, however, we place offshore lending by foreign banks in the context of their overall penetration of the U.S. commercial banking market.

Offshore credit and foreign banks' share of U.S. commercial lending

The conventional view of the foreign bank share of the U.S. commercial lending market only considers loans to businesses in the United States *booked in the United States*. Such loans totaled $196 billion at the end of 1991, when all commercial and industrial loans in the United States were estimated to total $603 billion. Subsidiaries accounted for $50 billion and branches and agencies accounted for $146 billion of the foreign banks' onshore lending.

Thus, the conventional view is that the foreign bank share had reached 33 percent in 1991, up from 15 percent in 1983. Sometimes loans to businesses in the United States booked at U.S. bank branches abroad, branches of both U.S.-owned banks and foreign banks' U.S. subsidiaries, are included in the definition of the market, but their modest size leaves the conventional measure of the foreign bank share at 31 percent.

The view taken here is that the U.S. commercial lending market is better conceived as borrowing by businesses located in the United States: where a loan is booked is of secondary importance. To be sure, one reason for not considering commercial loans booked offshore by foreign banks is that we do not have a precise measure of them. The burden of our argument, however, is that a very accurate measure of a piece of the total is less useful than an approximate measure of the whole.

With this principle in mind, we calculate the foreign share of the U.S. commercial and industrial market to have grown from 18 percent in 1983 to 45 percent in 1991 (Table 1, first memorandum line). Estimated offshore loans by foreign banks rose from 4 to 20 percent of the total market; this growth offshore represented more than half the growth in foreign banks' market share. Indeed, the increase in the offshore component of foreign loans was more rapid than that in the onshore component in each of the years between 1983 and 1990 (lines II A and II B in Table 1). It is interesting that this pattern reversed itself between 1990 and 1991.

These estimates raise anew and with more force an old question: Why did foreign banks displace U.S. banks in their home market in the 1980s? In addition,

[5] See Rama Seth and Alicia Quijano, "Japanese Banks' Customers in the United States," Federal Reserve Bank of New York *Quarterly Review*, vol. 16, no. 1 (Spring 1991), pp. 79-82.

Table 1

Foreign Bank Share of U.S. Commercial and Industrial Loan Market

Billions of Dollars Except As Noted

	1983	1984	1985	1986	1987	1988	1989	1990	1991-I	1991-II	1991-III	1991-IV
Commercial and Industrial Loans to U.S. Addressees	467	512	556	623	654	712	765	803	797	786	782	777
I. Loans by U.S.-owned banks	381	402	419	454	445	464	481	477	466	453	440	428
A. Onshore	364	382	401	439	431	446	460	454	443	430	417	407
B. Offshore	17	20	18	15	15	18	21	22	23	23	23	22
II. Loans by foreign-owned banks†	86	110	137	169	209	248	284	327	332	333	342	348
A. Onshore	66	78	92	109	130	153	168	179	185	186	191	196
B. Estimated offshore‡	20	31	45	60	79	95	116	148	146	148	151	152
Memo: Foreign Share (percent)	18	21	25	27	32	35	37	41	42	42	44	45
A. Onshore	14	15	17	18	20	21	22	22	23	24	24	25
B. Offshore	4	6	8	10	12	13	15	18	18	19	19	20

Sources: Bank for International Settlements; Federal Financial Institutions Examination Council, Reports of Condition; Federal Reserve Form 2502; Federal Reserve Form 2951; *Federal Reserve Bulletin*, Statistical Table 4.3; Federal Reserve Bank of New York staff estimates.

Note: Banks in the United States include all banking institutions that file Reports of Condition with the Federal Financial Institutions Examinations Council.

†Includes branches, agencies, and subsidiaries with at least 10 percent foreign ownership.

‡These figures are estimated in two steps. We calculate the commercial and industrial proportion of total claims on nonbanks of branches and agencies of foreign banks in the United States. Then, assuming that the offshore proportion is the same, we apply this fraction, 60 percent, to the offshore claims on U.S. nonbanks of foreign banks. Also, 1991-I Bahamian and 1991-I and 1991-II Cayman Islands' figures for lending are carried over from end-1990.

the estimates raise a less familiar question: Why did foreign banks book such a high share of their new loans offshore in the late 1980s? We answer each question in turn.

Reasons for foreign banks' gain in market share

Foreign banks appear to have drawn on two different kinds of advantages in bidding for U.S. corporate business in the 1980s. First, they could undercut the prevailing pricing *and still satisfy the demands of their shareholders*. Second, they could offer international services and thereby persuade U.S. corporate treasurers to switch some business.

Price advantages

According to a recent study, Continental and Japanese banks enjoyed substantially lower costs of equity than did U.S. banks in the period 1984-90.[6] In other words, investors in equities in Frankfurt, Tokyo, and Zurich put a higher price on a given internationally comparable stream of bank earnings than did U.S. investors. Such pricing in turn allowed Continental and Japanese bank managers to target a smaller spread between the cost of funds and commercial lending rates than U.S., Canadian, or British bank managers could accept. U.S. banks' required spreads on commercial loans in the United States were on average more than 50 basis points, or one-half of 1 percent, wider than those of Japanese banks operating in the United States, 30 basis points wider than those of German and Swiss banks, and even 10 basis points wider than those of British and Canadian banks.[7] In the competitive world of commercial banking, these are telling differences.

Survey evidence supports the cost of capital interpretation of the penetration of foreign banks. Greenwich Associates conducted interviews with financial decision makers at U.S. corporations of various sizes in 1988 and found that firms trimmed the ranks of their U.S. banks while increasing the ranks of their foreign banks between 1987 and 1988 (Chart 3). Survey respondents cited "competitive loan pricing" as their principal reason for favoring foreign—and, in particular, Japanese—banks (Table 2).

Nonprice advantages

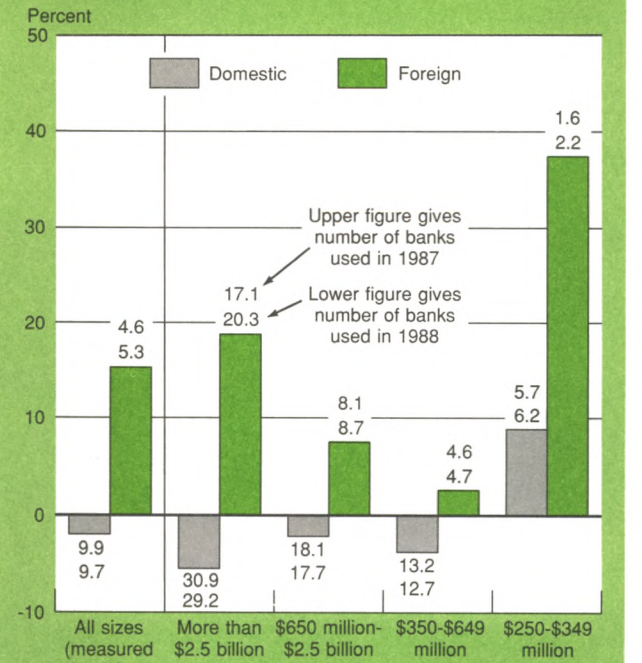
The same surveys suggested that foreign banks benefited from their international presence in bidding for U.S. customers. U.S. corporate treasurers indicated that international service capabilities and knowledge of innovative international banking alternatives made foreign banks more attractive lenders than domestic banks (Table 2).

Reasons for foreign banks' offshore bookings

We hypothesize that foreign banks arbitraged regulatory differences in booking U.S. commercial loans offshore. Under Federal Reserve Regulation D, which governs reserve requirements, a foreign bank branch or agency had to post a non-interest-bearing 3 percent reserve when it sold a large so-called Yankee, or foreign bank, certificate of deposit in New York to fund a corporate loan (see box). In addition, once a foreign bank's U.S. offices had collectively run up net obligations to the bank's branches abroad, that bank had to post a sterile 3 percent reserve against additional Eurodollars borrowed abroad to fund U.S. assets, including corporate loans booked in the United States. But a foreign branch or agency so bound by the

Chart 3

Percentage Change in the Number of U.S. and Foreign Banks Used by the Average U.S. Company between 1987 and 1988



Source: Greenwich Associates, *The Coming Shift in Bank Relationships* (Greenwich, Connecticut: 1988).

[6]Steven A. Zimmer and Robert N. McCauley, "Bank Cost of Capital and International Competition," Federal Reserve Bank of New York *Quarterly Review*, vol. 15 (Winter 1991), pp. 33-59. See also Robert Z. Aliber, "International Banking: A Survey," *Journal of Money, Credit, and Banking*, vol. 16 (November 1984, part 2), pp. 661-78.

[7]Zimmer and McCauley, "Bank Cost of Capital," p. 49, Table 3. The table compares costs at branches.

Eurodollar reserve requirement could avoid it by booking a loan to a U.S. firm at a branch abroad.[8] If the foreign bank chose a jurisdiction with a reserve requirement lower than 3 percent, quite possibly one with no reserve requirement, it could be said to have engaged in *regulatory arbitrage*.

U.S. chartered banks could not play this game.[9] For them the Eurodollar reserve was assessed not only against net borrowings from affiliates abroad but also against loans to U.S. nonbanks booked at their foreign branches. The more inclusive reserve base entailed a requirement that U.S. chartered banks provide detailed information on their foreign branches and affiliates. As a result, a U.S. bank bound by the Eurodollar reserve requirement could not avoid it by booking a loan to a U.S. resident offshore.

[8]No explicit guidelines against booking loans from offshore centers were given to foreign banks in particular. The Board of Governors of the Federal Reserve System, however, had discouraged U.S. banks from running U.S. business through their foreign branches. (See "Foreign Branches—Deposits Unconnected with Foreign Business," Section 3-698 in the Board's Interpretation of Regulation K, June 1981, pp. 3.302-3.303.)

[9]U.S. banks' foreign offices could, however, lend to multinationals' foreign offices free of reserves, and those offices in turn could relend the funds to their U.S. home offices. In this case, the regulatory arbitrage would show up in the balance of payments data as an intercompany loan, reducing U.S. direct foreign investment abroad (U.S.-based multinationals) or increasing direct foreign investment into the United States (foreign-based multinationals). For examples of the latter associated with acquisitions by British companies, see Robert N. McCauley and Dan P. Eldridge, "The British Invasion: Explaining the Strength of U.K. Acquisitions of U.S. Firms in the late 1980s," in *International Capital Flows, Exchange Rate Determination and Persistent Current Account Imbalances*, Bank for International Settlements, June 1990, pp. 323, 324.

Before we can confirm this interpretation of the rapid growth of foreign banks' offshore loans to U.S. firms, at least five conditions must be met:

1) Foreign banks must have been bound by the Eurodollar reserve requirement, or they would have no incentive to book offshore.
2) U.S.-chartered and foreign banks must have differed in their booking behavior, since only the foreign banks had the opportunity to arbitrage regulations.
3) The jurisdictions in which the offshore loans were booked in fact must have offered regulatory advantages.
4) The configuration of onshore and offshore rates must have favored offshore booking by foreign banks.
5) Finally, the reduction to zero of the Eurodollar reserve requirement at the end of 1990 should have made booking loans offshore much less attractive.

We examine each condition in turn.

Were foreign banks bound by the Eurodollar reserve requirement?

Data collected by the Federal Reserve indicate that many foreign branches in the United States indeed had clear incentives to book their loans offshore. By 1990, 123 out of 245 U.S. branches and agencies of foreign banks, representing over 50 percent of total assets of branches and agencies, had a positive net related Eurocurrency liability (Chart 4); that is, they were bound by the Eurodollar reserve requirement. In addition, branches and agencies representing an additional 3.5 percent of total assets were nearly bound (that is, they

Table 2

U.S. Corporations' Motives for Using Foreign Banks

A Reason Index

	All Foreign	Japanese	German	U.K.	Canadian	Swiss
Competitive loan pricing	15	27	1	0	0	− 2
International service capabilities, domestic or offshore	11	− 4	8	8	− 3	9
Ability to propose innovative international banking alternatives	3	− 3	− 3	0	− 3	6
Large lending capacity	− 9	−14	−10	−14	−16	−13
Best at integrating merchant and commercial banking services	− 9	−10	−14	−10	−10	− 8
Reliable source of credit	−10	−17	−16	−12	−16	− 9
Caliber of banking officers	−15	−28	−24	−17	−19	−17
Capital markets and corporate finance capabilities	−16	−20	−14	−24	−22	− 5
Knowledge of innovative domestic banking alternatives	−18	− 8	− 6	− 6	− 6	− 3
Historical relationship	−25	−39	−32	−36	−29	−39
Cash management	−46	−52	−58	−53	−41	−60

Source: Greenwich Associates, *The Coming Shift in Bank Relationships* (Greenwich, Connecticut, 1988), pp. 18-29.

Note: The index is the difference between the percentage of responses given for using foreign banks and that given for using domestic banks in 1988.

Box

This box outlines the reserve requirements set forth in Regulation D. Section 204.3 requires that "a depository institution, a U.S. branch or agency of a foreign bank, and an Edge or agreement corporation shall maintain reserves against its deposits and Eurocurrency liabilities."[†] Section 204.2 defines "Eurocurrency liabilities" as follows:

> (1) for a depository institution or an Edge or agreement corporation organized under the laws of the United States, the sum, if positive, of the following:
>
> (i) net balances due to its non-United States offices and its international banking facilities ("IBFs") from its United States offices;
>
> (ii) ... assets ... acquired from its United States offices and held by its non-United States offices, by its IBF, or by non-United States offices of an affiliated Edge or agreement corporation;...
>
> (iii) *credit outstanding from its non-United States offices to United States residents* [emphasis added]...
>
> (2) for a United States branch or agency of a foreign bank, the sum, if positive, of the following:
>
> (i) net balances due to its foreign bank (including offices thereof located outside the United States) and its international banking facility after deducting an amount equal to 8 percent of ... the United States branch's or agency's total assets...;
>
> (ii) assets (including participations) acquired from the United States branch or agency ... and held by its foreign bank (including offices thereof located outside the United States), by its parent holding company, by its non-United States offices or an IBF of an affiliated Edge or agreement corporation, or by its IBFs.

Section 204.9 charts the reserve requirement ratios as follows:

Category	Reserve Requirement
Net Transaction Accounts	
$0 to $40.5 million	3% of amount
Over $40.5 million	$1,215,000 plus 12% of amount over $40.5 million
Nonpersonal Time Deposits	
By original maturity (or notice period):	
less than 1½ years	3%
1½ years or more	0%
Eurocurrency Liabilities	3%

On December 4, 1990, the Federal Reserve Board announced that reserve requirements would be reduced to zero on previously reservable nonpersonal time deposits and Eurocurrency liabilities.[‡] The change was implemented in two steps. For depository institutions reporting weekly, the reserve ratios were reduced first to 1.5 percent in the reserve maintenance period beginning December 13 and then to zero in the maintenance period beginning December 27.

[†]Board of Governors of the Federal Reserve System, "Regulation D Reserve Requirements of Depository Institutions," 12 C.F.R. 204; as amended effective December 31, 1987.

[‡]Federal Reserve Bank of New York, "Reserve Requirements," Circular no. 10406, December 4, 1990. See also amendment to Section 204.9 in Board of Governors of the Federal Reserve System,"Supplement to Regulation D."

were 1 percent of their assets or less away from having a reservable net due to position in relation to their foreign offices).

Bound in aggregate by the Eurodollar reserve requirement, U.S. branches and agencies of foreign banks were maintaining substantial non-interest-bearing Eurodollar reserves, $485 million in October 1990, and could therefore fund a loan to a U.S. corporation more cheaply by booking it offshore. We consider below why some foreign banks were paying the Eurodollar reserve.

Did U.S. and foreign banks book differently?

As described above, Regulation D called for different treatment of foreign branches and agencies, on the one hand, and U.S. chartered banks, on the other. This asymmetry in treatment was mirrored by the asymmetry in behavior: foreign banks' offshore loans to U.S. firms more than quintupled between 1984 and 1990, while U.S.-chartered banks' offshore loans showed little growth by comparison—5 percent during the same period.

The difference in regulation depended not on ultimate ownership but on the U.S. charter. Regulation D treated foreign bank subsidiaries like U.S.-owned banks rather than like foreign branches in the United States. The fact that foreign bank subsidiaries used their foreign

branches no more than did U.S.-owned banks (Table 3) therefore strengthens the regulatory interpretation.

Were foreign banks booking their U.S. loans in jurisdictions with lower regulatory burdens?
Most of the offshore loans to U.S. nonbanks are booked in jurisdictions that impose no reserve requirements, such as offshore centers and the United Kingdom (Chart 1). Jurisdictions that do impose relatively high reserve requirements, such as Germany, have not seen much growth in their loans to U.S. nonbanks.[10] We conjecture that the growth of loans from other industrial countries, including Japan, occurred in the Japan Offshore Market (JOM) in Tokyo. Since December 1, 1986, this market has permitted foreign loans to be funded with money not subject to reserve requirements.[11]

Clear evidence of regulatory arbitrage is seen in the use of shell branches in offshore centers such as the Cayman Islands (Table 4).[12] More than two-thirds of all

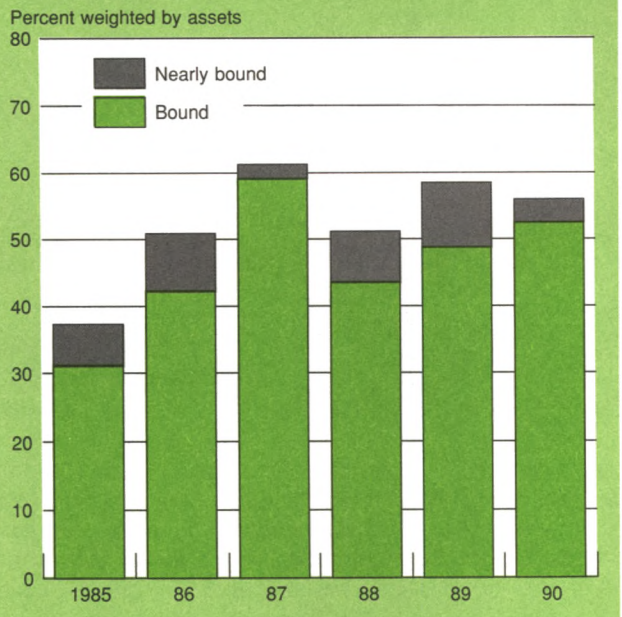
[10]Reserve requirements on domestic liabilities range as high as 12 percent in some cases (sight liabilities of more than DM 100 million). Under an extended compensation regulation, however, foreign currency liabilities to nonresidents in an amount equal to the book value of corresponding claims in foreign currency with maturities less than four years are exempt from reserve requirements.

[11]The JOM in Japan is modeled after the IBF (international banking facility) in the United States. In addition to the reserve requirement exemption, such facilities are also exempt from deposit insurance, withholding/stamp taxes, and some income taxes. Moreover, they face no ceiling on deposit rates.

[12]The distribution of assets across banks in the Cayman Islands further attests to the advantage enjoyed by foreign banks in

Chart 4

Share of U.S. Branches and Agencies of Foreign Banks Bound by the Eurodollar Reserve Requirement



Source: Federal Reserve Form 2951.

Notes: Data are for Second District banks only, for October of each year. Banks that had a positive net Eurodollar liability with related institutions are bound by the reserve requirement. Banks that had a small net "due from" position with related institutions (less than 1 percent of their total assets) are classified as "nearly bound."

Table 3

The Ratio of Commercial and Industrial Loans Booked Offshore to Those Booked in the United States

1990; Billions of Dollars Except As Noted

	Loans Booked Offshore	Loans Booked Onshore	Ratio (Percent)
Banking institutions not chartered in the United States	147	127	116
U.S.-owned banks	22	454	5
U.S. subsidiaries of foreign banks	1	52	2

Source: See Table 1.

Note: Because reserve requirements were removed in 1991, 1990 data are provided for reference.

Table 4

External Positions of Banks in the Cayman Islands in December 1990

	Claims on Banks	Claims on Nonbanks
Claims on residents of all countries (billions of dollars)	235	198
Claims on U.S. residents (billions of dollars)	106	134
As a share of total claims by all banks in the Cayman Islands (percent)	45	68
As a share of total overseas claims on U.S. residents (percent)	19	49
Share of banks not chartered in the United States (percent)	77	85

Sources: National sources; Bank for International Settlements, *International Banking and Financial Market Developments.*

loans to nonbanks booked in the Cayman Islands were to U.S. addressees in 1990, and these loans amounted to nearly 50 percent of all offshore loans made to U.S. nonbanks.

As an aside, we note that foreign banks from different countries took varying advantage of the regulatory arbitrage possibilities (Chart 5). Japanese banks, which had the biggest cost of capital advantage, engaged in regulatory arbitrage the least—perhaps, as suggested below, owing to the home country authorities' views. Japanese banks accounted for only 5 percent of nonbank loans made by all foreign banks in the Cayman Islands, as opposed to 72 percent of the commercial and industrial loans made by all foreign branches and agencies in the United States. Continental banks, by contrast, appear to have exploited arbitrage opportunities.

The Japanese banks' small share of foreign bank assets in the Cayman Islands suggests that the Japanese share of the U.S. commercial banking market is overstated by loans booked in the United States. For example, adding estimated commercial loans booked in the Cayman Islands to those booked in the United States reduces the Japanese share in foreign bank loans to U.S. corporations from 60 percent to 40 percent.[13]

To be sure, Japanese banks stood out in the 1980s for their increasing market share of U.S. commercial lending. But contrary to the view that Japanese firms take every opportunity to gain advantage over their U.S. competitors, in this case the Japanese banks placed a slow third behind European and Canadian banks in exploiting shell branches.

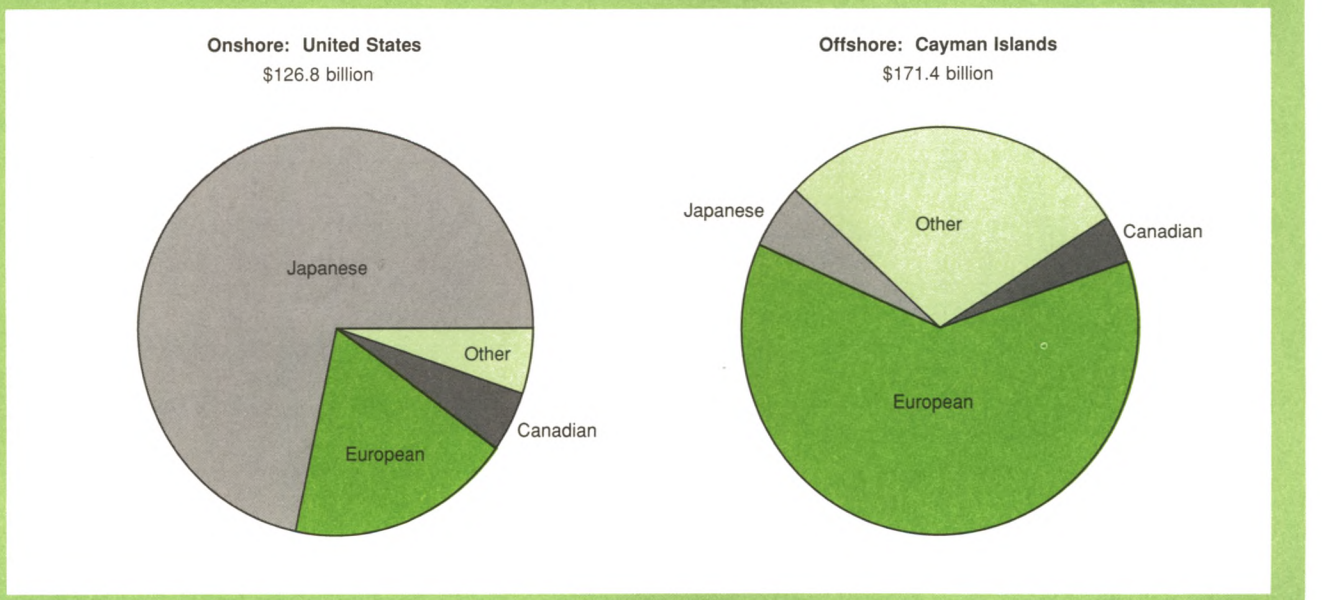
Footnote 12 continued
booking loans offshore: 85 percent of these loans were booked by non-U.S. banks. U.S.-chartered banks might have realized tax advantages from booking loans in the Caymans, but such banks could not thereby avoid the reserve requirements.

[13]This calculation assumes that the Japanese share in loans to U.S. corporations made by all foreign banks in the Cayman Islands is the same as the Japanese share in all nonbank loans made by foreign banks in the Cayman islands.

Chart 5

Loans by Foreign Banks in the United States and Cayman Islands

By Nationality of Bank, Year-End 1990



Sources: Federal Financial Institutions Examinations Council, Reports of Condition; national sources.

Notes: Onshore loans are commercial and industrial loans by foreign banks' branches and agencies in the United States. Offshore loans are claims on all nonbanks by foreign banks in the Cayman Islands.

Did the configuration of onshore and offshore rates favor offshore booking?

At the beginning of the 1980s, U.S. wholesale certificate of deposit rates were substantially below the Eurodollar rate, that is, the London Interbank Offered Rate (LIBOR). In this circumstance, most foreign banks could fund a loan most cheaply in the U.S. money market, even if the foreign bank had to pay a Yankee premium (a premium paid by foreign banks to raise funds in the United States) of 5 basis points and to post the 3 percent reserve requirement.[14] Indeed, in the early 1980s, banks in the United States arbitraged the New York and London dollar markets by raising funds in the former and placing funds in the latter and thereby accumulated a net claim on their affiliates abroad.[15]

Through the 1980s, however, rates in the New York money market rose relative to those in the London dollar market (Charts 6A and 6B). This change in relative rates was consistent with first the cessation of net bank outflows from the United States and then the reflux of net bank funds into the United States, both of which helped to finance the U.S. current account deficit. The reflux tended to make the Eurodollar reserve requirement bind.

Beginning in 1984 and regularly after 1985, a foreign bank choosing between (1) booking a U.S. corporate loan onshore and funding it with a reservable deposit and (2) booking the loan offshore and funding it with an unreservable Eurodollar deposit (see appendix) faced a new incentive. Booking a loan to a U.S. company offshore and funding it without holding any reserve became the course that would minimize funding costs. (From 1984 on, the bold and dashed lines on Chart 6B are above the zero line, which represents LIBOR.) In 1989-90, it was cheaper to fund an onshore loan with a reservable Eurodollar than with a Yankee certificate of deposit, but it was still cheaper to book the loan offshore. (The dashed line in Chart 6B cuts below the bold line, but both remain above the zero line.) The cost saving of

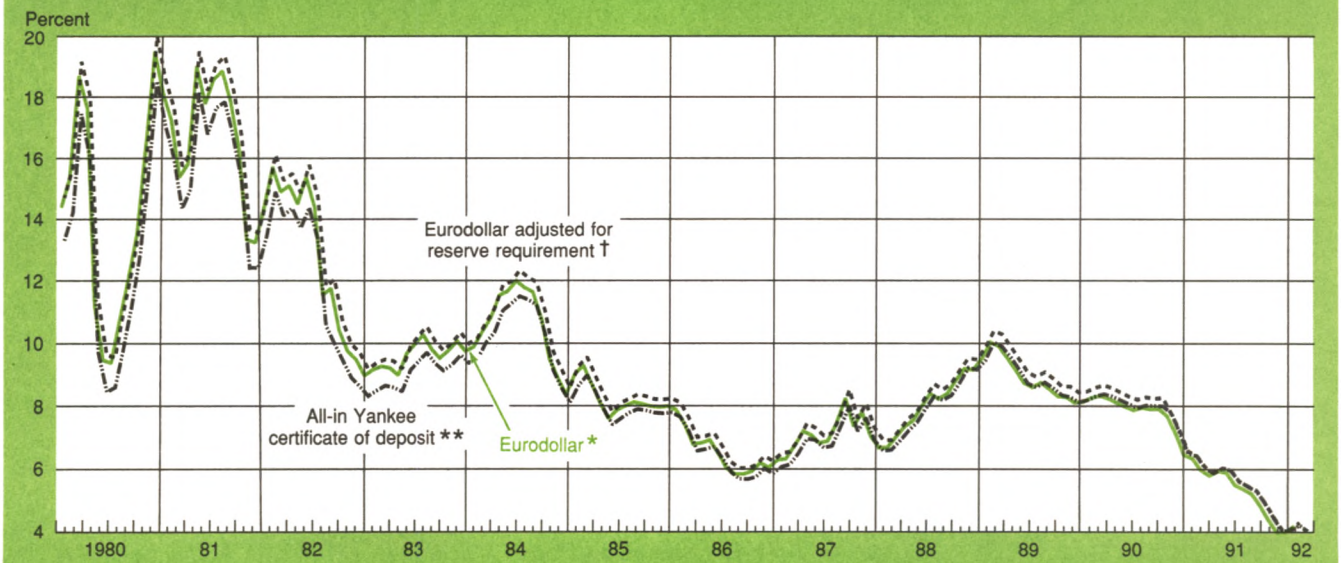
[14] See, for example, Marcia Stigum, *The Money Market* (Homewood, Illinois: Dow Jones-Irwin, 1983), p. 539. For a treatment of the foreign premium in the U.S. commercial paper market, see Robert N. McCauley and Lauren Hargraves, "U.S. and Eurocommercial Paper: Converging Money Markets?" Federal Reserve Bank of New York *Quarterly Review*, vol. 12 (Autumn 1987), pp. 24-35.

[15] See Lawrence L. Kreicher, "Eurodollar Arbitrage," Federal Reserve Bank of New York *Quarterly Review*, vol. 7 (Summer 1982), pp. 10-22.

Chart 6A

Onshore and Offshore Deposit Costs

Three-Month Interest Rates



* London interbank offered rate (LIBOR) for the dollar.

† LIBOR adjusted for 3 percent reserve requirement in effect until December 1990.

** U.S. certificate of deposit rate plus 5 basis point issuance costs and 5 basis point premium. Rate is also adjusted for 3 percent reserve requirement in effect until December 1990.

booking a loan offshore varied with the relationship between onshore and offshore rates, but it reached about a quarter of 1 percent (Chart 6B, shaded area).

In short, the opportunity to engage in regulatory arbitrage only became valuable to foreign banks in the United States as onshore rates rose relative to offshore rates. The more than doubling of the share of the U.S. commercial loans booked offshore by foreign banks in the years 1985-90 (Table 1) is consistent with our reading of how the rate configuration created opportunities for regulatory arbitrage.

Has the removal of the Eurodollar reserve requirement made a difference?

Once the Eurodollar reserve requirement was reduced to zero at the end of 1990, the growth of offshore loans slowed to a crawl after years of rapid growth. Loans booked at shell branches in the Cayman Islands actually fell for the first time in 1991 after growing steadily between 1983 and 1991 (Chart 1).[16] In addition, responses to inquiries prompted by sizeable changes in U.S. claims of weekly reporting branches and agencies suggest that a fair amount of shell branch loans have been rebooked into the United States—at least $12 billion between February 1991 and May 1992.

Although the incentives to book offshore have clearly declined, it may be premature to consider them nonexistent. Some foreign banks may fear that the reserve requirements lowered to zero in late 1990 might be raised again.[17] In addition, they may fear the imposition of the Federal Deposit Insurance Corporation insurance premia on their branches and agencies; bringing their loans onshore might increase some future burden. Finally, not only regulatory arbitrage but also tax arbitrage is a consideration in the booking of loans.

Why didn't foreign banks book all their loans offshore?

As we have seen, loans booked at U.S. offices of for-

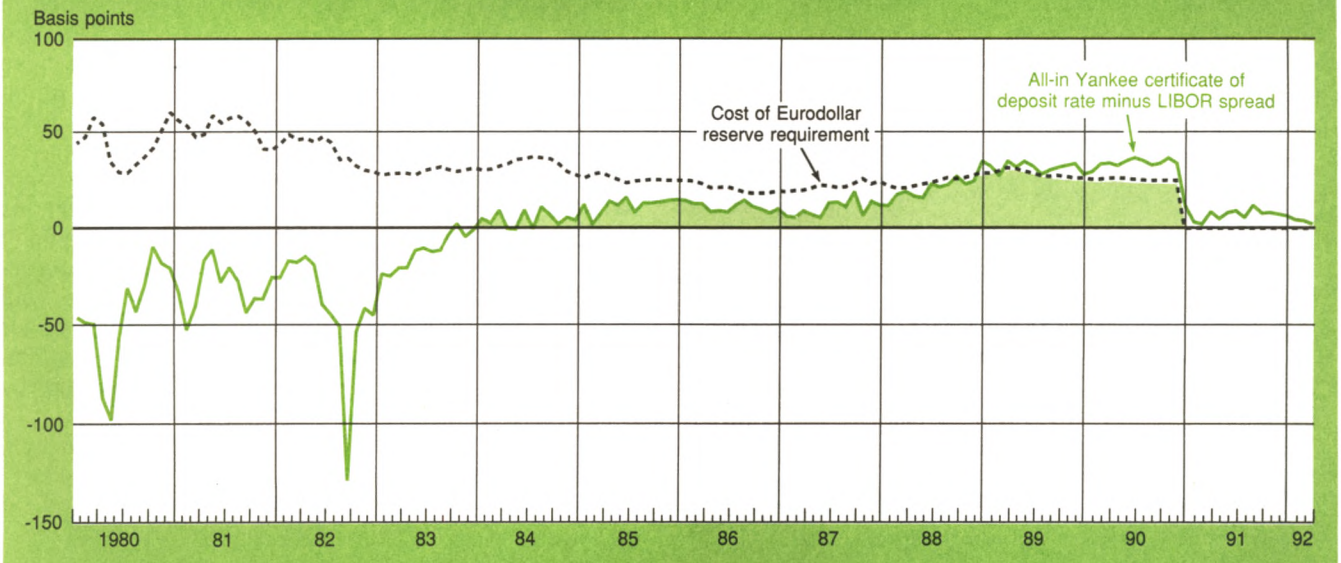
[16]Some rebooking occurred on the liability side of the balance sheet. Some foreign banks that had not been bound by the Eurodollar reserve requirement found it cheaper to fund U.S. loans with unreservable Eurodollars as long as Yankee certificates of deposit were reservable. But once large nonpersonal time deposits, including Yankee certificates of deposit, were no longer reservable, these banks compared Eurodollar rates directly with the rates on Yankee certificates of deposit and found the latter attractive. If these banks were large, well-rated foreign banks with little paper outstanding in the U.S. market, money market mutual funds may

Footnote 16 continued
not have imposed on them much of a premium over the best U.S. banks' rates. See "Monetary Policy Report to the Congress," *Federal Reserve Bulletin*, vol. 77 (September 1991), p. 701.

[17]Regulation D sets a range of reserve ratios on Eurocurrency liabilities and transaction and nontransaction accounts. In 1991 the Federal Reserve Board determined that these ratios would be reduced to zero for Eurocurrency liabilities and all nontransaction accounts, but it did not *eliminate* reserve requirements. An act of law is not required to reinstate these requirements.

Chart 6B

Spread between Cost of Reservable Deposits and LIBOR



Sources: Federal Reserve Bank of New York; Board of Governors of the Federal Reserve System.

eign banks continued to expand in the late 1980s, and banks from different countries appear to have taken varying advantage of the opportunity to book loans offshore. These developments prompt us to ask why foreign banks as a group did not take fuller advantage and why some seem to have taken advantage more than others.

At the outset, recall that all foreign banks were not bound by the Eurodollar reserve requirement: only about half the foreign banks were (Chart 4). In other words, about half the foreign banks could fund a loan at the margin with Eurodollars and not pay any reserves.[18]

Still, foreign banks and agencies did hold a Eurodollar reserve in the amount of $485 million as of October 15, 1990. At a 3 percent reserve ratio, this sum translates into over $16 billion of loans that might have been profitably rebooked offshore. Two rather tentative explanations may be offered.

First, some banks may have sought to avoid discussion with federal or state tax authorities over offshore loans. This consideration may apply particularly to Cayman Island shell branches managed in New York.

Second, some foreign banks bound by the Eurodollar reserve requirement may have been reluctant to book at Caribbean shell branches out of bankerly caution and the fear of official opprobrium. Over the years, the Federal Reserve has discouraged U.S. banks from using shell branches to relocate deposits and loans alike because of the implications for monetary control. Other authorities did not view shell branches with enthusiasm: the Japanese authorities were slow to authorize branches in the Cayman Islands, and perhaps as a consequence, Japanese banks used this option relatively little.[19] Italian banks may be underrepresented in the Cayman Islands owing to official discouragement before and after the Banco Ambrosiano affair.[20]

[18]For instance, foreign bank branches in the first half of 1991 were replacing unreservable Eurodollar funding with newly unreservable domestic liabilities (see footnote 16). These branches sold such a large volume of Yankee certificates of deposit that growth in M3 was distorted during this period.

[19]Bank of Tokyo was the first to have a branch in the Cayman Islands. Nippon Long Term Credit Bank followed in 1982, Sumitomo Trust in 1983, and Sumitomo Bank in 1984. Subsequently, two banks started operations in 1986, one in 1987, five in 1988, and two in 1989.

[20]A freeze was imposed on subsidiaries of Italian banks in countries where the supervisory structure was inadequate and where the Bank of Italy did not have access to aggregate information. This freeze was lifted only in 1986 for reasons of international competitiveness. Although there was no explicit freeze on branches and agencies, shell branches in offshore centers of Italian banks were largely authorized after 1986. According to a 1982 study, Japanese and Italian banks had a very limited presence in the Caribbean. See Henry S. Terrell and Rodney H. Mills, Jr., "International Banking Facilities and the Eurodollar Market," in

How large was the cost advantage from regulatory arbitrage in relation to the cost of capital advantage of foreign banks?

On balance, the cost saving from regulatory arbitrage was smaller than foreign banks' cost of capital advantage. At most, foreign banks saved 26 basis points from funding with unreserved Eurodollars rather than with reservable Yankee certificate of deposit rates. Over the period 1987-90, the cost saving averaged no more than 15 basis points. Only for British and Canadian banks did the savings approach the size of their modest cost of capital advantage. For Continental and especially Japanese banks, the passing advantage from regulatory arbitrage was quite small in relation to the measured cost of capital advantage. Certainly the large gains in market share in U.S. commercial lending were won by Japanese and Continental banks, as one would expect if the cost of capital differences had dominated regulatory arbitrage.

Reassessing the growth of corporate credit in the 1980s

Offshore bank loans to U.S corporations grew at a rate faster than onshore loans until the U.S. reserve requirements on wholesale deposits were reduced to zero at the end of 1990.[21] Since the policy change, offshore loans have continued to grow faster than the aggregate of onshore loans, but at a rate lower than that of onshore loans extended by branches and agencies of foreign banks.

As argued above, the relatively fast growth of offshore loans in the late 1980s reflected reserve incentives that came into play only as offshore dollars cheapened in relation to onshore dollars and as banks in the United States tapped their foreign offices for funds. Behind these forces lay a U.S. current account deficit that placed dollar wealth in the hands of foreign investors who were more prepared than U.S. residents to hold Eurodollars.

Whatever its causes, rapidly growing and substantially unaccounted offshore credit to U.S. corporations has obscured the profile of U.S. corporate leveraging in the 1980s and the deceleration and decline in corporate borrowing since 1989. Again, the flow of funds data (Chart 7, broken line) serve as the point of reference for our restatement of bank credit (Chart 7, solid line). The difference between credit growth as measured by

Footnote 20 continued
Paolo Savona and George Sutija, eds., *Eurodollars and International Banking* (New York: St. Martin's Press, 1985), p. 188.

[21]Thus, before the reserve change, offshore lending never reached a mature phase of balanced growth in comparison to onshore lending. See Robert Z. Aliber, "The Integration of the Offshore and Domestic Banking System," *Journal of Monetary Economics*, vol. 6 (1980), p. 520.

the flow of funds data and credit growth according to our estimate widened fairly steadily after 1985 (Chart 7). When we use the more comprehensive figure for offshore bank credit to U.S. corporations, the growth of corporate bank debt in the years of the merger and acquisitions boom of the 1980s emerges as even higher than conventional measures have suggested.

With a closer approximation of offshore loans, bank credit appears less squeezed after 1989. That is, the more inclusive measure of bank credit shows considerably less shrinkage in 1991—1 percent by our estimates, as opposed to 14 percent according to conventional measurement. By the same token, we estimate that bank credit also decelerated less after 1989 than has generally been believed. When offshore loans are taken into account, foreign banks provided a greater offset to the contraction of credit by U.S. chartered banks than has been appreciated.

Import of offshore lending to U.S. firms for securitization

The existence of a substantial sum of generally unrecognized bank loans to U.S. corporations means that the rise in corporate reliance on securities markets for borrowed funds in the 1980s has been overstated. We compute the ratio of funding from the securities markets—mostly corporate bonds, but also commercial paper and bankers' acceptances—to funding from intermediated sources—banks and finance companies. We calculate this ratio in two ways: first, using the offshore loans as captured by the U.S. balance of payments data in the flow of funds accounts (Chart 8, broken line); second, using the offshore loans as we have computed them (Chart 8, solid line). Our calculations suggest that the ratio of securities borrowing to intermediated corporate credit rose less in the 1980s than conventional measures have indicated.

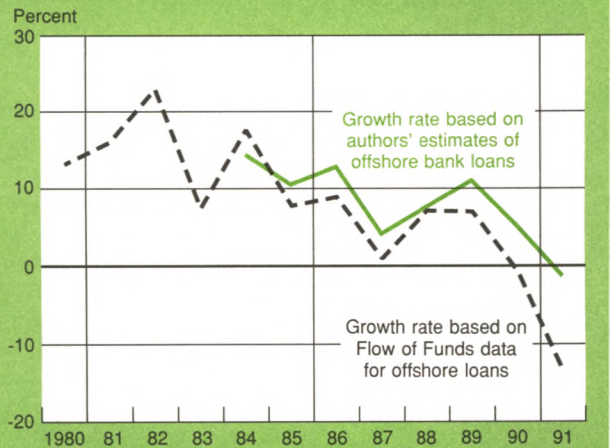
Conclusions

In the latter half of the 1980s, U.S. reserve requirements interacted with money market interest rates to give foreign banks an incentive to book loans offshore. The rapid growth in this offshore component of foreign loans was in part missed by the U.S. reporting system, notwithstanding improvements in that system. This article argues that bank lending to U.S. corporations in the 1980s rose more rapidly, and securitization proceeded more gradually, than conventional measures have suggested. When the foreign loans booked offshore are estimated more comprehensively, foreign penetration of the U.S. market for commercial and industrial loans emerges as more extensive than generally recognized.

Chart 7

Growth in Bank Debt of U.S. Nonfinancial Corporations

Annual Growth Rate

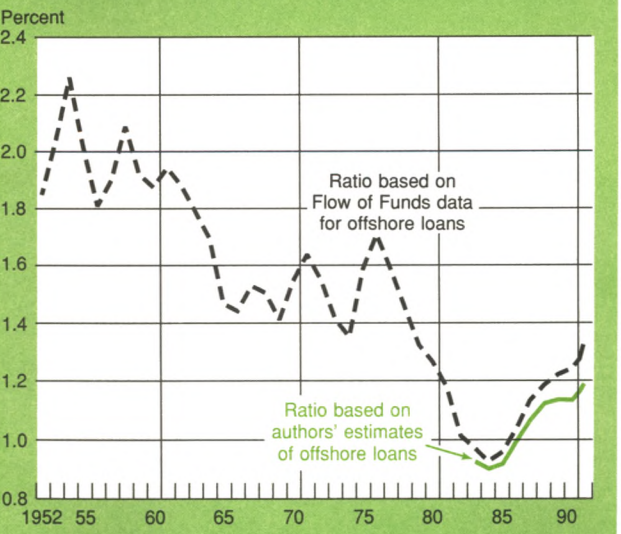


Sources: Board of Governors of the Federal Reserve System, Flow of Funds; sources in Table 1.

Chart 8

Ratio of Securities to Loans

Nonfinancial, Nonfarm Corporate Business



Sources: Board of Governors of the Federal Reserve System, Flow of Funds; sources in Table 1.

Note: Ratio is the sum of outstanding bonds, commercial paper, and bankers' acceptances divided by the sum of outstanding bank loans and finance company loans.

Appendix: Loan Booking by a Foreign Branch—Onshore or Offshore?

This appendix shows how the configuration of New York and London dollar money market rates interacted with the Eurodollar reserve requirement to provide an incentive for offshore booking. Rates characteristic of 1984 and 1989 will be examined under the assumption, first, that the Eurodollar reserve did not bind and then that it did. We begin with the configuration of rates in 1984:

$$\left.\begin{aligned} CD^{US}_{1984} &= 10.3 \text{ percent} \\ E\$_{1984} &= 10.8 \text{ percent} \\ RR^{CD} \\ RR^{E\$} \end{aligned}\right\} = 3 \text{ percent,}$$

where CD^{US}_{1984} is the secondary market yield of New York three-month certificates of deposit of prime U.S. banks, $E\$_{1984}$ is the Eurodollar offered rate payable by major internationally active banks for three-month deposits in London, and RR^{CD} and $RR^{E\$}$ are, respectively, the required reserves against large nonpersonal time deposits and required reserves against net Eurodollar liabilities.† We estimate that foreign banks had to offer a premium on their certificates of deposit of 5 basis points; this so-called Yankee premium was consistent with the extra yield offered by foreign commercial paper issuers and reflected the same home-name preference on the part of managers of money market mutual funds, managers of trust accounts, and others.‡ In addition, we assume that issuing costs amount to another 5 basis points.

The foreign bank maximizes profit for a given yield on a loan by booking it where it can be funded most cheaply. The foreign branch faces an incentive to book a loan to a U.S. resident offshore if:

cost of offshore booking and funding < cost of onshore booking.

This inequality will hold if

Cost of offshore booking and funding < minimum of { cost of onshore booking and onshore funding or cost of onshore booking and offshore funding }

or if

$$E\$_{1984} < \min\left\{\frac{(CD^{US}_{1984} + .05 + .05)}{(1 - RR^{CD})}, \frac{E\$_{1984}}{(1 - RR^{E\$})}\right\}.$$

If the branch was not bound by the Eurodollar reserve requirement in 1984, the booking choice became:

$$10.8 \overset{?}{<} \min\left\{\frac{(10.3 + .05 + .05)}{(1 - .03)}, \frac{10.8}{(1 - 0)}\right\},$$

or

$$10.8 \overset{?}{<} \min\ \{10.7, 10.8\}.$$

Since the inequality did not hold, the unbound branch faced no incentive for offshore booking. Onshore booking and funding minimized cost.

If the branch was bound by the Eurodollar reserve requirement, offshore funding of the loan booked onshore became more expensive:

$$10.8 \overset{?}{<} \min\left\{\frac{(10.3 + .05 + 0.5)}{(1 - .03)}, \frac{10.8}{(1 - .03)}\right\}$$

or

$$\overset{?}{<} \min\ \{10.7, 11.1\}.$$

Since onshore booking and funding remained the least costly choice, the foreign branch faced no incentive for offshore booking. The New York market remains the cheapest source for dollars whatever the reserve position of the foreign branch. The net claim position of U.S. banks against their foreign branches is consistent with this observation.

Now revisit the problem in 1989:

$$CD^{US}_{1989} = 9.0 \text{ percent}$$
$$E\$_{1989} = 9.1 \text{ percent,}$$

and RR^{CD} and $RR^{E\$}$ are unchanged. The unbound branch checked

$$9.1 \overset{?}{<} \min\left\{\frac{(9.0 + .05 + 0.5)}{(1 - .03)}, \frac{9.1}{(1 - 0)}\right\}$$

$$9.1 \overset{?}{<} \min\ \{9.4, 9.1\}.$$

and concluded again that the strict inequity did not hold. The unbound branch was indifferent between onshore or offshore booking but found it cheaper to fund offshore. Thus the unbound branch tended to become a bound branch.

The bound branch checked

$$9.1 \overset{?}{<} \min\left\{\frac{(9.0 + .05 + 0.5)}{(1 - .03)}, \frac{9.1}{(1 - .03)}\right\}$$

$$9.1 \overset{?}{<} \min\ \{9.4, 9.4\}.$$

†See "Revision of Regulation D," *Federal Reserve Bulletin*, vol. 66 (September 1980), pp. 758-73.

‡Robert N. McCauley and Lauren A. Hargraves, "Eurocommercial Paper and U.S. Commercial Paper: Converging Money Markets," Federal Reserve Bank of New York *Quarterly Review*, vol. 12 (Autumn 1987), pp. 24-35.

Appendix: Loan Booking by a Foreign Branch—Onshore or Offshore? *(Continued)*

Since the strict inequity held, the bound branch faced an incentive to book offshore. Convergent onshore and offshore rates interacted with the Eurodollar reserve requirement to induce offshore booking. Note that, according to the last two calculations, foreign branches not bound by the Eurodollar reserve requirement faced the greatest cost incentive *not* to sell Yankee certificates of deposit. And it was precisely these banks that increased their Yankee certificates of deposits outstanding when reserve requirements on such deposits were removed.[§]

Although no foreign branch would have had reason in 1989 to sell a Yankee certificate of deposit, certificates were in fact sold. The puzzle of foreign branch behavior is somewhat like the question why foreign banks did not book all their loans offshore. Recognizing the cost and time required to gain acceptance in domestic U.S. portfolios, banks may not have been quick to withdraw in response to a particular rate configuration that might prove temporary. In addition, the possibility of liquidity problems in the London deposit market that would not affect the New York dollar market would discourage extensive reliance on either market, given reasonable rate differentials.[‖]

[§]The banks' switching from offshore to onshore liabilities affected M3 so noticeably that their behavior merited special attention in Chairman Greenspan's Humphrey-Hawkins testimony in mid-1991. "Monetary Policy Report to the Congress," *Federal Reserve Bulletin*, vol. 77 (September 1991).

[‖]See *Recent Changes in Liquidity Management Practices at Commercial Banks and Securities Firms* (New York: Federal Reserve Bank of New York, 1990).

The New York City Recession

by David Brauer and Mark Flaherty

The New York City economy is now mired in its deepest slump since the mid-1970s. In the first quarter the city unemployment rate reached 10.5 percent, the highest rate in fifteen years, and substantially above the national average. Between April 1989 and March 1992, payroll employment declined by 9.9 percent, reversing all of the progress made during the 1980s.[1] This article examines the origins, scope, and sectoral profile of the New York City recession. In addition, we document the buildup of imbalances in the economy before the downturn and discuss the extent to which these imbalances have been alleviated.

Although the city's recession originated in the finance, insurance, and real estate (FIRE) sector, it subsequently spread to every major sector except health care. The local recession began in the spring of 1989 and intensified when the national economy slipped into recession in July 1990. After city employment lagged significantly behind both suburban and national employment even during the period of expansion, job losses during the recession greatly exceeded those experienced by the rest of the nation but were only slightly worse than those of the suburbs. Our analysis suggests that roughly two-thirds of New York's employment loss in the recession reflects city- and area-specific factors, with the national recession accounting for the remaining one-third. Finally, we find that imbalances generated during the expansion of the 1980s, including high and rising labor costs and excess office capacity, were only partially corrected as of the end of 1991.

[1]All employment figures in this article are seasonally adjusted by the authors. See the appendix for details.

The scope of the current recession

To understand the origins and scope of the New York City recession, one must examine developments in the preceding decade. Between 1977 and 1987, employment in the city grew at an average annual rate of 1.2 percent, with much of this growth fueled by expansion in the financial sector. The recessions of the early 1980s had only minor and short-lived effects on employment in the city. Until 1987, it appeared that the boom would continue indefinitely.

The city's prospects, however, changed dramatically with the October 1987 stock market crash. The subsequent slump can be divided into four phases (Chart 1). Employment grew very slowly for a year and a half following the crash. In the second phase, beginning in April 1989, employment in the city turned down, falling by 1.5 percent. The downturn reflected declines in construction, FIRE, trade, and manufacturing. The decline in the New York City economy, however, was somewhat milder than that of the surrounding region. The third phase is defined by the national recession, which began in the summer of 1990 and apparently ended in the spring of 1991. During this period, employment in the city fell a further 4.7 percent. The most recent phase is characterized by a continuing slide in city employment despite a stabilization in national employment. Overall, since April 1989, total employment in the city has fallen 9.9 percent, with weakness in every major sector except health services (Table 1).

Notwithstanding the sharp decline in employment during the current recession, at this time comparisons with the recession of the mid-1970s are overdrawn. Between 1973 and 1976, employment fell by roughly the

same amount as in the current recession, but in 1973 employment was already about 7 percent below its 1969 peak. Thus the total decline during the city's long slump in the 1970s was nearly twice as large as in the current recession to date. Nevertheless, while the earlier recession was indeed much longer and deeper, the *rate* of job loss has been significantly faster in the current recession.

Sectoral effects

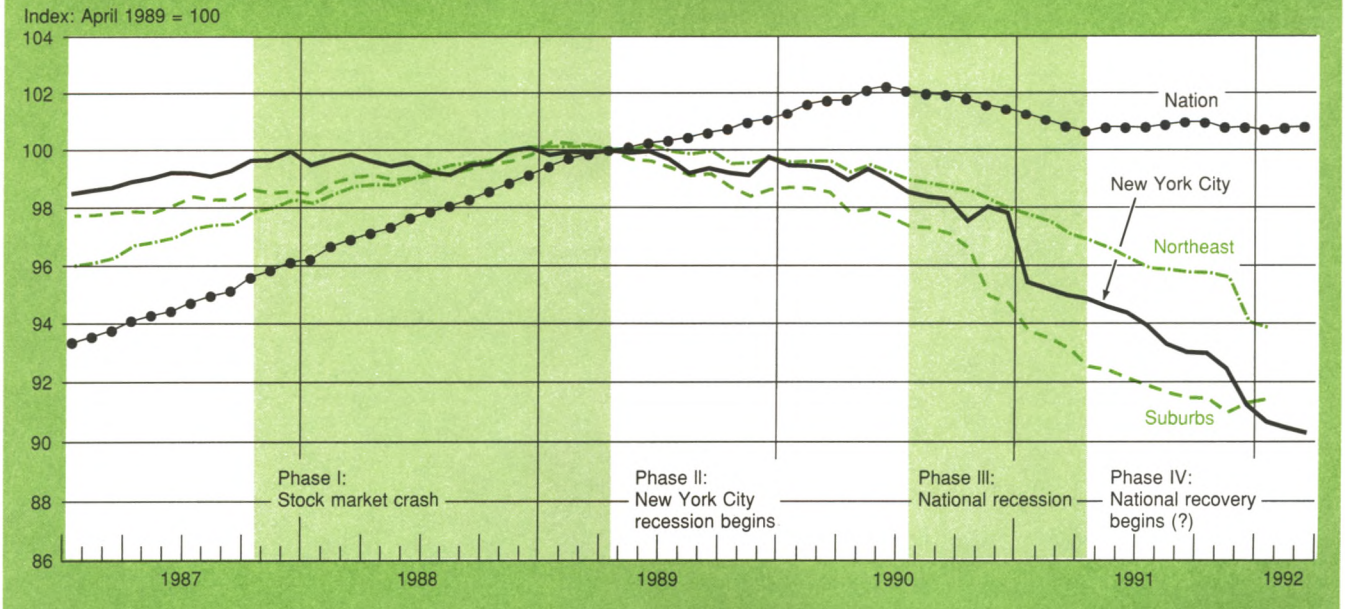
A look at the recession's impact on employment by sector is instructive. In the 1969-77 downturn, manufacturing accounted for nearly half of New York City's employment losses, while in the current recession it is responsible for only about 20 percent of the decline in employment. This difference reflects not only a smaller percentage decline in manufacturing output in the current period, but also the much smaller role of manufacturing in the local economy. Manufacturing's current share of total New York City employment is less than half that of 1969, with only printing and publishing and apparel maintaining a significant local presence (Table 2). The decline in manufacturing's importance mirrors broad national trends, but the structural changes in the New York City economy are also related to such city- and region-specific factors as high taxes, land and labor costs, and a deteriorating infrastructure.

Another significant difference between the current and earlier downturns concerns the performance of the service sector. Total service employment (excluding financial services) in the city has fallen by 5.4 percent since April 1989, with business services accounting for virtually all of the decline. Compared with other sectors, services have declined modestly in percentage terms, but because services now account for nearly a third of total employment in New York City, the weakness in this sector has been an important contributor to the overall employment decline. By contrast, during the 1970s recession, services were the only pocket of strength: between 1969 and 1977, services employment was virtually unchanged.

The FIRE sector accounts for about 15 percent of city employment, a figure more than double the national share. FIRE's overall role in the New York City economy, however, is even greater. Financial services accounted for about a third of the 400,000 new jobs created in the city between 1977 and 1987. In addition, growth in the financial sector indirectly boosted city employment in several ways. Business and other services catering to the financial sector benefited. Incomes generated in the financial sector also spilled over into consumer spend-

Chart 1

Employment Trends since the Stock Market Crash



Sources: New York State Department of Labor and Bureau of Labor Statistics.

Note: All data are seasonally adjusted.

ing, helping to arrest a long decline in retail trade employment. Likewise, much of the revival of construction activity can be linked directly or indirectly to financial services.

The close relationship between financial services and the health of the New York City economy explains why the October 1987 stock market crash was such a critical turning point. Over the next year and a half, FIRE employment fell sharply, the growth of business and related services and retail trade slowed significantly, and no major new construction projects were undertaken. Even though the pace of layoffs on Wall Street slowed by 1989, these ripple effects, together with the slowdown in national economic growth, helped push the local economy into recession.

Industrial composition and employment growth

Despite the local recession's severity, there is no evidence that the city suffers from a mix of industries that have experienced weaker than average long-term growth. On the contrary, a favorable industrial composition partially explains the city's strong performance between 1977 and 1987. In particular, services and FIRE, which during this period grew more rapidly than other sectors nationally, constituted more than a third of 1977 city employment, compared with only a fourth of national employment. At the same time, the shrinking manufacturing sector represented a much smaller fraction of employment locally than nationally. In fact, had the 1977 New York City economy shown the same employment shares as the national economy, city employment during this period would have grown at an annual rate of only 0.7 percent, a figure just over half the actual 1.2 percent growth rate.[2] Furthermore, the underrepresentation of cyclically sensitive industries in the New York City economy suggests that sectoral composition alone cannot explain the city's recession.

Table 3 provides a rough accounting of the employment declines during the New York City recession. Since the start of the local recession, employment in the city has declined at a 3.5 percent annual rate, representing a 4.7 percentage point decline in growth relative to the 1977-87 expansion. The suburbs have also suffered a great deal, with employment falling at a 3.2 percent rate since April 1989. Thus, unlike the 1969-77 downturn, when the suburbs grew during the city's recession, the current downturn seems to reflect regional rather than purely city-specific difficulties. Because growth in both the city and the region has fallen roughly 3 percent more than at the national level, we infer that region-specific problems account for about two-thirds of New York City's employment decline. The national slowdown is also partly responsible: employment growth nationally (excluding the New York metropolitan area) has slowed 1.7 percentage points, accounting for roughly a third of the city's employment losses relative to the 1977-87 trend.

Continuing economic imbalances

The city's rapid growth during the 1980s brought with it

Table 1
Employment Growth by Sector, New York City
Percent Change

	1969-77	1977-87	April 1989-March 1992†
Total‡	−16.1	12.6	−9.9
Construction	−39.3	85.0	−28.4
Manufacturing	−34.8	−29.5	−18.9
FIRE§	−10.8	32.7	−9.0
Services	0.4	41.5	−5.3
Business	N.A.	52.6	−22.6
Health	N.A.	26.8	10.8
Trade	−17.2	2.8	−16.6
Transport and utilities	−20.3	−16.7	−7.8
Government	−7.1	14.3	−3.6

†Values are seasonally adjusted, except for business and health services.

‡Total employment in New York City declined by 610 thousand between 1969 and 1977, increased by 402 thousand between 1977 and 1987, and declined by 357 thousand between April 1989 and March 1992.

§Finance, insurance, and real estate.

[2]The exact calculation is $\sum_{i=1}^{13} w_i e_i$, where w_i is defined as the proportion of the nation's employment accounted for by sector i in 1977, and e_i is the rate of employment growth in sector i in New York City between 1977 and 1987. The calculation includes the sectors shown in Table 1 as well as mining. Trade is divided into wholesale and retail, and manufacturing is divided into apparel, printing and publishing, and all other.

Table 2
Employment Shares
Percent

	New York City		Nation	
	1977	1991	1977	1991
Construction	2.0	2.9	4.7	4.3
Manufacturing	16.9	9.1	23.9	16.9
FIRE†	13.0	14.7	5.4	6.2
Services	24.6	32.6	18.6	26.4
Business	6.1	6.5	2.4	4.9
Health	5.8	7.9	5.6	7.6
Trade	19.5	16.6	22.5	23.3
Transport and utilities	8.1	6.5	5.7	5.3
Government	15.9	17.5	18.3	16.9

†Finance, insurance, and real estate.

high rates of price and wage inflation and a buildup of overcapacity in the real estate sector. These side effects of prosperity helped put a brake on the expansion and contributed to the length and severity of the current recession. As of the end of 1991, these imbalances appeared to have been only partially corrected, thus impeding a quick resumption of income and employment growth.

Table 3
Accounting for the Decline in New York City Employment Growth
Percent Change, Annual Rate

	1977-87	April 1989-Jan. 1992	Difference
(A) New York City	1.2	−3.5	−4.7
(B) Suburbs†	2.2	−3.2	−5.4
(C) Rest of nation	2.2	0.5	−1.7
(D) = (A)-(C) City versus nation	−1.0	−4.0	−3.0
(E) = (B)-(C) Suburbs versus nation	0	−3.7	−3.7
Memo: New York City compositional advantage	0.5	0.8‡	0.3

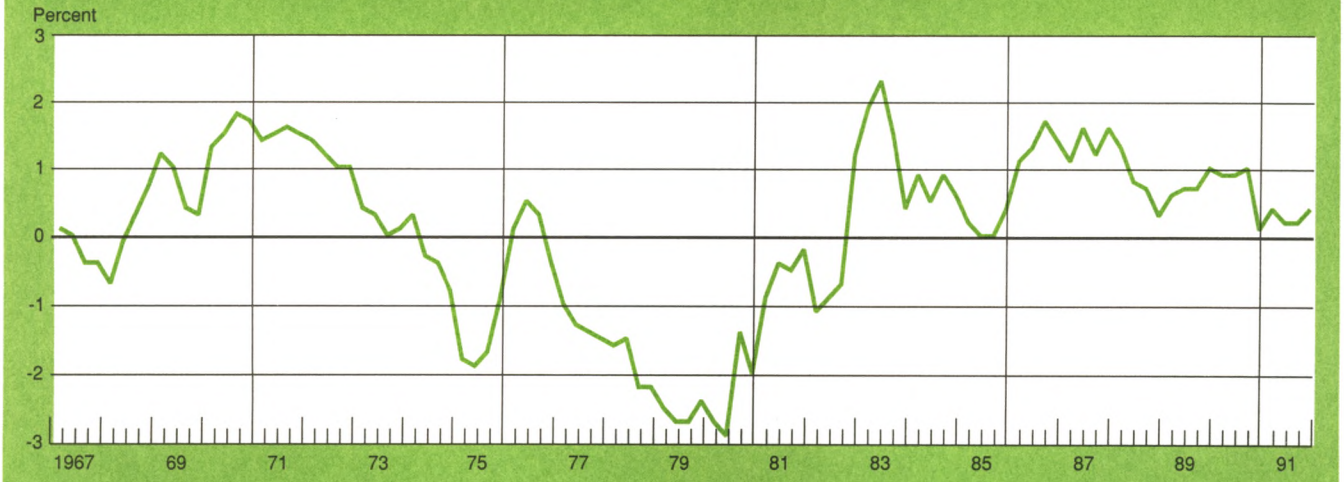
†Includes Nassau, Suffolk, Putnam, Rockland, and Westchester Counties in New York State; and Bergen, Essex, Hudson, Morris, Passaic, Sussex, and Union Counties in New Jersey.
‡1989-91 full year.

Wages and the cost of living

Despite the longer, deeper recession in the New York area, wage and price inflation here has not eased to the extent that it has nationally. In the past two decades, inflation in New York has exhibited two distinct trends (Chart 2). From 1972 to 1982, the area's slower than average growth was accompanied by a rate of inflation lower than that of the rest of the nation. After 1982, the trend was reversed. As the New York economy grew, inflation was consistently higher locally than nationally. Although the city entered the most recent recession earlier and fell deeper, its inflation has remained stubbornly higher. There are signs, however, that this trend may be ending. The gap in rates has narrowed from a high of 1.4 percentage points in 1987 to only 0.3 percentage points in the fourth quarter of 1991.

The link between wage and cost-of-living inflation has been evident in the pattern of local wages. Wages in New York City have for a long time been higher than those paid to comparable workers in the rest of the country. During the expansion of the 1980s, local wages rose even further relative to national averages. Between 1981 and 1991, manufacturing workers' average hourly earnings rose at an annual rate of 4.6 percent, compared with the national average of 3.4 percent. To be sure, the annual growth in local manufacturing wages has slowed to 2.8 percent, as against 3.1 percent nationally, since the end of the city's boom in 1987. But available data on various white-collar occupations in nonmanufacturing industries show no slowdown in labor

Chart 2
Consumer Price Inflation Differential: New York Area Compared with the United States



Source: Bureau of Labor Statistics.

cost inflation. For example, from 1987 to 1991, New York computer operators' wages grew 5.5 percent annually. Wages for clerical positions, including file clerks, word processors, and secretaries, rose even faster, at annual rates above 8 percent.[3]

Real estate markets

The real estate market clearly illustrates the boom and bust experience of New York. Home prices, commercial rents, and construction costs rose at rates considerably above the national average during the 1980s. Although significant progress has been made in unwinding the excesses caused by the boom, imbalances persist.

Residential home prices exploded during the early 1980s. The median single-family home in the New York metropolitan area sold for as much as $194,000 in 1988, more than double the national average and almost triple the median price in 1981 (Chart 3). Since then, prices have fallen considerably, dropping to $170,800 in the fourth quarter of 1991. Still, despite rising prices nationally, New York home prices remain about 70 percent above the national average. As a consequence, in the fourth quarter of 1991 the median family income in the New York area was only 64.3 percent of the income necessary to afford the mortgage on a median-priced home in the area. Although this "affordability index" shows an improvement over the mid-1990 level of 44.5, it remains far below the national average of 122.5.

After reaching high levels in 1988, commercial rents, too, have moderated. As of the fourth quarter of 1991, asking rents in the downtown and midtown areas have dropped 16 percent and 7 percent, respectively, since early 1988. Anecdotal evidence on effective rental rates, moreover, suggests even more marked drops in rental costs. Official statistics on rental rates likely mask the pattern of newly negotiated contracts, which would be expected to show a greater response to the depressed market. Despite falling rents, the vacancy rate for downtown office space has grown from just over 10 percent in 1987 to over 20 percent in the last quarter of 1991 (Chart 4). Such high and increasing levels point to excess capacity that has yet to be worked off.

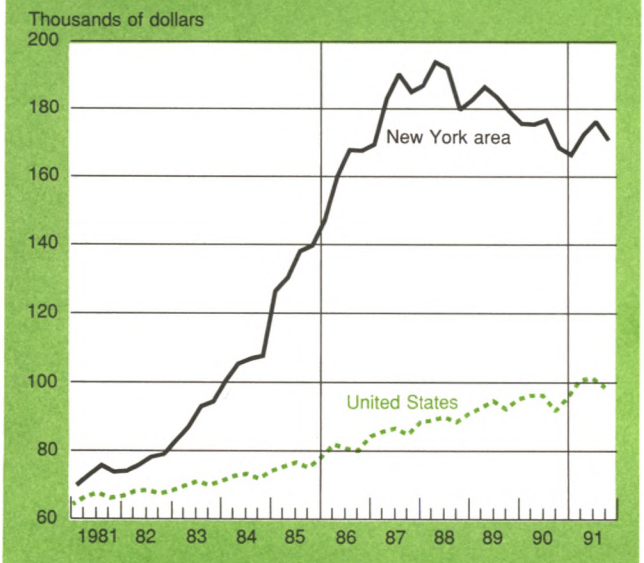
The boom in building during the 1980s was accompanied by accelerating construction costs. From 1977 to 1987, city construction costs rose at an annual rate of 6.8 percent.[4] Although construction cost inflation has slowed to a 4.5 percent rate since 1987, this deceleration has not matched the slowdown in the rest of the country. During 1991, city construction costs rose 3.0 percent, compared with 2.3 percent nationally, leaving the city's cost index 31 percent above the national average.

[3]Manufacturing wage data come from the New York State Department of Labor. The source of occupational wage data is the U.S. Department of Labor's Area Wage Survey.

[4]The cost measure is a weighted average of material costs, labor rates, and equipment rental rates indexed to a thirty-city average calculated by R.S. Means Inc., a private engineering consulting firm.

Chart 3

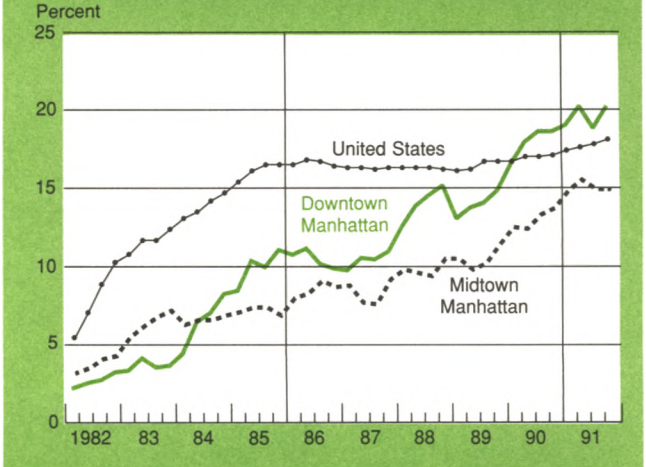
Median Home Prices



Source: National Association of Realtors.

Chart 4

Office Vacancy Rates



Source: Coldwell Banker.

Conclusion

Because FIRE sector firms are heavily represented in New York, the city benefited greatly from explosive growth in that sector during the 1980s. The stock market crash of 1987 sapped this sector of much of its strength and signaled coming economic difficulties. Financial sector weakness subsequently spread throughout the local economy. The local downturn has been exacerbated by the national recession and by the continuing decline in manufacturing employment.

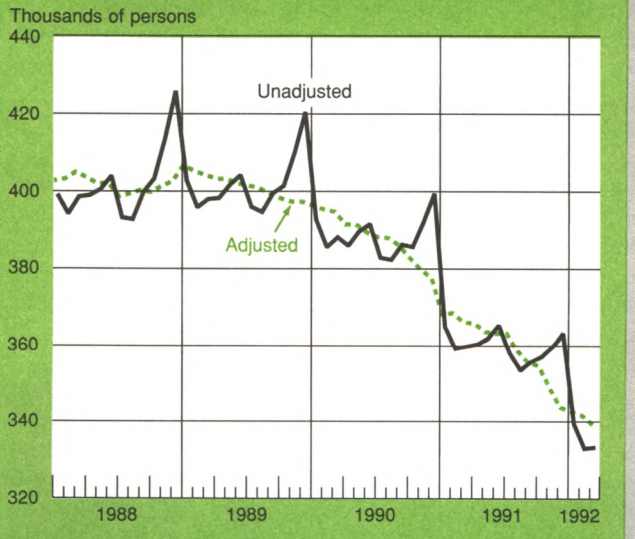
The boom brought on economic imbalances such as high cost inflation and speculative real estate markets. These imbalances have aggravated the recession and posed obstacles to recovery. Although the downturn to date has not matched the recession of the 1970s in its duration or severity, ongoing job losses and persistent economic imbalances mean that New York City's economic recovery is likely to be gradual.

Appendix: The Use of Seasonally Adjusted Data

Seasonal adjustment removes from a data series the effects of events that follow a regular seasonal pattern. This correction makes underlying trends and cyclical fluctuations in the data more apparent. In this article, we use the X-11 method, which assumes that the unadjusted series is the product of trend/cycle, seasonal, and irregular components.† The procedure is applied to employment totals to determine seasonal adjustment factors. The adjusted series is then calculated by dividing each month's unadjusted figure by the adjustment factor. For New York City and its suburbs, total employment is calculated by seasonally adjusting employment separately by industry and then aggregating.‡

To understand the value of such adjustments, consider New York City employment in retail trade. Employment tends to peak in December, then drop sharply in January, with a smaller dip typically taking place in July and August (see chart). Without seasonal adjustment, only comparisons between identical months in separate years would be meaningful. But by correcting for seasonal patterns, we can identify cyclical fluctuations or changes in the trend much more quickly. For instance, the adjusted data reveal that retail employment began to decline in the spring of 1989, but with unadjusted data a clear change in the trend cannot be detected until the fall of that year.

The Effect of Seasonal Adjustment on Retail Trade Employment



Sources: New York State Department of Labor (unadjusted data); authors' calculations (adjusted data).

†For most of its seasonally adjusted series, such as the national unemployment rate and payroll employment, the Bureau of Labor Statistics applies the slightly more sophisticated X-11 ARIMA (autoregressive integrated moving average) model.

‡The industries are construction, manufacturing, transportation and utilities, wholesale trade, retail trade, FIRE, services, and government. Wholesale and retail trade are combined in the suburbs.

Monetary Policy and Open Market Operations during 1991

Overview

During 1991, monetary policy was directed toward achieving the resumption of a sustainable economic expansion while making further progress toward price stability. The Federal Reserve implemented a series of easing steps early in the year against a backdrop of declining economic activity. Policy was unchanged from midspring through midsummer amid signs that activity was picking up. When the recovery faltered during the final months of the year, the Federal Reserve took more aggressive easing steps. At that time, credit demands and the broader monetary aggregates were weak, consumer confidence was dropping, and earlier efforts to reduce inflation were beginning to pay off.

The substantial degree of monetary accommodation brought about a considerable reduction in market interest rates. The Federal Reserve's easing steps lowered both the discount rate and the federal funds rate by 3 percentage points over the year. Yields on shorter term fixed-income securities fell by about as much, but those on longer term issues declined by much less. Longer term yields were propped up for much of the year by concerns over heavy supplies of debt and by fears that progress against inflation would be stymied as the economy revived.

Lower short-term market rates reduced the opportunity cost of holding liquid types of money and stimulated rapid growth in total reserves and M1, but growth in the broader monetary aggregates nevertheless was quite weak. The less liquid components of these aggregates, particularly time deposits, suffered in competition with a variety of alternative market instruments. Depository institutions did not bid aggressively for these deposits because of weak asset growth and continued industry consolidation. The combination of rapid growth in transactions deposits and declines in time deposits and other managed liabilities meant that M2 and M3 grew only modestly and ended the year near the bottom of their annual growth ranges.

The large interest rate declines helped reduce the heavy debt service burdens that many households and businesses had accumulated during the 1980s. Low rates and the mild improvement in the economy encouraged many investors to hold lesser rated fixed-income securities as well as equities. In this environment, many firms refinanced costlier outstanding debt. Some of the funds used to retire such debt came from stepped up equity issuance. On balance, the private component of nonfinancial debt grew exceptionally slowly during the year.

Implementation of the Federal Reserve's more accommodative policy stance took place against the background of the cut in reserve requirement ratios that took full effect in January 1991. The steep decline in required reserves brought balances held at the Federal Reserve below the levels many institutions needed to

Adapted from a report submitted to the Federal Open Market Committee by Peter D. Sternlight, Executive Vice President of the Bank and Manager for Domestic Operations of the System Open Market Account. Cheryl Edwards, Senior Economist, Open Market Analysis Division, and R. Spence Hilton, Senior Economist, Open Market Analysis Division, were primarily responsible for the preparation of this report under the guidance of Ann-Marie Meulendyke, Manager, Open Market Department. Other members of the Open Market Analysis Division assisting in the preparation were Robert Van Wicklen, Theodore Tulpan, and John Phelan. Cara Lown, Economist, Domestic Research Division, also assisted.

support comfortably their payments and clearing operations. The difficulties experienced by banks working with low reserve balances were especially acute early in the year when seasonal movements in required reserves and applied vault cash brought reserve balances at the Fed to their annual trough. In structuring its reserve operations around this time, the Federal Reserve's Trading Desk sought to ensure that reserves would be adequate for banks' clearing needs. Still, depositories' cautious management of reserves early in the day, intended to guard against running overnight overdrafts, sometimes generated temporary intraday pressure in the money market and helped make the federal funds rate unusually volatile.

These pressures abated after seasonal movements enlarged reserve balances at the Fed. In addition, with the expansion of M1, required reserves grew rapidly, and banks opened or enlarged required clearing balances, which earn credits that can be applied to payment for Fed services. Both developments helped maintain total reserves held at the Fed at more comfortable levels over the remainder of the year.

Borrowing from the discount window in 1991 continued to be heavily constrained by banks' concern that an institution identified as having tapped this facility would be perceived as being in financial difficulty. Many banks avoided the window for fear of the public scrutiny that could follow. Consequently, adjustment borrowing in 1991 usually hovered around exceptionally low levels, even allowing for the generally narrow spreads between the federal funds and discount rates. The reluctance to borrow diminished the value of the discount window as a safety valve for alleviating temporary reserve pressures. Moreover, the Desk, which bases its formal objectives for reserves on the presumption of a predictable relationship between the level of borrowing and the spread between the funds and discount rates, had to treat the borrowing assumption incorporated in its reserve objective very flexibly in formulating its operations.

Pressures in the reserve market, as measured by deviations in the funds rate from its expected level, were frequently at variance with the Desk's estimates of reserve availability. These differences often resulted from widespread market expectations that monetary policy would be eased. On other occasions, faulty reserve estimates—those available either to the Desk or to depository institutions—were the cause. Faced with these differences, the Desk frequently gave greater weight to trading conditions prevailing in the morning than to its reserve estimates when it structured its open market operations. With market participants closely monitoring the funds rate as a key indicator of policy, this approach to reserve management was intended to minimize the possibility that observers would misconstrue the Fed's current policy stance. By waiting to address reserve situations until conditions in the funds market reflected the estimated need, the Desk sometimes had to arrange very large repurchase agreements (RPs) late in a period. The dilemma between meeting estimated reserve needs and avoiding misleading market signals was more severe when the conflict persisted on settlement days. In some instances, the Desk eschewed meeting its formal objectives. As a result, the funds rate sometimes plummeted. On other occasions, the funds rate surged, forcing heavy borrowing at the discount window.

The Federal Reserve Bank of New York's approach to choosing primary dealers—dealers who act as business counterparties for conducting open market operations—came under scrutiny during the year after Salomon Brothers, a major dealer firm, admitted to bidding irregularities in Treasury auctions. In the wake of these admissions, the Treasury, Securities and Exchange Commission, and Federal Reserve undertook a joint review of various aspects of the U.S. government securities market, including the Treasury's auction process and the Fed's methods for selecting and monitoring primary dealers. As a result, the Treasury made several changes in auction bidding rules, and the Treasury and Federal Reserve developed procedures to verify the authenticity of large customer bids. In addition, in January 1992, the Federal Reserve announced changes in the administration of its relationships with primary dealers. To provide for a more open system of trading relationships, the Fed dropped the requirement that a primary dealer maintain a market share of at least 1 percent of total customer activity reported by all primary dealers. It also discontinued its dealer surveillance activities to help make clear that the Federal Reserve is not the regulator of primary dealer firms. Capital standards were revised to rest essentially on meeting the standards of the dealers' regulators, along with a minimum capital criterion to ensure that counterparties can operate in size terms useful to the Fed. The revised standards still require that the Fed's counterparties make good markets to the Fed, provide it with useful market information, and participate meaningfully in Treasury auctions.

The setting for policy

The economy and prices

The recession, which had started in mid-1990, gave way to a weak recovery in the spring of 1991 (Chart 1). The declines in real gross domestic product (GDP) in the fourth quarter of 1990 and the first quarter of 1991 stemmed primarily from contractions in expenditures for

consumer durable goods and investment, although increases in net exports and government purchases mitigated their severity (Table 1).[1] Consumer expenditures on automobiles were particularly weak over this period. Moreover, the decline in economic activity was exacerbated by a drop in consumption around the time of the Persian Gulf War.

Economic activity picked up over the middle of the year, but by historical standards the improvement was anemic for the early stages of a recovery. Consumption and residential construction rose modestly in the second and third quarters, while nonresidential construction continued to shrink. The expansion in the third quarter was limited by a contraction in net exports as slowing economies overseas depressed foreign demand for U.S. goods, and by a decrease in defense purchases.

The recovery faltered in the fourth quarter in part because of flagging consumption. The weakness in consumption likely reflected the dramatic worsening of consumer sentiment. As Chart 2 shows, two commonly cited measures of consumer confidence, the University of Michigan and Conference Board surveys, dropped off sharply during the fourth quarter. The plunges in these series may have captured concerns that a spate of announced layoffs—which in some cases would extend over several years—represented permanent job losses that could lead to slow economic growth and reduced living standards in the years ahead. The slowdown in activity may also have stemmed from an increased propensity of businesses and households to pare debt. Although this restructuring of balance sheets was a healthy response to the heavy debt burdens accumulated during the 1980s, it worked against the normal forces of recovery.

The recession and anemic recovery dampened demand pressures on wages and prices during 1991. In addition, a considerable decline in energy prices helped reduce overall inflation pressures. Energy prices had moved sharply higher in 1990 following the Iraqi invasion of Kuwait, but with the resolution of the Persian Gulf conflict, they slumped (Table 2). The implicit GDP deflator and the consumer price index (CPI) registered their smallest advances since 1986. Meanwhile, the producer price index (PPI) edged downward for the first time since 1986. The so-called core components of the CPI and PPI, which exclude food and energy prices, rose at faster rates than the total indexes over 1991; however, these increases were smaller than those of the previous year.

[1]GDP replaced GNP (gross national product) as the Bureau of Economic Analysis's standard measure of the nation's output during 1991. Unlike GNP, GDP excludes goods and services produced abroad by U.S.-owned capital or labor and includes goods and services produced by foreign-owned resources located in the United States.

Chart 1
Real Gross Domestic Product
Annualized Rates of Change

Interest rates

Most interest rates fell considerably during the year, reflecting the substantial easing of monetary policy, the weakness in the economy, and some moderation in inflation expectations. The Treasury yield curve steepened markedly over the year as the declines in short-term interest rates exceeded those on long-term rates (Chart 3). Short-term rates fell more or less in step with the moves toward monetary policy accommodation, but decreases in long-term rates were more grudging (Chart 4). The yield on the thirty-year Treasury bond remained in a range between 8 and 8½ percent for much of the year, in part because investors showed little confidence that the reduction in inflation would be sustainable as economic activity recovered. Massive ongoing federal deficits also concerned investors. When the economy showed signs of weakening during the fourth quarter, the long bond yield moved lower, especially in the wake of the December 20 cut in the discount rate by a full percentage point. The long bond yield finished the year about 85 basis points below its year-earlier level (as measured by the constant maturity series).

The monetary aggregates

Lower interest rates stimulated M1 growth, but growth in the broader monetary aggregates remained quite weak. Estimates available during the year indicated that the

broader aggregates slipped during the summer to the bottom of their target ranges, where they essentially remained over the rest of the year (Chart 5).[2] From the fourth quarter of 1990 to the fourth quarter of 1991, M1 surged 7.9 percent, M2 advanced 2.7 percent, and M3 grew 1.3 percent.[3] The decline in market interest rates over the year reduced the opportunity cost of holding non-interest-bearing currency and demand deposits. Moreover, for most of the year, the rates offered on other checkable deposits fell more slowly than other deposit rates in response to the decline in market rates. Consequently, M1 deposits became relatively more attractive.

The growth of the broader monetary aggregates was restrained by weak asset growth at depository institutions and by shifts of funds out of the aggregates and into higher yielding financial instruments. Slow asset growth reflected anemic loan demand in a sluggish economy and the efforts of many banks and thrifts to improve their capital positions in the face of asset quality concerns. With the brisk rise in liquid deposits providing most of the funding for their asset growth, many institutions sought to trim the expansion of their managed liabilities, including the time deposits in M2, by reducing deposit rates, raising fees, or cutting promotional expenditures. Faced with low deposit rates, many depositors shifted funds out of the aggregates and into higher yielding capital market instruments, such as bond or equity mutual funds.[4] Moreover, since loan rates were much higher than deposit rates, some

[2]The target ranges were established by the Federal Open Market Committee in February and were reaffirmed in July.

[3]Data are as of February 6, 1992. These data do not incorporate the annual benchmark and seasonal factor revisions of February 12, 1992, or subsequent revisions because the earlier data more closely approximate the information that the Committee had available when it was making its decisions. As of April 30, 1992, net revisions have lifted both M1 and M2 growth by 0.1 percentage point and have depressed M3 growth by a similar amount. Based on the April data, M2 growth was slightly higher over the second half of the year, while M3 growth was a bit weaker. Nonetheless, M2 remained in the lowest quarter of its target range.

[4]Some depositors decided to hold their balances in the liquid components of M2 rather than shift the funds completely out of the aggregate. Such shifts do not affect M2 growth but do affect its composition.

Table 1

Real Gross Domestic Product and Its Components

Seasonally Adjusted Annual Growth Rates, in Percent

	1990	1991				1990 Q-IV over Q-IV	1991 Q-IV over Q-IV
	IV	I	II	III	IV		
Real GDP	−3.9	−2.5	1.4	1.8	0.4	−0.1	0.3
Consumption	−3.5	−1.3	1.4	2.3	0.0	0.3	0.6
Durables	−14.0	−11.9	−1.8	9.5	−5.7	−2.7	−2.8
Nondurables	−3.4	−0.3	0.9	0.0	−3.9	−1.0	−0.9
Services	−0.9	0.7	2.5	2.2	3.7	1.9	2.2
Fixed investment	−9.6	−19.3	−1.7	−0.2	0.4	−2.9	−5.6
Producer durables	−1.6	−18.1	0.0	6.7	−1.6	3.1	−3.7
Nonresidential construction	−19.7	−15.7	−10.3	−23.9	−7.8	−4.6	−14.7
Residential construction	−15.0	−24.8	3.1	10.9	12.3	−11.8	−0.9
Change in inventories (billions of dollars)	−31.2	−32.8	−30.4	0.1	7.6	0.8	−55.5
Change in net exports (billions of dollars)	34.5	12.6	6.3	−18.8	9.8	38.8	9.9
Exports	17.7	−7.4	19.4	7.3	9.7	7.6	6.8
Imports	−9.3	−15.4	13.3	22.3	2.1	−0.4	4.6
Government purchases	4.6	2.8	−0.1	−3.4	−5.4	3.2	−1.6
Real GNP	−2.5	−2.8	0.3	2.0	0.4	0.2	0.0
Addenda							
Change in nonfarm payroll employment (in thousands)	−393	−628	−323	128	−31	−551	−855
Civilian unemployment rate	6.0	6.5	6.8	6.8	7.0	0.7†	1.0†

Note: Data are as of April 17, 1992.

†In percentage points.

depositors used their money balances to pay down consumer credit or to finance spending.

The activity of the Resolution Trust Corporation (RTC) also had a damping effect on M2 and M3. When the RTC resolved a troubled thrift, it carried some of the thrift's assets on its own balance sheet until disposition. The RTC funded these assets with Treasury securities, whereas the thrift had mostly used M3 deposits. Therefore, RTC-assisted resolutions directly depressed M3. Moreover, depositors at the failed institution may have taken the opportunity to review their banking relationship and to restructure their portfolios, especially if their high-rate certificate of deposit contracts had been abrogated. This activity likely reinforced the tendency of depositors to substitute nonmonetary financial assets for M2 deposits.

Financial market developments

The financial market strains that had emerged or intensified during 1990 began to recede during 1991. These strains stemmed largely from the heavy debt burdens accumulated during the 1980s. For some households and firms, the overhang of debt proved increasingly difficult, if not impossible, to service when economic activity softened. Consequently, in 1990, "quality spreads," or the differences between yields on lower rated debt and those on higher rated debt of similar maturities, widened considerably, while the ratio of total corporate downgrades to upgrades rose sharply. Companies in troubled sectors found their access to the capital markets limited at a time when financial intermediaries, which had financed a large portion of the debt buildup, adopted more restrictive lending practices to help clean up their own troubled balance sheets.

The ebbing of financial market strains during 1991 can be attributed in part to the substantial reduction in overall interest rate levels during the year. This reduction directly improved cash flow by cutting the rates paid

Chart 2
Measures of Consumer Confidence

on adjustable rate debt. In addition, it encouraged businesses and consumers to decrease debt servicing costs by refinancing or paying off higher rate debt. Moreover, lower rates and the modest pickup in economic activity boosted equity prices, thus prompting a number of corporations to issue new equity to improve their capital positions. The proceeds of the equity issuance were sometimes used to pay down costly outstanding debt.

Reflecting the propensity of consumers and businesses to pay down debt, total debt of nonfinancial sectors rose only 4.5 percent in 1991 (fourth quarter over fourth quarter) and ended the year at the lower bound of the Federal Open Market Committee's monitoring range (Chart 6).[5] The nonfederal component of debt showed even more modest growth of 2.4 percent, the slowest rate since 1945. Much of the growth in debt can be attributed to the federal government; its debt expanded 11.2 percent.

The restructuring of corporate balance sheets during 1991 and signs of a modest pickup in economic activity soothed concerns about the financial health of many firms. In this environment, some investors were willing to take on additional risk in order to pick up yield. As a result, credit spreads in most sectors narrowed sharply during 1991 (Chart 7). With this narrowing and the improving economic outlook, a number of firms that had experienced curtailed access to the credit markets were able to issue debt once again. Most notably, issuance in the below-investment-grade, or "junk," sector of the corporate bond market rebounded to $8.8 billion, up sharply from only $550 million in 1990. According to Moody's Investor Service, while corporate debt downgrades still outnumbered upgrades during 1991, the ratio of downgrades to upgrades, 2.9 to 1, was appreciably lower than the 4.4 to 1 ratio of 1990, and close to the 2.5 to 1 ratio of 1989.

The financial position of many bank holding companies improved during the year. An indication of this improvement was the decreased pace and volume of loan write-offs and loan-loss provisions during 1991. Yields on most bank holding company debt relative to those on Treasury issues narrowed during the year as market participants perceived that the worst was over. The narrowing of spreads prompted many bank holding companies to sell new debt, while a pickup in their stock prices encouraged some bank holding companies to offer new equity to enhance their capital positions.

Despite the diminished sense of fragility in most sectors, concerns about the financial health of insurance companies rose during 1991. Like banks, many life insurance companies had been hurt by declining real estate values and losses on their holdings of below-investment-grade bonds. These difficulties came under

[5]Data are as of March 12, 1992. Continuing a series of reductions, the Committee lowered the monitoring range for debt growth in 1991. The cut reflected its expectations that private credit demands would be limited by the increased caution of borrowers and lenders and that federal government borrowing would continue to grow rapidly.

Table 2

Price Information

Seasonally Adjusted Annual Growth Rates, in Percent

	1990	1991				1990 Q-IV over Q-IV	1991 Q-IV over Q-IV
	IV	I	II	III	IV		
Consumer price index							
Total	6.9	3.2	2.5	2.7	3.6	6.3	3.0
Excluding food and energy	4.4	6.5	3.8	3.9	3.8	5.3	4.5
Energy	41.4	−21.8	−11.6	−0.1	3.6	18.0	−8.0
Producer price index							
Total	10.0	−1.7	−0.9	0.1	2.1	6.4	−0.1
Excluding food and energy	3.3	5.5	2.6	2.0	2.7	3.5	3.2
Energy	93.3	−28.4	−14.5	−0.3	6.4	34.1	−10.2
Implicit GDP deflator	3.1	4.9	3.2	2.2	1.7	4.2	3.0
Fixed-weight GDP index	3.2	5.4	3.3	2.6	2.1	4.4	3.4
Employment cost index†	2.6	5.7	4.1	4.8	2.5	4.9	4.3

Note: Data are as of April 17, 1992.

†This index is computed for the final month of each quarter. The growth rates therefore represent growth from the final month of the previous quarter; they are not quarterly average rates.

the spotlight during the summer, following the failure of Mutual Benefit Life Insurance Company. In 1991, six sizable life insurance companies failed, all but one of which experienced runs by policy holders before their failure. Other insurers, meantime, found themselves in weakened capital positions. Nevertheless, the difficulties in this sector appeared to be somewhat confined to a small segment of the industry. Unlike banks, life insurers had maintained a roughly constant share of real estate holdings since 1975.[6] Moreover, the exposure of life insurance companies to junk bonds was concentrated among a few firms.

Course of policy

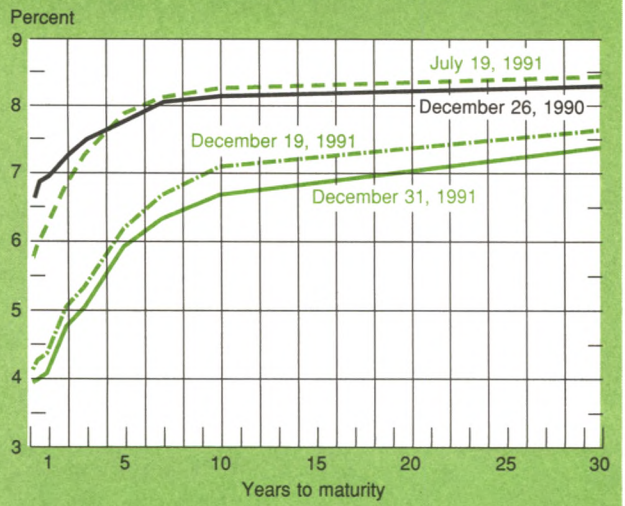
During 1991, the Federal Reserve responded to the weakness in economic activity and the moderation in inflation pressures by continuing the gradual loosening of monetary policy initiated in mid-1989. The ten easing steps by the Federal Open Market Committee (FOMC) brought about a substantial cumulative reduction in reserve pressures in 1991 as the federal funds rate fell 3 percentage points. Consistent with the moves on reserves, the Board of Governors approved five cuts in the discount rate, also producing a cumulative decline of 3 percentage points (Table 3). At the end of the year, the discount rate stood at 3½ percent, the lowest level since November 1964.

During the winter and early spring, the FOMC reduced reserve pressures through a series of four easing steps that lowered the federal funds rate by 1¼ percentage points, and the Board approved two half-point reductions in the discount rate. Economic activity was observed to be declining over the winter as production and employment shrank. The threat of oil-related inflation dissipated in February in the wake of coalition successes in the Persian Gulf War, and broad price measures recorded only modest increases or fell. By late March, however, conditions appeared to be in place for a turnaround in economic activity, in part because of the significant easing of reserve pressures that had

[6] Their share rose from 3 percent in 1970 to a peak of 3.6 percent in 1986. In 1990, it was 3.1 percent. These data were taken from Andrew Yuengert, "Empirical Evidence: Life Insurance and Annuities," Federal Reserve Bank of New York, Internal Working Paper, 1991.

Chart 3

Yield Curves for Selected U.S. Treasury Securities



Notes: Treasury bill yields are on a bond-equivalent basis. Coupon yields are constant maturity values.

Chart 4

Long-Term and Short-Term Interest Rates

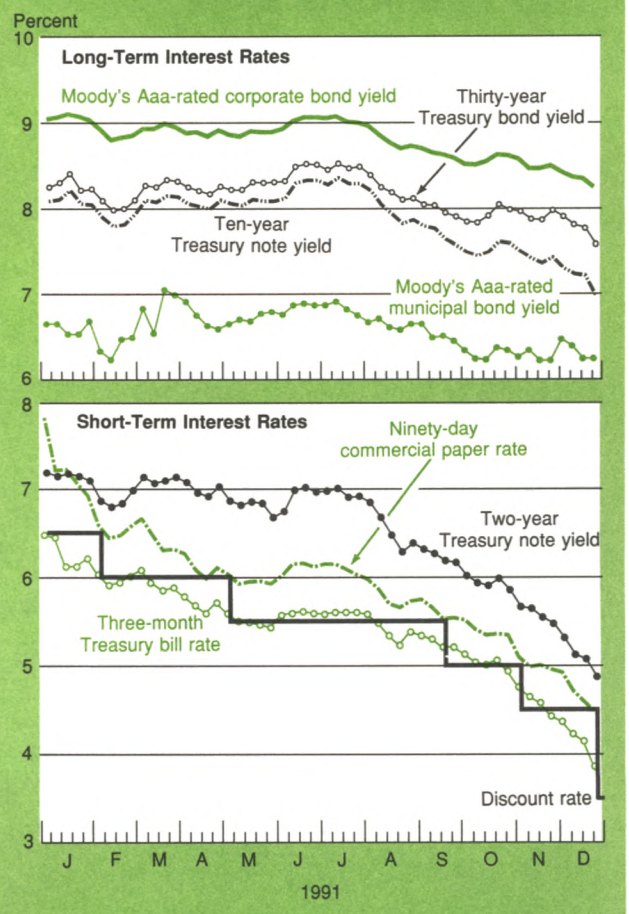


Chart 5A

M2: Levels and Target Ranges

Cones and Tunnels

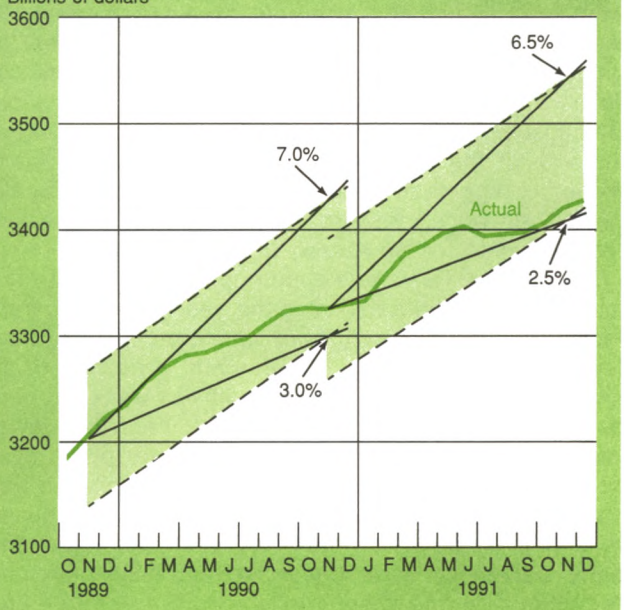


Chart 5B

M3: Levels and Target Ranges

Cones and Tunnels

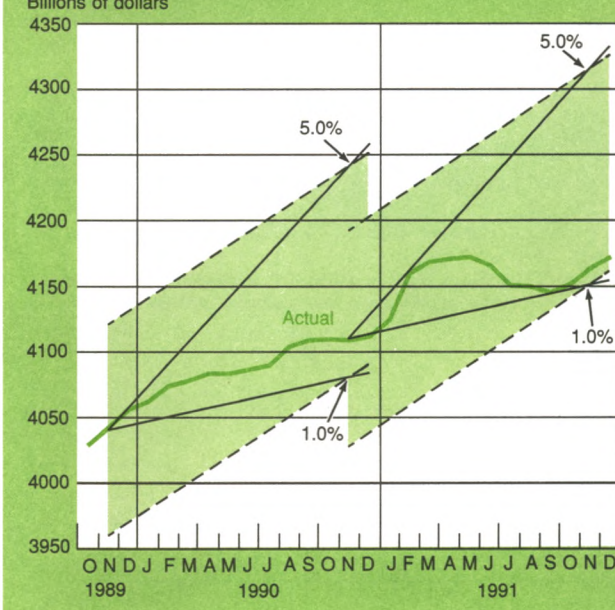


Chart 5C

M1: Levels and Growth Rates

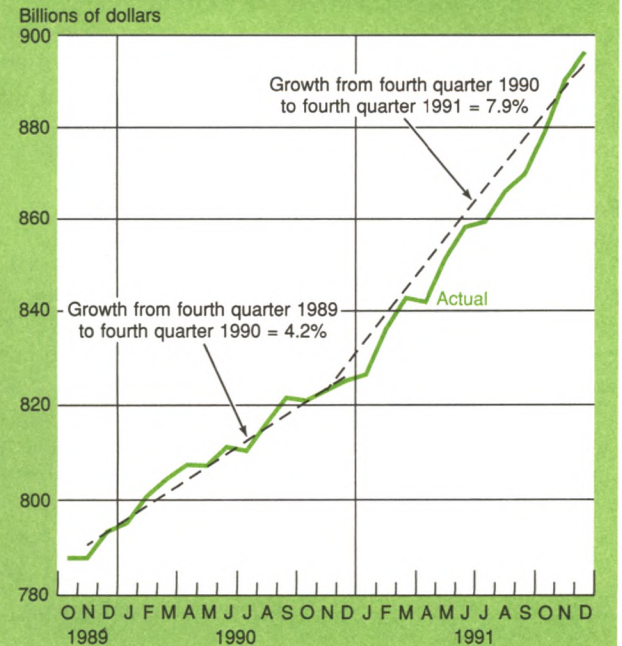
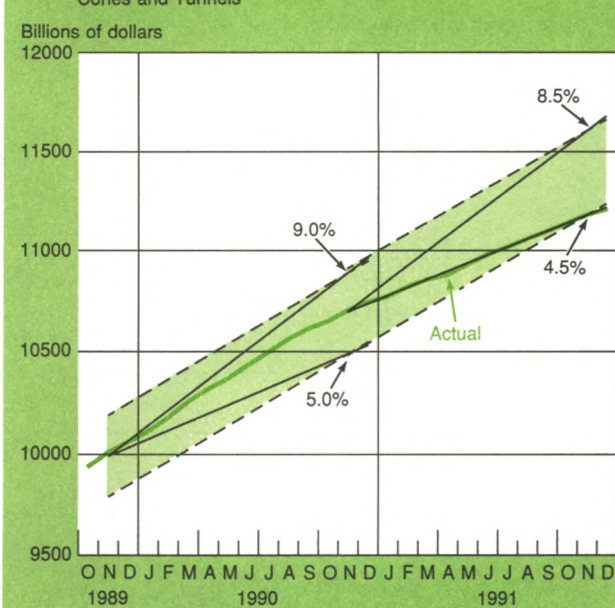


Chart 6

Total Domestic Nonfinancial Debt: Levels and Monitoring Ranges

Cones and Tunnels



taken place since the latter part of 1990.[7] Nonetheless, the Committee remained alert to the possibility that the recovery might falter. Indeed, amid signs of continued weakness, especially in the industrial and capital goods areas, the Board approved a cut in the discount rate on April 30, and the FOMC allowed part of the reduction to show through to the funds market.

[7]The federal funds rate had fallen 2 percentage points between mid-October 1990 and late March 1991, with half the decline registered in 1990.

Chart 7
Yield Spreads

The FOMC adopted a posture of watchful waiting from midspring through midsummer. Economic indicators suggested that a recovery, albeit uneven, was under way, while inflation pressures remained modest. In these circumstances, the Committee felt it prudent to guard against the risk of excessive monetary stimulus, which might allow inflationary imbalances to develop. By midsummer, however, some data cast doubt on the strength of the recovery at a time when the broader monetary aggregates were showing persistent weakness. With price pressures abating, the FOMC eased reserve pressures on August 6.

The Federal Reserve stepped up the pace of accommodation over the balance of the year as various data indicated that the upturn in economic activity had faltered. During the fall, business and consumer confidence eroded markedly, bank credit was weak, and the broader monetary aggregates were near the lower bounds of their target ranges. Meantime, price measures supported the notion that the rate of inflation was coming down. In this environment, the FOMC reduced reserve pressures every month between September and early December, while the Board approved half-point reductions in the discount rate in September and November. By mid-December, evidence of the downward trend in inflation was even stronger, and economic activity remained sluggish. Consequently, the System took more forceful steps to ease policy. On December 20, the Board of Governors approved the first 1 percentage point cut in the discount rate since 1981, and the Committee effected a 50 basis point decline in the funds rate, the second cut of that size during 1991. The Board and the Committee anticipated that these steps, along with the cumulative effects of earlier actions, would encourage a resumption of sustainable economic expansion.

Policy implementation

Adjustment to the cut in reserve requirements

Policy implementation in the early months of 1991 entailed assessing and adapting to the effects of the cut in reserve requirement ratios in December 1990. The reduction in requirements was phased in over two consecutive maintenance periods and took full effect in the period ended January 9, 1991. The reserve requirement cut immediately introduced a huge reserve surplus. The Desk absorbed the extra reserves largely through redemptions and outright sales of securities in December 1990.[8] The cut in reserve requirements also had a

[8]The Desk's operations in late 1990 are discussed in some detail in last year's report, "Monetary Policy and Open Market Operations during 1990," Federal Reserve Bank of New York *Quarterly Review*, Spring 1991.

Table 3

Specifications from Directives of the Federal Open Market Committee and Related Information

Date of Meeting	Specified Short-Term Growth Rates (Percent) M2	M3	Discount Rate (Percent)	Borrowing Assumption for Deriving NBR Path (Millions of Dollars)	Associated Federal Funds Rate† (Percent)	Effect on Degree of Reserve Pressure	Guidelines for Modifying Reserve Pressure‡
12/18/90	November to March		7	100	7.25	Decrease	A slightly greater degree
	4	1	6.5 on 12/19	125 on 12/19§	7	slightly	*might* be acceptable. A
				100 on 1/9‖	6.75		somewhat lesser degree *would*
			6 on 2/1	100††	6.25		be acceptable.
2/5 to	December to March		6	100	6.25	Maintain	A slightly greater degree
2/6/91	3½-4	3½-4		75 on 3/8‖	6		*might* be acceptable. A
				125 on 3/21‡‡			somewhat lesser degree *would*
							be acceptable.
3/26/91	March to June		6	125	6	Maintain	A somewhat greater or
	5½	3½		150 on 4/18‡‡			somewhat lesser degree *might*
			5.5 on 4/30	175 on 4/30§	5.75		be acceptable.
				200 on 5/2‡‡			
5/14/91	March to June		5.5	200	5.75	Maintain	A somewhat greater or
	4	2		225 on 5/16‡‡			somewhat lesser degree *might*
				250 on 6/13‡‡			be acceptable.
				275 on 6/20‡‡			
				325 on 6/27‡‡			
7/2 to	June to September		5.5	325	5.75	Maintain	A somewhat greater or
7/3/91	5½	3		350 on 7/11‡‡			somewhat lesser degree *might*
				400 on 7/25‡‡			be acceptable.
				375 on 8/6‖	5.5		
8/20/91	June to September		5.5	375	5.5	Maintain	A somewhat greater degree
	0	−1		350 on 9/5‡‡			*might* be acceptable. A
				300 on 9/12‡‡			somewhat lesser degree *would*
			5 on 9/13	325 on 9/13§	5.25		be acceptable.
10/1/91	September to December		5	325	5.25	Maintain	A slightly greater degree
	3	1½		300 on 10/3‡‡			*might* be acceptable. A
				275 on 10/10‡‡			slightly lesser degree *would*
				250 on 10/17‡‡			be acceptable.
				175 on 10/31§§	5		
11/5/91	September to December		5	175	5	Decrease	A slightly greater degree
	3	1	4.5 on 11/6	175‖‖	4.75	somewhat	*might* be acceptable. A
				150 on 11/7‡‡			slightly lesser degree *would*
				125 on 11/14‡‡			be acceptable.
				100 on 11/29‡‡			
				75 on 12/6‖	4.5		
12/17/91	November to March		4.5	75	4.5	Maintain	A slightly greater degree
	3	1½	3.5 on 12/20	100 on 12/20§	4		*might* be acceptable. A
							somewhat lesser degree *would*
							be acceptable.

† The federal funds rate trading area that is expected to be consistent with the borrowing assumption.

‡ The factors to consider in making a modification did not change materially until the December 1991 meeting. Through November they were progress toward price stability, trends in economic activity, behavior of the monetary aggregates, and developments in foreign exchange and domestic financial markets. At the December meeting, the Committee specified that, in the context of its long-run objectives for price stability and sustainable economic growth, modifications would be possible after giving careful consideration to economic, financial, and monetary developments.

§ This increase was made so that only part of the accommodation from the cut in the discount rate showed through to the market.

‖ Change in borrowing assumption reflects adjustment to reserve pressures.

†† The assumption was unchanged because the full effect of the discount rate cut was allowed to show through to the market.

‡‡ Change in borrowing assumption reflects a technical adjustment to account for actual or prospective behavior of seasonal borrowing.

§§ Change in borrowing assumption reflects a change in reserve pressures and a downward technical adjustment.

‖‖ The assumption was unchanged because an increase to permit only part of the discount rate cut to show through to the market was offset by a downward technical adjustment.

more lasting impact on the Desk's approach to reserve management: it reduced the level of *required reserve balances* to a range that made reserve management difficult at times for many banks and led to strong pressures in the reserves market. Required reserve balances consist of all reserves that depository institutions hold at Federal Reserve Banks to meet their reserve requirements.[9] Many depositories maintain reserve balances at the Fed not only to meet their reserve requirements, but also to process transactions and to guard against unexpected late-day deposit withdrawals that could send them into overdraft.[10] The cut in reserve requirement ratios lowered required reserve balances for many institutions below the level needed to support their clearing operations.[11]

The difficulties that the drop in reserve balances presented to depositories in managing their reserve positions were especially pronounced early in 1991 for two reasons. Many of the larger banks had little or no experience working with such low operating balances, and so had trouble initially adapting to the new reserve requirement ratios.[12] Furthermore, the cut in reserve requirements took full effect shortly before seasonal movements in the level of required reserves and of applied vault cash caused required reserve balances to drop to their annual low point in late January and early February. Consequently, these seasonal movements pushed the level of required reserve balances to exceptionally low levels (by recent historical standards) early in 1991.[13]

Banks responded to the low levels of required reserve balances by managing their reserve positions more cautiously.[14] To guard against inadvertent overdrafts, depositories often held onto their reserves early in the day, sometimes despite an already large accumulated excess position. This practice gave rise to a tendency towards firmness in the funds rate in the morning. In late afternoon trading, as banks became more confident about their reserve positions for the day, they tended to unload their holdings, sometimes driving the funds rate sharply lower. (Chart 8 shows the resulting volatility of the funds rate in early 1991.) Demand for excess reserves typically ran above normal levels as depositories sought to boost their operating balances, and although adjustment borrowing still remained at relatively low levels, depositories turned to the discount window more often than in the recent past.

In conducting open market operations during the early part of the year, the Desk had to adapt to these developments. When it set its objectives for reserves, it anticipated that demands for excess reserves would exceed the recent average of around $1 billion. The excess reserve allowance was treated much more flexibly because the size of these elevated demands was

[9]Required reserve balances are defined as required reserves less applied vault cash. Required reserve balances together with required clearing balances, which are discussed later in this section, are termed "required operating balances." Total operating balances at the Fed also include excess reserves.

[10]Depository institutions are penalized for ending the day overdrawn. They are charged the higher of 2 percentage points over the day's effective federal funds rate or 10 percent. Moreover, the overdraft amount must be offset by higher reserve balances on other days in the two-week maintenance period to meet the average reserve requirement.

[11]The reserve requirement cut lowered required reserve balances by about $11¾ billion. The remainder of the $13½ billion in required reserves released by the cut had been met with vault cash.

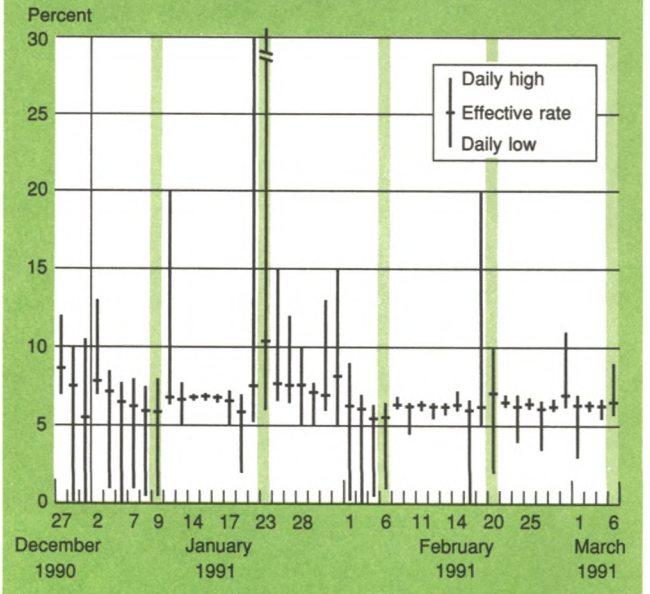
[12]Many small banks and thrifts routinely held more vault cash than they needed to meet their reserve requirements even before the 1990 cut in requirements. Consequently, they were unaffected by the cut.

[13]Required reserve balances fell from $33.5 billion in the period ended December 12, 1990—just before the cut in reserve requirements—to $16.1 billion in the period ended February 6, 1991.

[14]Reserve management practices of depository institutions around this time were also affected by increased worries over the health of many depositories, worries that prompted some institutions to curb their lending limits to other institutions. This development was discussed in last year's report.

Chart 8

Daily Trading Ranges for Federal Funds



Notes: Shaded areas represent settlement days. Federal funds rate reached a high of 90 percent on January 23.

very uncertain. Temporary reserve operations on some days were aimed at ensuring that reserves were sufficient to support banks' payments operations that day, even when they were not needed to meet reserve requirements for the two-week maintenance period. Because the federal funds rate was volatile, it could no longer serve as a reliable barometer of the availability of reserves for meeting reserve requirements; instead, the Desk sometimes viewed firmness in the funds rate as an indication that the level of operating balances was not adequate for clearing purposes.

During the first two maintenance periods of the year, the Desk took greater account of the expected level of operating balances when formulating its daily operations. In the days immediately following January 1, however, the focus was on allowing banks to work off in an orderly fashion the huge excess reserve positions accumulated just ahead of the year-end.[15] Conditions in the money market in the following maintenance period, the first full period in the new year, settled down somewhat but still remained relatively volatile. Excess reserves in this period were initially expected to be on the high side, but in fact ran on the low side, thanks to large positive carry-ins from the period covering the year-end.

Difficulties associated with low levels of operating balances intensified in the next period, which ended February 6. Required reserves, which typically peak around the year-end holidays and then quickly fall off early in the new year, dropped sharply in this later period. Meanwhile, a large buildup in vault cash around the turn of the year, related to the public's currency demands during the holiday season, became available for meeting reserve requirements in this period and caused applied vault cash to jump.[16] During this period, conditions in the money market were generally tight in the morning, and the funds rate frequently became volatile in later trading. The Desk provided reserves in an aggressive manner during the first week of the period, arranging six consecutive rounds of System RPs. These RPs, which more than met the period's formal need, were partly aimed at providing banks with sufficient reserve balances for clearing.[17] On one day, the Desk preannounced its operation when the level of operating balances was expected to plunge as a result of a spike in the Treasury's Fed balance.[18] As depositories' excess reserve position gradually accumulated, the Desk raised its formal allowance for excess reserves. Later in the period, when reserve pressures relaxed somewhat, the Desk drained reserves, but it only absorbed limited amounts on any one day to avoid bringing operating balances below the level depositories would need to manage their positions.

Pressures remained strong in the period ended February 20 even though applied vault cash fell back from its seasonal high. The Desk continued to respond both to the firmness in the funds rate in the morning and to estimates that showed low levels of operating balances on some days. The Desk added a large volume of reserves on the February 20 settlement day to bring balances to a level believed consistent with clearing needs, although available estimates showed that reserves were more than sufficient for meeting reserve requirements plus expected excess reserve demands for the period.

In subsequent maintenance periods, several developments boosted reserve balances, thus reducing the volatility of the funds rate and other pressures in the reserve market. Seasonal movements in reserve requirements and applied vault cash helped to raise operating balances to more comfortable levels. In addition, depository institutions took measures that increased their reserve balances at the Fed on a permanent basis. A number of banks built up their required reserve balances by economizing on their holdings of vault cash, a strategy that caused vault cash to grow somewhat more slowly in 1991 than in recent years. Many banks also opened or expanded their required clearing balances, lifting the total size of these balances from $1.8 billion in the maintenance period just prior to the cut in reserve requirement ratios to $3.9 billion one year later.[19] Most of this increase occurred

[15]The success that banks had in running down their excess holdings in the second week of the January 9 period proved somewhat surprising. The level of accumulated excess reserves through the first week of this period was about $10 billion, and excess reserves for the period as a whole were about $3½ billion.

[16]Under existing accounting procedures, vault cash holdings could be applied to meeting reserve requirements two maintenance periods later. In February 1992, when the Board announced that a further cut in reserve requirements would take effect in April, it also put out for public comment a proposal to shorten the vault cash lag to one period. Evidence suggests that the shorter lag would lessen the seasonal decline in required reserve balances that occurs in early February.

[17]One of these System RPs was also intended to communicate a policy easing.

[18]Net proceeds from the January auctions of two-year and five-year notes on their settlement date lifted the Treasury's total cash holdings well above its total deposit capacity in the private banking sector.

[19]A depository institution can establish a required clearing balance by specifying an average level of reserves that it will hold at the Federal Reserve for clearing purposes in addition to any balances that it must hold to meet reserve requirements. In exchange, it receives credits on its required clearing balance that it can use to pay for priced services provided by the Fed. Thus, it earns implicit interest on its clearing balance. The Desk knows the size of required clearing balances for a given maintenance period at the beginning of that period but not necessarily the size for future periods.

too late in the year to alleviate reserve pressures in early 1991; by the period ended February 20, required clearing balances had grown to just $2.4 billion.

Despite these developments, required operating balances (required reserve balances plus required clearing balances) in early December 1991 were still about $5 billion below the level prevailing one year earlier, just before the cut in reserve requirements. A tendency for excess reserves to run above recent historical levels and increasing evidence that depositories were wasting their positive reserve carry-ins from previous periods suggested that some banks were still occasionally hampered by low operating balances in managing their reserve positions.

Operating procedures

Borrowed reserves

During 1991, the FOMC continued to frame its operating objectives in terms of the desired degree of reserve pressure, a concept that has been associated with a specified amount of adjustment and seasonal borrowing at the discount window and with a given spread of the federal funds rate over the discount rate. (Anticipated borrowing levels and other reserve measures are presented in Table 4.) The Desk's reserve management procedures are aimed at providing an amount of nonborrowed reserves that together with the intended level of discount window borrowing will just meet the estimated demand for reserves.

In recent years, the relationship between the level of adjustment borrowing and the spread between the federal funds and discount rates has become less reliable, and banks have shown an increased reluctance to borrow from the discount window. As a consequence, wider spreads between the federal funds and discount rates have typically been required to induce banks to turn to

Table 4

1991 Reserve Levels

Millions of Dollars

Period Ended		Required Reserves (Current)	Required Reserves (First Published)	Excess Reserves (Current)	Excess Reserves (First Published)	Total Reserves	Adjustment and Seasonal Borrowed Reserves	Nonborrowed Reserves plus Extended Credit Borrowed Reserves (Current)	Nonborrowed Reserves plus Extended Credit Borrowed Reserves (First Published)	Nonborrowed Reserves Interim Objective	Initial Assumed Excess Reserves	Final Assumed Excess Reserves	Extended Credit Borrowing
1991													
Jan.	9	51,480	51,529	3,593	3,472	55,073	274	54,779	54,727	55,997	2,500	4,500	22
	23	48,477	48,535	938	653	49,415	857	48,531	48,332	49,704	1,800	1,300	28
Feb.	6	46,438	46,363	2,722	2,798	49,160	161	48,970	49,000	49,703	1,600	3,500†	30
	20	46,935	46,819	1,752	1,929	48,687	153	48,508	48,594	47,882	1,500	1,200	27
Mar.	6	46,637	46,615	1,221	1,187	47,858	377	47,432	47,427	47,978	1,500	1,500	50
	20	47,616	47,611	1,007	1,068	48,622	138	48,438	48,541	48,686	1,200	1,200	47
Apr.	3	47,563	47,511	1,375	1,417	48,938	151	48,726	48,778	48,587	1,200	1,200	62
	17	50,218	50,216	801	907	51,019	148	50,795	50,977	51,146	1,200	1,000	75
May	1	48,644	48,691	1,199	1,210	49,842	142	49,598	49,760	49,559	1,100	1,000	102
	15	48,469	48,518	970	945	49,438	186	49,124	49,277	49,418	1,100	1,100	128
	29	47,357	47,343	1,121	1,135	48,477	240	48,178	48,238	48,336	1,100	1,100	59
June	12	49,411	49,288	731	815	50,142	275	49,859	49,829	50,163	1,100	1,100	8
	26	49,110	49,099	1,282	1,311	50,392	307	50,078	50,105	49,825	1,000	1,000	7
July	10	50,375	50,462	882	806	51,256	596	50,656	50,673	51,180	1,000	1,000	5
	24	49,492	49,518	941	886	50,433	466	49,964	49,941	50,163	1,000	1,000	4
Aug.	7	49,393	49,432	870	830	50,262	704	49,371	49,557	50,027	1,000	1,000	188
	21	49,917	49,892	1,061	1,055	50,977	399	50,298	50,549	50,517	1,000	1,000	281
Sept.	4	49,058	49,045	1,273	1,346	50,331	389	49,536	50,003	49,599	1,000	1,000	406
	18	51,447	51,290	732	885	52,179	332	51,351	51,843	51,931	1,000	1,000	496
Oct.	2	49,122	49,093	1,044	1,099	50,165	342	49,782	49,850	49,686	1,000	1,000	41
	16	50,908	50,904	1,016	1,163	51,924	284	51,634	51,784	51,686	1,000	1,000	6
	30	50,191	50,188	1,167	1,174	51,357	211	51,133	51,151	50,938	1,000	1,000	13
Nov.	13	51,907	51,915	913	917	52,820	112	52,706	52,721	52,515	1,000	1,000	2
	27	52,045	51,915	934	1,039	52,979	101	52,877	52,854	52,791	1,000	1,000	2
Dec.	11	53,842	53,883	605	562	54,446	110	54,337	54,337	54,795	1,000	1,000	1
	25	54,483	54,459	1,203	1,233	55,687	115	55,571	55,577	55,292	1,000	1,000	1
1992													
Jan.	8	56,020	55,979	1,138	1,206	57,158	521	56,637	56,666	57,098	1,200	1,200	1

†Temporarily raised to 2,500 during the period.

the discount window. This development has been linked to concerns about the ongoing difficulties of the financial services sector as a whole, and to the increased public scrutiny directed toward those particular institutions rumored to be in financial straits.[20] Banks, fearful that the public will perceive their use of the window as a sign of fundamental liquidity constraints, have shied away from using this facility.

This avoidance of the discount window was highlighted in the early part of 1991 when many banks were struggling with seasonally low levels of required reserve balances. Somewhat elevated levels of borrowing did occur, but very high federal funds rates were sometimes needed to induce banks to turn to the window. This reluctance to borrow diminished the value of the discount window as a safety valve for alleviating the kinds of temporary reserve pressures facing banks adapting to the lower reserve requirements. These developments were noted by Chairman Greenspan in his February 1991 Humphrey-Hawkins testimony before Congress. In his remarks, the Chairman encouraged banks to make greater legitimate use of the borrowing facility, and for a time his comments appeared to have had some effect. Nonetheless, a strong reluctance to tap the discount window persisted during the year.

Low levels of discount window borrowing were also encouraged by a generally narrow spread between the federal funds rate and the discount rate in 1991, which reduced the incentive to turn to the window.[21] A narrow spread between the two rates had emerged in late 1990 and remained throughout the following year. During 1991, the average effective federal funds rate exceeded the discount rate by 24 basis points, although in one maintenance period the average effective funds rate fell below the discount rate by about 20 basis points. In 1990, the spread had averaged 112 basis points, and it had been 228 basis points in the preceding year.

Reflecting these developments, adjustment credit averaged just $140 million in 1991, compared with levels of $233 million and $243 million in 1990 and 1989, respectively. The level of adjustment borrowing reached particularly low levels in the autumn; in the period ended November 13, it averaged only $14 million, its lowest maintenance period average since July 1980 (Chart 9).[22] As in other recent years, adjustment credit often remained very low until the final day of the period, when it rose as a result of settlement day pressures. "Special situation" adjustment borrowing, which is treated as akin to extended credit by the Desk in formulating its reserve objectives, was lower in 1991 than in the previous year. Absent this borrowing, adjustment credit was $123 million in 1991 and $164 million in 1990.[23]

Seasonal borrowing in 1991 followed its usual pattern: it rose slowly at first, more quickly in the early summer, and then fell off rapidly during the autumn. To keep pace with movements in seasonal borrowing, nine upward technical adjustments were made to the borrowing allowance between March and late July, and afterwards eleven seasonally related reductions were made to the allowance. Seasonal borrowing peaked at $351 million in the period ended August 7; its lowest average level was $28 million in the period ended January 23.[24] In part reflecting the narrow spread between the federal funds rate and the discount rate, the level of seasonal borrowing in every maintenance period of 1991 was below that in the corresponding period of the preceding year. For the year as a whole, seasonal borrowing averaged $155 million, compared with $223 million in 1990 and $275 million in 1989.

Conflicts between the federal funds rate and reserve estimates

The Desk's open market operations are designed to fill the gap between the objective for nonborrowed reserves and available estimates of nonborrowed reserve supplies.[25] Ideally, an estimated reserve need

[20]Last year's report includes a discussion of this change in discount window borrowing behavior.

[21]During most of the year, the federal funds rate and the discount rate declined more or less in step. The funds rate generally was slightly above the discount rate, although occasionally the rates were about the same. Under borrowed reserve targeting, introduced in the early 1980s, the relationship between the amount of borrowing and the funds rate is not stable when the funds rate is below the discount rate. This relationship, however, has not been very dependable in recent years even when the funds rate exceeded the discount rate, and the Federal Reserve has relied less on it. The experience gained in the last few years suggests that the Federal Reserve could probably operate with reasonable success even if the funds rate were persistently below the discount rate.

[22]The effective federal funds rate exceeded the discount rate by just 18 basis points in the November 13 period; it was below the discount rate in the week-long maintenance period that ended July 9, 1980.

[23]Special situation borrowing in the first half of 1990 was elevated by the demands of Bank of New England. This bank borrowed much smaller amounts of adjustment credit for a brief period in January 1991, after it had been seized by the Federal Deposit Insurance Corporation and had been converted into a bridge bank. In April 1991, Bank of New England was sold to Fleet/Norstar Financial Group Inc.

[24]Seasonal borrowing was $22 million in the period ended January 8, 1992. This period was the last in which the rate charged on seasonal borrowing was equal to the discount rate. Since that date, the seasonal borrowing rate has been determined by market-related rates: the average of the effective federal funds rate and the ninety-day composite rate on certificates of deposit from the preceding period.

[25]The objective or "path" for nonborrowed reserves is derived by

will be associated with tightness in the funds rate relative to expectations, an estimated reserve surfeit will be accompanied by a soft federal funds rate, and reserve levels that are on target will be accompanied by funds trading at the expected rate. In fact, however, the reserve estimates and the funds rate often give inconsistent signals. Conflicts between trading conditions in the reserves market and reserve estimates arose with unusual frequency in 1991. Sometimes the strong reluctance to borrow contributed to the disparities. Heightened market expectations of an impending easing in monetary policy sometimes encouraged depositories to defer meeting part of their reserve needs until late in a maintenance period. At other times, banks misjudged their reserve positions; they may have had a smaller tolerance for error because of lower reserve balances.

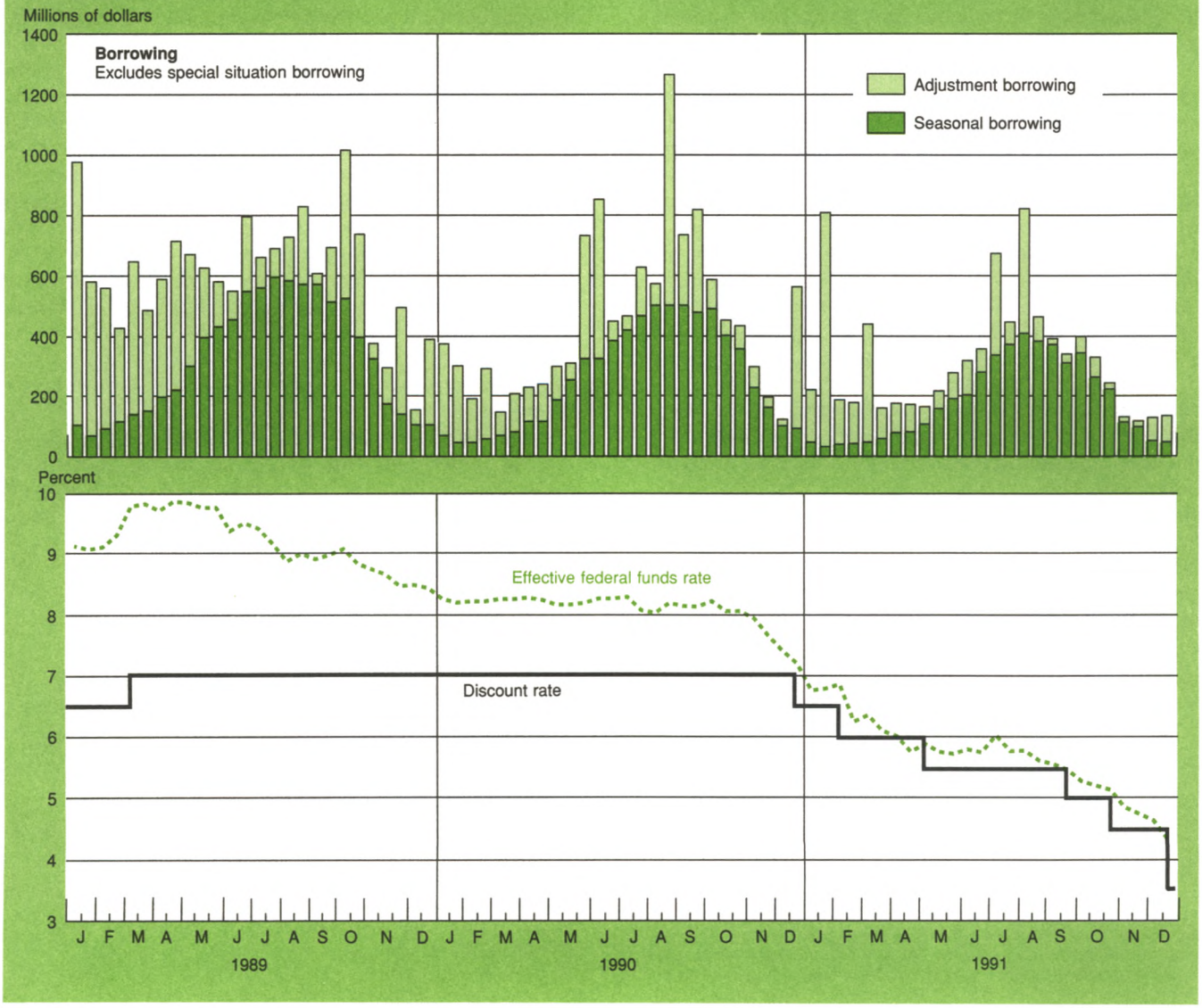
In structuring its temporary operations, the Desk pre-

Footnote 25 continued
subtracting the borrowing allowance from estimates of the total demand for reserves (required plus excess reserves).

Chart 9

Borrowing and the Behavior of the Federal Funds Rate and the Discount Rate

Maintenance Period Averages



fers to make needed reserve injections or absorptions gradually, allowing for the possibility of changes to the reserve outlook; it does not want to leave the bulk of the needed reserve adjustment to the end of the period because a very large one-day open market operation may be difficult or impossible to arrange. In 1991, inconsistencies between the reserve forecasts and the funds rate often interfered with this approach. When confronted with a conflict, the Desk frequently attached greater importance to the rate at which federal funds were trading in the morning than to its reserve projections. With market participants focusing closely on the funds rate as a key indicator of the Federal Reserve's policy stance, the Desk preferred to keep that rate close to its expected trading level so as not to send misleading signals to the market. Also, discrepancies between trading conditions in the funds market and reserve projections were sometimes taken as evidence that the available reserve estimates might be faulty. This approach to formulating open market operations occasionally led the Desk to postpone meeting its estimated reserve objectives until late in the period, aware that it might then have to arrange very large reserve operations or perhaps even fail to meet reserve objectives.

When the Desk did want to communicate a policy shift, it chose a technique after considering current conditions, including the level of the funds rate relative to its old and new expected trading levels, the extent to which market participants anticipated a move, and the overall reserve picture. For example, if the Desk intended a modest easing of reserve pressures when funds were still at their old level, it would probably arrange an overnight System RP—a step that would tend to be viewed as registering dissatisfaction with the prevailing funds rate. If the funds rate were already at its new level because an easing move was widely expected, the Desk might signal a modest ease by arranging a customer-related RP—an "unaggressive" action generally regarded as indicating acceptance of the prevailing funds rate. Finally, in a period marked by reserve surpluses of which market participants were generally aware, the Desk could provide what might be considered an inconclusive easing signal by refraining from any market operation rather than arranging a round of reserve-absorbing matched sale-purchase agreements (MSPs).[26]

In 1991, federal funds frequently traded at rates below the Committee's expected trading range when market participants saw the possibility of a move to a more accommodative policy. Such episodes often followed the release of key data showing unexpected economic slack or modest inflationary pressures. The Desk typically responded to these situations by structuring its actions to avoid misleading market participants about the Fed's current policy stance. When the policy stance had not changed, the Desk sometimes substituted a customer-related RP for a larger System RP that would have been more consistent with the estimated reserve need. In some instances, it postponed addressing an estimated reserve need until late in a period. On several occasions when funds were trading below the expected level, the Desk sought to make a clear policy statement by draining reserves with MSPs even though a reserve shortage was estimated at the time.[27] On April 15, the Desk responded to market perceptions that an easing was imminent or might have already occurred by entering the market to drain reserves about one hour ahead of its usual intervention time, thereby emphasizing that no easing in policy had taken place.[28]

Conflicts between the reserve picture and the funds rate occasionally emerged even when market participants were not anticipating an imminent policy change. Sometimes depositories allowed deficiencies to develop to ensure against cumulating excess reserve positions that could not be worked off without incurring overdrafts. The Desk at times postponed addressing sizable reserve shortages until very late in a maintenance period because the funds rate was below the expected level. When firm conditions finally emerged, large RP operations were arranged.

Incongruities between the reserve estimates and the morning funds rate remained or emerged on the settlement day on several occasions. Discrepancies at this late stage usually suggested that either the Desk or the banks did not have an accurate picture of the reserve situation. The Desk's responses in these cases varied. Knowing that it could not defer meeting reserve objectives, the Desk gave careful consideration to the various factors underlying its reserve projections. It recognized

[26]On the October 30 settlement day, the Desk faced a moderate drain need, and just before the usual market entry time, funds were being exchanged at a rate below the expected rate. At the time, the Committee was in the process of discussing a possible easing. The Desk, in consultation with the Chairman, refrained from draining reserves even though no definite policy decision had been made, recognizing that this lack of action might well be interpreted as signaling a move towards easing. An easing step was formally adopted the following day.

[27]These incidents occurred during the maintenance periods ended April 17, May 29, and October 16.

[28]In the week preceding this operation, conditions in the funds market had been soft because a weak payroll employment report and favorable inflation data had encouraged expectations of an imminent policy easing. During this week, the Desk arranged four rounds of MSPs, in part to communicate that policy remained unchanged, but at the time estimated reserves were close to path or showed only a modest reserve surplus. These draining operations helped give rise to the estimated reserve shortage on April 15.

that trading conditions in the funds market could be indicating that the reserve estimates were inaccurate, and, as always, the Desk was mindful that its actions could encourage speculation about the stance of policy. At times, reserve operations were formulated with the expectation that in later trading the funds rate could sink and excess reserves exceed desired levels, or that the rate could spike higher and borrowing run heavy.

On the August 7 settlement date, the Desk was guided by staff projections pointing to a very large reserve shortage even though the funds rate was only slightly above the level consistent with the FOMC's policy stance. The Desk attempted to meet the estimated reserve need by arranging a round of overnight System RPs; however, it was hampered by an unexpectedly small volume of propositions. Later in the afternoon, the funds rate touched a high of 30 percent, and borrowing climbed to nearly $5 billion. On the September 4 settlement date, the Desk responded primarily to very firm trading conditions in the funds market rather than to estimates that placed reserves above path. The firmness in the funds rate suggested the possibility of either a maldistribution of reserves or a projection error, and the Desk arranged a large volume of System RPs. Later that day, the federal funds rate plummeted, closing at ⅛ percent as the Desk's original reserve estimates proved correct.

Open market operations and reserve management

Changes in the System portfolio

In 1991, the System's portfolio of U.S. government securities expanded by a record $31 billion, a rate of growth more than double that of the preceding year and the average annual increase between 1981 and 1988.[29] (The portfolio fell in 1989.) Close to two-thirds of the increase was in Treasury bills, but the Desk also purchased a substantial amount of Treasury coupon issues. The Desk acquired from official foreign accounts a large volume of coupon securities, mostly of relatively short maturity, because several accounts were making large sales at times when the Desk wished to add reserves.[30] Some of the foreign account sales raised dollars to pay obligations stemming from Desert Shield and Desert Storm, while others were part of portfolio restructuring efforts by these accounts. Sales and redemptions of Treasury securities by the Desk in 1991 were negligible, and as in the preceding year the Desk undertook no outright sales of Treasury debt in the market.

The rapid growth in the System's portfolio supported strong overall demand for reserves as M1 grew rapidly and banks established required clearing balances. It also offset changes in operating factors that significantly reduced reserve supplies. In addition to offsetting the typical reserve drain from domestic currency, the Federal Reserve continued to reduce its holdings of foreign currencies, working down the unprecedented buildup of 1989.

Forecasting reserves and operating factors

In formulating its reserve strategy, the Desk makes use of estimates of the demand for and supply of reserves. Forecasts of the demand for reserves are based on estimates of required reserves and expectations for excess reserve demands. Projections of the available supply of reserves are derived from forecasts of various operating factors. In 1991, the accuracy of forecasts for most factors affecting reserve needs in a maintenance period usually improved as each period progressed, reflecting the availability of additional information. Still, large revisions coming late in the period did sometimes complicate the Desk's reserve management efforts. (Details of the staffs' forecasting accuracy are presented in the appendix.)

The accuracy of staff forecasts of required reserves available at the start of a period or at midperiod was about the same in 1991 as in the previous year. Excess reserves, however, were considerably harder to anticipate during the early months of 1991. Some deterioration in the excess reserve projections reflected the uncertainties about reserve needs when depositories were operating with sharply reduced required reserve balances. As banks opened required clearing balances and required reserves increased, excess reserves became less volatile and easier to predict.

Operating factors affecting the supply of reserves also proved harder to forecast in 1991 than in the preceding year. This difficulty was largely traceable to less accurate projections of the Treasury's Fed balance. Large forecast errors were made around major tax dates, with some tendency to underpredict Treasury revenues for the year as a whole. The timing of receipts into the Treasury's Defense Cooperation Account for Desert Shield and Desert Storm contributions was also difficult to anticipate. By contrast, projections of currency in circulation improved considerably in 1991. The improvement came about as the large shipments of currency overseas that had marked 1990 abated.

Primary dealers

In August 1991, Salomon Brothers Inc. announced that an internal investigation had uncovered misconduct in

[29]The appendix presents details of the 1991 portfolio changes and their causes, along with an overview of the Desk's transactions.

[30]The Desk only conducts outright transactions with foreign accounts when the orders are consistent with reserve needs.

connection with certain Treasury auctions. In the wake of these admissions, the Treasury, the Securities and Exchange Commission, and the Federal Reserve undertook a thorough review of the U.S. government securities market that included a reexamination of the primary dealer system. This review, which culminated in the publication of the *Joint Report on the Government Securities Market* in January 1992, prompted several changes in the primary dealer system that are now being implemented.[31]

The primary dealer system

Primary dealers are the Federal Reserve's private sector business counterparties. The Federal Reserve needs such counterparties because it implements monetary policy through the purchase and sale of U.S. government securities in the secondary market. These counterparties must be able to handle large orders efficiently and safely. The Federal Reserve, like any responsible market participant, wants to minimize the credit, delivery, and settlement risk associated with its transactions; therefore, it has developed criteria that its counterparties must meet to do business with it. In 1991, as in earlier years, these criteria required primary dealers to make markets across the entire maturity spectrum of Treasury issues, to maintain at least a 1 percent share of the aggregate customer volume of primary dealers, to maintain satisfactory capital, to be an active and competitive participant in Federal Reserve open market operations, and to bid meaningfully in all Treasury auctions. Seeking assurance that its standards were being met, the Federal Reserve also required that primary dealers submit reports and permit its staff to inspect dealer operations and books.

Many firms sought to achieve and maintain primary dealer status because they felt that it carried some advantages. Primary dealer designation was regarded as a source of prestige and a selling point in attracting customers. Several interdealer government securities brokers allowed essentially only the primary dealers to trade through their facilities or to obtain information about bids and offers from their video monitors. Nevertheless, another major broker has long offered access to its bid and offer information to anyone purchasing the service, and that broker has also permitted firms that were not designated as primary dealers to trade through it as long as they met the broker's own credit standards. In addition, in mid-1991, five interdealer brokers began providing price and trading volume data through a private joint venture called GOVPX.

Primary dealers also had some advantages in bidding at Treasury auctions until October 1991. They were among the group of market participants that were permitted to bid on behalf of customers and to bid without guarantee or deposit in note and bond auctions.

Changes affecting the primary dealer system

The joint agency review found that while the primary dealer system had worked well for a number of years, the system also had some drawbacks. Most notably, a public misimpression had developed that the Federal Reserve was the regulator of primary dealer firms. Moreover, the primary dealer designation had been viewed as conferring on firms a special status that carried an element of "franchise value" for their dealer operations and elevated the firms' standing in the marketplace.

To address these drawbacks and to provide for a more open system of trading relationships, the Federal Reserve Bank of New York amended its dealer selection criteria in conjunction with the joint agency review. It eliminated the requirement that primary dealers maintain a market share of at least 1 percent of total customer activity reported by all primary dealers. It also revised the capital requirements for primary dealers by specifying that primary dealers meet the capital standards of their regulators—in most cases the Securities and Exchange Commission. While the revised standards define a potential universe of counterparties that could number in the hundreds, it is not certain how many firms will be interested in becoming primary dealers. Initially, the number of primary dealers is expected to be limited because of resource constraints on Desk operations. But this group could expand further after an automated system for Desk operations is in place.

Many of the new criteria are similar to the previous guidelines. They stipulate that primary dealers make reasonably good markets to the Trading Desk, provide the Desk with useful market information and analysis, and participate meaningfully in Treasury auctions.[32] In addition, primary dealers must be either commercial banking organizations subject to official supervision by U.S. federal bank supervisors or broker/dealers registered with the Securities and Exchange Commission. Primary dealers must meet the minimum standards of

[31] This section draws heavily from the *Joint Report on the Government Securities Market* (Washington, D.C.: GPO, January 1992) and the statement by Peter D. Sternlight before the Subcommittee on Oversight of the House Committee on Ways and Means, September 26, 1991. The *Joint Report* contained a detailed description of the market for U.S. government securities and cited features that could be improved. It suggested several measures for broadening participation in Treasury auctions, strengthening enforcement of Treasury auction rules, and detecting and combating short squeezes. It also included proposed changes in Treasury auction procedures and recommendations for legislation. Our focus is on issues relating to primary dealers. Readers interested in a more in-depth discussion of the other issues should refer to the *Joint Report*.

[32] See Appendix E of the *Joint Report*.

their primary regulator and have at least $100 million of tier I capital (for commercial banking institutions) or $50 million of regulatory capital (for registered broker/dealers).

The Federal Reserve Bank of New York also indicated that it was discontinuing its dealer surveillance activities, consistent with its lack of formal regulatory authority over the firms designated as primary dealers and consistent as well with the Fed's desire to avoid fostering the public misconception that the designation represents an official "approval." The Federal Reserve will continue to evaluate each dealer's performance relative to the specified criteria on an ongoing basis, with a formal review once a year to decide whether a business relationship remains appropriate. In the event that a dealer's primary capital slips below standard, the Bank may suspend its trading relationship with the dealer until the capital position is restored. In making its determination, the Bank will consult with the dealer's primary regulator to assess whether the firm has an acceptable program to restore its capital position.

While discontinuing *dealer* surveillance, the Federal Reserve Bank of New York is undertaking an enhanced program of *market* surveillance to help evaluate anomalous market conditions that might call for reopening Treasury issues or for official inquiries into possible wrongdoing. The reporting program for primary dealers is expected to undergo some revision in conjunction with the Bank's enhanced market surveillance activities.

Broadening participation in Treasury auctions

The joint review also prompted the Treasury to consider the treatment given primary dealers bidding at its auctions. During the review, it became clear that there was a perception that primary dealers had an unwarranted advantage over other market participants in bidding at Treasury auctions. To address this perception, the Treasury took steps in October 1991 to broaden potential participation in its auctions. These steps included permitting all broker/dealers in U.S. government securities registered with the Securities and Exchange Commission to submit bids on behalf of customers at auctions, permitting any bidder to bid without deposit provided the bidder has a so-called autocharge agreement with a depository institution to provide payment for securities purchased, and raising the maximum noncompetitive award in note and bond auctions from $1 million to $5 million.

The joint agency review also examined whether a change in the Treasury's auction technique could further broaden auction participation. The report proposed an open-bid, iterative, single-price auction method in place of the current sealed-bid, multiple-price method.[33] Under the proposed approach, bidders should stand less risk of overpaying for an issue, a change that may encourage nondealer customers to bid on their own rather than through a primary dealer. In addition, successful collusive bidding is expected to be more difficult. The proposed technique, however, is feasible only with auction automation. The Treasury is currently soliciting comments on the technique.

[33]See *Joint Report*, pp. 14-16.

Appendix: Desk Activity for the System Open Market Account

This appendix summarizes the Trading Desk's outright and temporary transactions in 1991 and the factors that prompted them. It also assesses how accurately the staff was able to predict the supply of and demand for reserves during the year.

Outright changes in the System portfolio

Total System holdings of U.S. government securities grew by a record $31 billion in 1991, ending the year at $279 billion (Table A1). The rise far exceeded growth in 1990 and the average annual increase of about $14 billion from 1981 through 1988. (The portfolio fell in 1989.) Even so, the rise in the portfolio just kept pace with the rapid expansion of total marketable Treasury debt outstanding, and the System's share of that debt remained unchanged.

Composition of the System portfolio

About two-thirds of the total increase in the System portfolio was in Treasury bills. The $20 billion rise in bill holdings was a record, although it was not far above the previous record set in 1986. The growth in total Treasury coupon holdings was also large, about $11 billion, but it was exceeded by the $17 billion record increase in 1987. Almost all of the growth in coupons was in issues maturing within five years. Holdings of five- to ten-year coupons increased modestly, while the System's portfolio of long-term coupon issues edged slightly lower. Holdings of federal agency issues declined for the tenth consecutive year. With the expansion of the System's port-

Appendix: Desk Activity for the System Open Market Account *(Continued)*

folio concentrated in bills and short-term coupons and rollovers in quarterly financings remaining tilted toward the shorter options, the weighted average maturity of the portfolio fell by 2.6 months, to 37.9 months.

Bank reserve behavior

The record expansion of the System's portfolio offset large declines in reserve supplies that arose from movements in operating factors and supported substantial increases in the overall demand for reserves. Operating factors drained over $31 billion of reserves between the maintenance periods ended January 9, 1991, and January 8, 1992 (Table A2). Rising currency in circulation accounted for about two-thirds of the drain from factors. The rate of increase in currency was in line with growth during much of the past decade, with the exception of the record $27 billion increase in currency during 1990. Currency growth in 1990 had been raised by heavy shipments overseas following the Iraqi invasion of Kuwait. Shipments abroad remained very strong in the early months of 1991, at the height of the Persian Gulf crisis. They abated thereafter, and some of this currency eventually found its way back to the United States and out of circulation.

The other principal factor affecting reserves was the change in System holdings of foreign currency. The net decline in the System's holdings drained roughly $5 billion of reserves. The decline in these holdings resulted from a series of off-market transactions conducted directly between U.S. and foreign monetary authorities, and from a "dewarehousing" of some of the Treasury's foreign currency holdings at the Fed.† Net intervention in support of the dollar further reduced the Fed's foreign currency portfolio by about $400 million. Together, these transactions lowered the Federal Reserve's foreign currency holdings by about $8 billion equivalent. Two developments partly offset the impact of these operations: the Federal Reserve earned $2½ billion equivalent of interest on its foreign currency assets, and the market value of its foreign currency holdings rose a net $350 million in dollar terms.

Depository institutions expanded their holdings of required clearing balances during the year by $2 billion in order to raise their reserve balances at the Fed. For convenience, the Desk treats these balances as an operating factor, included in the "other items" category in Table A2. A rise in required clearing balances represents a decline in reserve supplies in this accounting framework. Strictly speaking, however, these balances are a source of demand for reserves.

As for other sources of reserve demand, strong growth of deposits in M1 throughout 1991 boosted required reserves. Meantime, excess reserves returned to more normal levels after having risen to exceptionally high levels around the end of 1990 because of strong year-end funding pressures and the reserve needs of depository institutions adjusting to the cut in reserve requirements.

Borrowed reserves were generally low during 1991 and played a small role in satisfying reserve demands. Nonetheless, settlement day pressures helped elevate adjustment borrowing in the period covering year-end 1991 to a level above that posted in the comparable period one year earlier. Over 1991, extended credit borrowing dropped from a low level to virtually zero.‡

Outright transactions

The Desk conducted outright operations when reserve projections suggested a large sustained need to add or drain reserves. The overall volume of outright transactions in 1991 was $31.8 billion, below the amounts in the previous two years, but the amount of outright purchases reached a record high of $31.4 billion. The almost complete absence of actions to reduce the portfolio in 1991 reflected in part the need for substantial portfolio growth. In addition, a large share of the seasonal reserve abundance that typically arises early each year had been addressed in December 1990 when the Desk drained large amounts of reserves at the time of the cut in reserve requirements. The size of the overage was also reduced somewhat by high Treasury balances through February.

Table A1

System Portfolio: Summary of Holdings

In Billions of Dollars

	Year-End 1991	Change during 1991	Change during 1990
Total holdings	278.6	+31.0	+12.0
Bills	138.7	+20.0	+11.8
Coupons	133.8	+11.3	+0.4
Agency issues	6.0	−0.3	−0.2

Notes: Values are on a commitment basis. Changes are from year-end to year-end. Figures may not add due to rounding.

†These transactions affected the holdings of the Treasury's Exchange Stabilization Fund as well. Details are provided in "Treasury and Federal Reserve Foreign Exchange Operations, May-July 1991," Federal Reserve Bank of New York *Quarterly Review*, Autumn 1991.

‡Extended credit borrowing was briefly elevated in the spring and again in the summer.

Appendix: Desk Activity for the System Open Market Account *(Continued)*

The distribution of outright transactions by counterparty and by type of security was unusual in 1991. Purchases from official foreign accounts totaled $21.2 billion, a level exceeding that of past years, because several foreign accounts were heavy sellers at times when the Desk wished to add reserves. Foreign institutions sold $9 billion of Treasury notes to the Desk, far above the amount sold in previous years.[§] Most of these purchases were of relatively short maturity issues. Heavy purchases were made from foreign accounts in February and March, thus reducing the need for outright Desk purchases in the market that often occurs in April. During the year, the Desk conducted three outright purchases of bills and one purchase of coupons, the first such market purchase since April 1989.[‖]

[§]In the previous ten years, total coupon purchases from foreign accounts exceeded $1 billion only once—$1½ billion in 1985.

[‖]The Desk bought $2½ billion of bills on May 29, $3½ billion on August 28, and $2 billion on October 30. It bought $2¼ billion of Treasury coupon securities on November 26. For operational convenience, offers in this operation were only considered for coupon securities maturing in July 1992 or later.

Table A2

Reserve Measures and Factors Affecting Reserves

	Maintenance Period Ended January 8, 1992	Change during 1991†	Change during 1990‡
Bank Reserves (In Millions of Dollars)			
Nonborrowed reserves			
Excluding extended credit	56,637	1,858	−9,843
Including extended credit	56,638	1,838	−9,841
Extended credit borrowing	1	−21	3
Borrowed reserves			
Including extended credit	522	226	−44
Adjustment plus seasonal credit	521	247	−46
Adjustment	499	266	−29
Seasonal	22	−19	−17
Required reserves[§]	56,020	4,540	−12,363
Excess reserves	1,138	−2,455	2,475
System Portfolio and Operating Factors[‖] (In Billions of Dollars)			
System portfolio	278.6	31.0	12.0
Operating factors			
Foreign currency[††]	22.6	−4.9	1.7
U.S. currency	307.2	−20.7	−26.7
Treasury balance	9.6	−2.1	−1.6
Float	0.9	−2.1	1.5
Special drawing rights	10.0	—	1.5
Gold deposits	11.1	—	—
Foreign deposits	0.5	0.2	0.1
Applied vault cash	29.6	0.7	0.6
Other items	18.8	−2.3	0.3
Foreign RP pool[‡‡]	6.7	—	−1.2

Note: Figures may not add because of rounding.

† Change from maintenance period ended January 9, 1991, to that ended January 8, 1992.
‡ Change from maintenance period ended January 10, 1990, to that ended January 9, 1991.
§ Not adjusted for changes in required reserve ratios.
‖ Sign indicates impact on bank reserves.
†† Acquisition value plus interest earnings. Revaluations of foreign currency holdings are included in "other items."
‡‡ Includes customer-related RPs.

Appendix: Desk Activity for the System Open Market Account *(Continued)*

The Desk largely restricted its activities in agency securities to rolling over maturing issues when a suitable replacement issue was available. It redeemed modest amounts of securities when new offerings were smaller in size than the maturing issue.

Temporary transactions

The Desk also met reserve needs through self-reversing transactions that helped smooth the uneven pattern of reserve availability arising from daily movements in operating factors. Repurchase agreements (RPs) were used to provide extra reserves on a temporary basis, while matched sale-purchase transactions (MSPs) drained reserves for short periods. MSPs were also arranged each day with foreign official accounts to meet their demand for an overnight investment facility. The Desk sometimes chose to arrange a portion of these MSPs in the market, as customer-related RPs, when it wanted to make a temporary reserve injection.

During 1991, there were 142 temporary transactions, up from 128 in the previous year. The aggregate value of these transactions was $509 billion in 1991, compared with $390 billion in 1990. System RPs accounted for 63 of the total number of temporary reserve injections in 1991, and for $333 billion of their total value. In 1990, the Desk arranged 61 System RPs totaling $262 billion. About half of the System RPs arranged in 1991 carried maturities of more than one business day, roughly the same percentage as in 1990. Customer-related RPs were arranged with somewhat greater frequency in 1991 than in the preceding year.

In 1991 the Desk arranged 33 MSPs in the market totaling $75 billion in value, down from 21 MSPs worth $48 billion in the preceding year. MSPs were arranged in the market with some frequency during the first few maintenance periods of 1991, when required reserves and currency fell and applied vault cash rose seasonally. A large number of MSPs were also arranged in April and May after lower than expected Treasury balances introduced reserve overages. Only 4 of the MSP transactions conducted in the market in 1991 had maturities exceeding one business day, compared with 11 the year before.

The Desk announced routine RP operations outside of the normal 11:30 a.m. intervention time on several occasions during the year. To ensure adequate propositions, it preannounced on three occasions large overnight System RPs on afternoons before days when a spike in the Treasury's Fed balance was expected to lead to an exceptionally large daily reserve deficiency.[††] The Desk also entered the market ahead of its usual intervention time seven times in 1991. Typically, it did so to ensure adequate propositions on days when the funds rate was firm and a large add need was seen. It also entered the market early on one occasion to drain reserves, dispelling a widespread misperception that a policy easing was underway.

Accuracy of staff forecasts

In planning reserve operations, the Desk takes into account estimates of the reserve need for a maintenance period. These estimates are based on staff projections of the demand for and supply of reserves. During 1991, the estimates of reserve demands and of operating factors available to the Desk were, on balance, somewhat less accurate than in the previous year (Table A3).[‡‡]

On the demand side, the accuracy of initial and mid-period forecasts for required reserves improved marginally in 1991. Forecasts of required reserves typically improved as each maintenance period unfolded and more data on actual bank deposits became available; projection misses were sharply reduced by the end of the period. A string of sizable initial projection errors (in both directions) occurred in the maintenance periods surrounding the important April tax deadline, a time when reservable deposit flows are often highly uncertain.

Excess reserves were particularly hard to estimate in the early months of 1991, when banks were struggling to learn how to manage reserves in an environment of low reserve balances.[§§] Once balances rose somewhat,

Footnote †† continued
the Treasury's regular auction cycle. The quarterly four-year note was dropped and replaced with a monthly five-year issue. The new notes, like the ones they replaced, settle at the end of each month on the same day as the Treasury's two-year notes. Hence, at the end of two of every three months each quarter, auction proceeds from newly issued five-year notes are not offset by payments on a maturing four-year note. On these occasions, the Treasury's total cash holdings rise sharply. These holdings can spill over into the Treasury's Fed balance, draining reserves, on days when the Treasury's holdings in its accounts at commercial banks are close to capacity. Large outpayments for Social Security or various government retirement plans usually bring Treasury balances down again early in the next month.

††The potential for large one-day spikes in the Treasury balance increased in 1991 as a result of changes made in

‡‡The Trading Desk uses forecasts of required reserves, excess reserves, and operating factors made by staffs at the Federal Reserve Bank of New York and the Board of Governors. The Desk also takes into account a forecast of the Treasury's Federal Reserve balance made by the Treasury staff.

§§Measurement of forecast errors of the demand for excess reserves is imprecise. As each maintenance period unfolds, the Desk supplements its forecasts of excess reserves with informal adjustments based on the observed pattern of estimated excess reserve holdings to date. Forecast misses of reserve supplies occurring on the last day of a period cannot be addressed in the Desk's operations and may be reflected in holdings of excess reserves that are higher or

the behavior of excess reserves returned to a pattern closer to that observed in earlier years.‖‖ After the first couple months of 1991, errors in forecasting excess reserves at the start of a period were typically much smaller. Forecasts tended to improve at midperiod when information on excesses or deficits carried into the period was first folded into the forecasts. Higher and more variable excess reserves increased both the average level and variability of reserve carry-ins.†††

Forecasts of operating factors were less accurate at the beginning and in the middle of maintenance periods in 1991 than in the previous year. By the final day of a period, the size of these projection misses usually had narrowed considerably and, on average, was even somewhat smaller than in recent years. There was a tendency to overstate the available supply of reserves early in maintenance periods in 1991.

Most of the decline in forecast accuracy for total market factors in 1991 reflected a deterioration in projections of the Treasury's Fed balance available at the start and in the middle of a maintenance period. A rise in period-to-period volatility in the Treasury balance most likely contributed to this loss in forecast accuracy. The mean absolute period-to-period change of this factor was $1.8 billion in 1991 and $0.8 billion in 1990; however, volatility in 1991 was not much higher than, and in some cases was well below, variability in other recent years.

As usual, some of the biggest projection misses occurred around dates requiring major payments of individual nonwithheld and corporate taxes. At these times, the size of the Treasury's revenue flows was often very uncertain, and the Treasury's total cash holdings frequently exceeded the available capacity of its accounts in the private banking system, causing large spillovers into its Fed balance.‡‡‡ A large forecast error for the Treasury's Fed balance in the January 9 period was caused in part by an unexpected decline in the total capacity of the Treasury's accounts in the private banking system.

Estimation of the Treasury balance was at times complicated by foreign official payments into the Treasury's Defense Cooperation Account for Desert Shield and Desert Storm expenses. The Desk was usually notified at

Footnote §§ continued
lower than predicted. Moreover, as noted in the text, in 1991 the Desk sometimes responded to pressures in the funds market on settlement day mornings by deliberately over- or under-providing reserves relative to estimated demands. Any resulting reserve surplus would be directly reflected in higher ex post holdings of excess reserves; a shortfall would be reflected in some combination of lower excess reserves and higher borrowing.

‖‖The variability of excess reserves also fell substantially after the first couple months of the year. The average period-to-period change in excess reserves was $525 million for all of last year, but if the first few periods are excluded, this figure drops to about $280 million, close to the 1990 level.

†††The average carry-in at large banks was $72 million in 1991, compared with $29 million in 1990.

‡‡‡Large forecast errors of the Treasury balance at the Fed occurred during the periods ended February 6, June 26, July 10, September 18, and December 25, periods that included or began soon after an important tax date. In 1991, unlike earlier years, forecast errors for periods following the April 15 tax date were not particularly large.

Table A3

Approximate Mean Absolute Forecast Errors for Various Forecasts of Reserves and Operating Factors

In Millions of Dollars

	1991			1990		
	First Day	Midperiod	Final Day	First Day	Midperiod	Final Day
Reserves						
Required	290-320	170-200	70-80	300-320	195	70
Excess	300-340	220-250	—	125-150	115-135	—
Factors	1,200-1,280	600-820	50-60	1,010-1,030	530-570	70-95
Treasury	865-890	480-660	40-45	630-670	380-430	45
Currency	330-410	170	15-20	500	210-280	30
Float	230-280	140-150	40-50	190-225	140-170	35-40
Pool	330	115	10	260	120	10

Note: Ranges indicate varying degrees of accuracy by the New York Reserve Bank and Board of Governors staffs.

Appendix: Desk Activity for the System Open Market Account *(Continued)*

least a day in advance of such payments, but on occasion there was little or no advance notice. These payments were especially heavy during March and led to a large underestimate of the Treasury's Fed balance for the period ended April 3. (The Treasury tax and loan accounts at commercial banks were at or near capacity at this time, forcing the flows into the Treasury's Fed account.) Moreover, as in 1990, unexpected delays in deposit insurance spending tied to the resolution of failed financial institutions tended to increase forecast errors.

These factors contributed to a tendency to underestimate the size of the Treasury's Fed balance. On average, the balance was about $500 million higher than expected at the start of each maintenance period; in 1990, the balance exceeded expectations at the beginning of each period by about $100 million. Capacity limitations caused the Treasury's Fed balance to rise above its $5 billion "target" level on about fifty business days in 1991—a much greater frequency than in 1990, when the Treasury balance exceeded this level on about fifteen days.

Initial errors in forecasting the size of the pool of temporary foreign investments increased modestly in 1991, with the size of the pool typically exceeding expectations. Some large projection misses occurred when foreign official institutions temporarily invested in this facility funds they were assembling for the Treasury's Defense Cooperation Account or for the purchase of home currency from the Federal Reserve or the Treasury. By the day the pool increased, the Fed had generally been informed.

Currency projections were more accurate in 1991 than in 1990, although forecast errors were about in line with those in earlier years. The improvement from 1990 reflected currency's return to more normal patterns of behavior as the large unexpected shipments abroad that characterized 1990 subsided after the first quarter. Projection misses remained relatively large early in the year, when these overseas shipments were still quite strong. Currency estimates were also improved by better information on shipments. During 1991, staff members charged with projecting reserves began to receive information about several major banks' net overseas currency shipments, as well as more timely data on currency shipments to and from Federal Reserve Banks.

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