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This Quarterly Review *is published by the Research and Statistics Group of the Federal Reserve Bank of New York. Statement of* E. GERALD CORRIGAN, *President of the Bank, on a framework for reform of the financial system begins on page 1. Among the members of the staff who contributed to this issue are* STEPHEN R. KING *and* ELI M. REMOLONA *(on the pricing and hedging of market index deposits, page 9);* JOHN WENNINGER *and* THOMAS KLITGAARD *(on exploring the effects of capital movements on M1 and the economy, page 21);* RAMA SETH *and* ROBERT N. MCCAULEY*(on the financial consequences of new Asian surpluses, page 32); and* BRUCE KASMAN *(on Japan's growth performance over the last decade, page 45).*

A Framework for Reform of the Financial System

Mr. Chairman, members of the Committee, I am pleased to have this opportunity to appear before you today to discuss broad-based reform of our banking and financial system. In my judgment, few issues before the Committee or before the Congress generally are more pressing or more important than is the subject of these hearings. Many of the issues and questions raised in your letter of invitation have been covered in my recent essay, *Financial Market Structure: A Longer View*, and in a major study on bank profitability completed by the Federal Reserve Bank of New York last year. Accordingly, I would ask that both of these documents be submitted for the record. I should also say at the outset that I am appearing here today in a personal capacity and not on behalf of the Federal Reserve System.

I approach the subject matter of these hearings with a deep conviction that participants in the process must rise above parochial interests. Indeed, to the extent that firms, groups of firms and their lobbyists continue to approach the process of banking and financial reform with the "winner-take-all" mentality that has been all too evident in the past, there will be no winners. What is fundamentally at issue here is not a turf war but rather how we as a nation can best see to it that legitimate public interest considerations associated with a safe, efficient and impartial banking and financial system are well served. I, for one, believe that goal is within reach, but I also believe that time and events are not in our favor. Indeed, the longer we wait, the more difficult the task becomes, and the greater the risks that an unpleasant surprise will intervene. As we all know, in such circumstances efforts aimed at reform can quickly take on a regressive, rather than a progressive, character.

Statement by E. Gerald Corrigan, President, Federal Reserve Bank of New York, before the United States Senate Committee on Banking, Housing, and Urban Affairs, on Thursday, June 18, 1987.

The case for reform

As I see it, the case for fundamental reform in our banking and financial system is compelling. The speed and scope of change we are seeing in our financial markets and institutions have taken on a revolutionary character. But, revolutions do not occur in a vacuum—they have their causes. In this particular case, many of the causes are to be found in patterns of economic performance here and around the world over the past decade or more. Over the same time frame, changing technology and innovation have fostered the application of very sophisticated forms of mathematics and computer technology to the financial marketplace, making possible the design of new techniques, new instruments, and worldwide trading and funding strategies. These developments have worked to highlight longstanding differences in supervisory, tax, accounting and regulatory treatment of classes of institutions here and abroad, thereby further sharpening competitive differences and incentives for patterns of behavior that exploit loopholes

To the extent that firms, groups of firms and their lobbyists continue to approach the process of banking and financial reform with the "winner-take-all" mentality that has been all too evident in the past, there will be no winners.

and circumvent supervisory policies. Thus, while it is beyond debate that the process of change and innovation has brought with it important benefits, there persists a nagging sense of unease—a sense of unease that is prevalent among financial market practitioners themselves—that all is not well. To some considerable extent, that sense of unease seems to grow out of the concern that legitimate broad-based public interest considerations about the structure and stability of financial markets and institutions are being swept aside in a helter-skelter of events that lacks an underlying sense of direction and may be weakening the system.

In considering this crosscurrent of events and circumstances that is at work in the financial marketplace, there is one further point that should be raised. Namely, there is also the subtle danger that the developments we are witnessing—at least at the margin—are being reinforced by a belief that the public safety net associated with banking and finance will protect not just the system as a whole but also all of its individual component parts, including those who have acted in an irresponsible and undisciplined manner. To the extent that perception exists it must be changed, for of all the freedoms contemplated by the current environment, the freedom to fail must be part of the equation. To put it differently, we simply cannot have a financial system in which even a few participants seem to believe that standards of behavior start with the maximization of profits and end with the socialization of losses.

Banking, finance and the public interest

For decades, indeed for centuries, it has been recognized that there are characteristics associated with banking and finance that warrant a higher level of official supervision than is associated with most other forms of commercial enterprise. In this regard it should be of more than casual interest to note that one of the earliest and strongest voices for the regulation of banking was none other than Adam Smith, writing in the *Wealth of Nations*. Even in this age of deregulation, the central question before us is not whether the banking and financial system should be subject to official supervisory oversight but rather how we strike an appropriate and reasonable balance between the dictates of competition and efficiency on the one hand and safety and integrity on the other.

While it is beyond debate that the process of change and innovation has brought with it important benefits, there persists a nagging sense of unease...that legitimate broad-based public interest considerations about the structure and stability of financial markets and institutions are being swept aside in a helter-skelter of events that lacks an underlying sense of direction and may be weakening the system.

Seeking to achieve that necessary balance in current circumstances runs afoul of many practical difficulties but it also is hampered by an intellectual barrier. Namely, in looking at the particular functions of the banking and financial system that are of special importance in a public policy perspective, there is something of a natural tendency to take their significance for granted and to look at them in isolation.

We simply cannot have a financial system in which even a few participants seem to believe that standards of behavior start with the maximization of profits and end with the socialization of losses.

That is, there is a tendency to say there is nothing unique or special about extending credit; nothing unique or special about making or receiving payments; or nothing unique or special about issuing transaction or demand balances. The difficulty, of course, is that these functions cannot be looked at in isolation but rather, must be viewed as something of a trilogy—the unifying force for which is that the system as a whole is a credit system in which very large amounts of claims on financial institutions must be satisfied on demand or on very short notice. Those claims include not just the stock of conventional "demand" deposits housed in depository institutions but also the hundreds of billions of dollars in debit and credit entries made daily that are now associated with our highly integrated financial markets on a worldwide basis. Therefore, each institution in the loop must not only satisfy itself that it is making all of its credit judgments in a rigorous and objective manner, but it must also have confidence that others to whom it may be indirectly exposed are doing the same. For these reasons, and because the business of banking and finance is essentially the business of public and mutual confidence, the public at large and market participants more specifically have expected and demanded a degree of official surveillance over the system—a system in which credit and credibility are the unifying forces.

The process of reform: overall objectives

While the details of efforts aimed at financial reform are very complex, it seems to me that the objectives of reform are quite straightforward and reduce to only three key elements:

- First, we want a market-driven system in which our

scarce financial resources are mobilized and allocated in the most efficient and cost-effective manner.

- Second, we want a system in which the impartiality of all elements of the credit decision-making process is preserved if not enhanced.
- Third, we want a *system* which is strong enough to withstand shocks, disruptions and failures in its component parts, even if the component part in question is large. This latter consideration is of particular importance in a setting in which some observers believe that the system is more fragile or more accident-prone than it should be or than it need be. As an extension of this, we also want a banking and financial system that is strong enough to serve as the transmission vehicle through which monetary policy influences overall economic activity.

In considering how to translate those broad objectives into a series of operational principles, I believe we must keep several related points in mind. These include:

- First, the capital resources needed to safely support banking and financial enterprises will only be forthcoming to the extent the returns on that capital are high enough to attract capital resources from alternative and competing uses.
- Second, given the realities of global financial markets, the structure we choose to adopt here must at least be sensitive to arrangements elsewhere. In that regard it should be stressed that with changes now taking place in the United Kingdom and Canada, the United States and Japan are the only remaining major countries that do not permit rather generalized blending of banking and other financial enterprises within the same corporate entity.
- Third, contrary to segments of opinion, concerns about the stability of the system are not limited to problems at large institutions. To be sure, problems at large institutions are often more difficult to deal with and will generally entail systemic considerations. But, let me remind the Committee that in 1985 we experienced a chain of events that were threatening indeed, even though "major" institutions were not a direct part of the problem.

  That chain of events began with the failure of a small Florida securities firm, which then (1) spread to Ohio where it unleashed the Ohio thrift crisis, (2) triggered the failure of a second small securities firm, which in turn (3) resulted in circumstances which came very close to putting the entire market for mortgage-backed securities into gridlock, and (4) produced the Maryland thrift crisis, including its spillover into certain real estate firms, which in turn threatened the well-being of several important mortgage insurance companies.
- Fourth, while we can draw comfort from the enhancements to the financial safety net that have been put in place over the past several decades, we should not allow that sense of comfort to delude us into thinking that arrangements that were conceived in the past are necessarily sufficient for the present, much less the future. In this regard I would want to emphasize that the speed, volume and complexity of contemporary financial markets are of a very different order of magnitude than they were even a decade ago, as is the nature of the worldwide operational, liquidity and credit interdependencies that grow out of these arrangements. When I see days in which the electronic payments flowing through the Federal Reserve Bank of New York exceed $1.5 trillion—something I see with some frequency—the realities of these worldwide interdependencies are very vivid indeed.

...the central question before us is not whether the banking and financial system should be subject to official supervisory oversight but rather how we strike an appropriate and reasonable balance between the dictates of competition and efficiency on the one hand and safety and integrity on the other.

The process of reform: guiding principles

In my own thinking about a practical approach to reform of the financial system, I have given important weight to six guiding principles that, as I see it, flow out of the broad objectives mentioned above. These guiding principles are as follows:

- First, the separation of "banking" from commerce should be preserved.
- Second, in the interest of competitive equity and supervisory harmony, the regulatory costs associated with special "banking" functions should, to the fullest extent possible, be neutralized or eliminated across classes of institutions.
- Third, the approach should provide scope for achieving the benefits of greater competition in the marketplace for financial services while preserving the important public benefits growing out of an appropriate degree of supervisory oversight of the system.
- Fourth, supervision should take account of function, not merely institutional form.
- Fifth, the structure of the system should incorporate principles of "volunteerism" whereby individual firms can choose their position on the financial landscape based on their own corporate strategies and their own assessments of the costs and benefits of one

form of corporate organization over others.

- Sixth, and most importantly, the approach should strengthen the stability and soundness of the system in part by providing greater room for self- and market-discipline but also by enhancing the strength and flexibility of the official supervisory apparatus where necessary.

Building on these principles, the structure I have suggested can be summarized as follows:

- First, the approach would maintain a basic separation between banking and commerce while permitting firms engaged in providing financial services to operate in a broad range of banking and financial product and service markets. That is, common corporate ownership of banks, thrifts, insurance companies, and securities companies would be permitted—subject to appropriate regulatory restraints—as would combinations of commercial firms and nonbank financial concerns. However, commercial firms could not own and control insured depositories. On the other hand, securities, insurance or other financial concerns could own and control insured depositories subject, of course, to appropriate supervisory policies. The approach is fully consistent with the view that "banks are special" while at the same time sensitive to the market realities associated with the provision of financial services in a contemporary setting here and abroad.

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- Second, the approach recognizes that competitive realities require that artificial distinctions between classes of financial institutions offering functionally similar financial services must be narrowed, especially as they pertain to those financial services that are of particular concern from a public policy perspective. Accordingly, the proposals would:
  - eliminate the prohibition against paying interest on transaction deposits;
  - provide for the payment of interest on required reserves;
  - make all transaction accounts subject to required reserves;
  - eliminate required reserves on nonpersonal time deposits;
  - establish an interest-earning liquidity reserve applicable to all major direct participants in the large-dollar electronic payments network;
  - broaden the class of institutions that have some form of direct access to the payments mechanism and the discount window; and
  - broaden the class of integrated financial institutions that are subject to a degree of consolidated official supervision by the Federal Reserve.
- Third, the approach would also usher in a greater degree of more balanced competition in the marketplace for banking and financial services. Indeed, by permitting combinations of financial and banking entities in a setting in which commercial firms may continue to offer a full range of nonbank financial services, the thrust of competitive forces would be driven more by market considerations. However, all of this would take place in a framework in which the supervisory apparatus associated with banking and finance would be preserved and enhanced. And, it would also be possible to phase in such arrangements over a period of time in a manner not unlike that in which regulation Q ceilings were reduced and then eliminated over a period of time under the provisions of the 1980 Monetary Control Act.
- Fourth, official supervision would increasingly take account of function, not merely form. This goal is achieved in several ways, including by virtue of the steps outlined in the second item above. Beyond those particular suggestions, the approach also contemplates:
  - the adoption of risk-based capital standards for U.S. banking organizations that would permit a convergence in such standards between U.S. banks and foreign banks and over time would also be conceptually compatible with the goal of achieving a greater degree of convergence in capital requirements, as among like classes of activities in banks and other financial entities;
  - the creation of an interagency "Financial Services Oversight Board" to insure, among other things, that a uniform definition of financial services is applied to all classes of banking and financial entities;
  - that component parts of bank, thrift and financial holding companies would be subject to direct institutional supervision in much the same fashion as is the case today but against a set of functionally based prudential and customer protection standards; and
  - that any financial organization that has access to the discount window and is a major user of the large-dollar electronic payments system would be subject to a degree of consolidated supervision by the Federal Reserve.

- Fifth, taken as a whole, the proposals provide for a high degree of choice or "volunteerism" on the part of individual business enterprises. That is, any firm that wishes to be in the business of providing banking or financial services has clear options available to it depending on how that firm weighs the costs and benefits of one corporate form versus others. Beyond that, and within each major category of enterprise, the firm would have considerable discretion—subject, of course, to appropriate regulatory restraints—to choose the specific types and forms of services it might wish to provide. And it would also be possible for firms to shift from one category to another, recognizing, of course, that a bank or financial firm that was acquired by a commercial firm or that chose to enter commercial lines of business would have to divest any depositories it owned.

...the acid test of the approach [to financial reform] is whether it would work in the direction of reducing systemic risk while at the same time leaving ample room for market discipline to play its necessary and appropriate role.

While all of the above considerations are important, the acid test of the approach is whether it would work in the direction of reducing systemic risk while at the same time leaving ample room for market discipline to play its necessary and appropriate role. Insofar as the stability of the system as a whole is concerned, there are several aspects of these proposals that clearly work in the direction of reducing vulnerabilities. For example:

- the narrowing of artificial distinctions among classes of financial institutions would work in the direction of reducing inhibitions on the regulatory side in calling for stronger prudential standards in such areas as capital adequacy;
- the incentives to move activities offshore or to the point of least supervisory purview would be reduced;
- the payment of interest on demand deposits and reserves would reduce the incentives for intraday and day-to-day churning in financial markets;
- the liquidity reserve would increase the cushion of cash balances in the system, thereby reducing intraday credit exposure and providing a thicker liquidity cushion—short of the central bank—for individual institutions and for the system as a whole;
- more open access to the payments system and finality of payment in large-dollar electronic payments systems would reduce the systemic risks in the payments system while also working in the direction of isolating problems at their source, which in turn would provide a degree of greater flexibility in official responses to problems if and when they arise; and
- providing for a degree of consolidated supervision of diversified financial firms would appreciably narrow a major gap in the official supervisory network.

In considering the factors outlined above, the most difficult question is not whether they will work in the direction of strengthening the system but rather whether they might work too well. By that, of course, I mean that there is always a danger that they will be perceived merely as extending the "safety net" and thus running the risk that the result will be a further erosion of discipline in the marketplace, since market participants may conclude that the safety net will protect not just the system but all of its component parts, even those who have acted in an irresponsible or undisciplined fashion.

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As I said earlier, that perception, to the extent it does or might exist, must be changed. To repeat, the freedoms contemplated by the current market environment must include the freedom to fail. And, by extension, the financial system must be a system in which discipline operates through prior restraints—saying "no" to unduly risky activities and transactions—and not by falling into situations in which restraint and discipline are achieved only as a by-product of instability and failure.

The separation of banking and commerce

While the current debate regarding reform of the banking and financial system has many controversial aspects, one source of debate that is especially crucial to the deliberations of the Congress relates to whether, as a matter of public policy, we should preserve a separation between banking and commerce.

I have spent countless hours deliberating the wisdom of maintaining the separation of banking from commerce. Having done that, I can say, Mr. Chairman, that if my views have changed, they have changed in the direction of further solidifying my judgment that it is in the public interest to have a legislative framework that

prevents commercial firms from owning and controlling banks unless there is some absolutely compelling reason to permit such combinations. Since I see no such compelling reason at this time, I remain opposed to such arrangements.

The case for permitting commercial firms to own and control banks is based on a view that says either that there is nothing inherently wrong with such combinations or that such combinations can provide economic benefits in a framework in which regulatory and/or managerial protections can be put in place that will insure that public interest considerations are adequately served. I, for one, have grave doubts on both accounts. In order to make that case, let me begin with several points of reference.

- First, when society vests a select group of institutions with certain privileges such as deposit insurance, access to the payments, credit and liquidity facilities of the central bank and the implicit sanctions of official supervision, something of a social compact is created whereby the institution accepts certain responsibilities, most notably the responsibility to conduct its affairs in a safe, prudent and impartial manner.
- Second, the central question at issue with respect to the banking-commerce separation doctrine is whether it is desirable for wholly unregulated, unsupervised commercial concerns to be able to own and control depositories having access to the overall Federal financial safety net. In seeking to answer the question we should, for starters, keep in mind that if we in the United States go that route, such arrangements would be unusual among the industrial countries of the world in that in no other major countries are banks, as a general matter, owned and controlled by commercial companies. To be sure, in some countries, such as Germany, banks have greater flexibility in the extent to which they may hold equity interests in commercial companies than is the case in the United States, but commercial ownership and control of banks are not common.
- Third, if, as a legal matter, commercial concerns are able to own and control banks, it seems apt to ask would they choose to do so, and if so, why? To some extent we know the answer to the first question, since at least some commercial firms already own insured depositories and others seem to have an interest in doing so. In that setting, the operative question is why they would wish to do so. Here there can be only three possible answers. First, among the alternative uses of capital, they visualize the relative returns available in banking as superior; second, they see synergies in the combination of banking with existing lines of business that will permit them to maximize the overall return on capital; or, third, they see economic advantages in gaining access to one or more of the privileges associated with banking, such as access to the market for insured deposits or direct access to the payment system. Of course in reality, the motivation might well reflect some combination of the above factors. The key point, however, is that if the motivation for commercial companies to own banks is even partly related to the second and/or third explanations cited above, there are clear dangers in permitting such combinations.
- Fourth, one might be more inclined to run those risks if there is some absolutely compelling public policy reason to do so. Satisfying the business interests of a relative handful of corporations does not strike me as a compelling public purpose. On the other hand, if there was (1) strong evidence of an absence of competition in banking or (2) strong evidence that combinations of banking and commercial concerns would unleash powerful new economies of scale which did not run afoul of public interest considerations, or (3) if the banking industry was suffering a chronic shortage of capital, one would look at banking and commerce in a different light.

The central question at issue with respect to the banking-commerce separation doctrine is whether it is desirable for wholly unregulated, unsupervised commercial concerns to be able to own and control depositories having access to the overall Federal financial safety net.

While a case can be made that the capital base of the banking industry should be further bolstered, it is by no means clear that the only way, or the best way, to remedy that problem lies with permitting commercial firms to acquire and control insured depositories. Indeed, it is not even clear that permitting commercial firms to make such investments would materially augment the true capital base of the banking industry. Whether, and the extent to which, that result is achieved would depend, among other things, on the nature of such investments, the prices paid and the manner in which the investment is financed by the commercial company. More importantly, at the end of the day capital will be attracted only by underlying profitability. Merely permitting commercial ownership of banks would seem to do little to change that unless the owners were permitted to push extensive interrelationships,

which is the very source of my concern.

- Fifth, a final consideration which is of relevance in evaluating the case for or against the separation of banking and commerce is the rather straightforward matter of how businesses conduct their affairs. That is, when we look at the manner in which large diversified bank holding companies, financial conglomerates or even commercial-financial firms are managed, do we see—especially in times of stress—an integrated approach to management, or do we see parents and offspring each willing and able to go its own way even when one or the other is faced with adversity?

  While some observers cite a limited number of examples that they believe provide evidence of failsafe managerial firewalls, I believe that any objective examination of the evidence—evidence that runs the gamut from advertising to episodes in which firms have taken large losses even in the face of ambiguities about their legal liability—leads conclusively to the view that firewalls are not failsafe and that, far more often than not, large financial concerns are managed and operated as consolidated entities. Looked at differently, the mere need to set up an elaborate system of firewalls says something about the basic issue of whether it makes good sense to prompt such combinations in the first place.

Taking all of those considerations into account, there are two major classes of risks that must be considered if we are prepared to permit the blending of commerce and banking. The first set of risks are the historic concerns about concentration, conflicts, unfair competition and breaches of fiduciary responsibilities. Interestingly enough, even most proponents of blending banking and commerce acknowledge that those risks are present. In response to this, the proponents suggest that the problem can be dealt with by regulation. However, if regulation is effective, it will, by definition, eliminate the synergies of any such combination such that the commercial firm in question is left only with a truly passive investment. If that is the objective of the commercial firm, there is nothing to prevent such firms from making large equity investments via the open market in any number of banking or financial entities so long as any one such investment does not achieve control over the company in question. Indeed, a commercial firm can buy up to 5 percent of the stock in any one bank without even having to disclose such an investment.

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The second set of risks associated with permitting the merging of banking and commerce are the dangers that such arrangements will involve the de facto extension of parts of the safety net to any firm that would own and control banks. In response to this point, the proponents argue that the situation is really no different from the situation we have today with the bank holding company. In fact, there is a very big difference and that difference is that the bank holding company—as an integrated whole—*is* subject to official supervision. Moreover, in the reform plan I have suggested, *all* component parts of a bank or financial holding company would be subject to some form of official supervision, much as they are today, *and* the company as a whole would be subject to at least a degree of consolidated official supervision.

At the extreme, the logic of the matter is unavoidable; if the bank cannot be fully insulated from the entity as a whole, the consequences are either (1) the safety net surrounding banking will have to be extended—at least to an extent—to all who would own and control banks, or (2) the safety net should be eliminated altogether.

There is another way to look at the problem. Namely, I assume that even the proponents of merging banking and commerce would agree that the acquisition of a bank by a commercial company would be subject to some sort of official approval process. I assume they would also agree that a part of that application process would have to focus on the financial strength of the acquiring firm as well as the regulatory and managerial firewalls which they agree should be constructed. I assume they would further agree that some such applications would be approved while others would be denied and that some form of ongoing monitoring would be necessary. In making this point, it should be emphasized that commercial firms wishing to own banks undoubtedly will not be limited to a few "blue chip" companies. To the contrary, the list of *potential* acquirers will include all comers—something I am convinced we should be especially sensitive to in this era of merger mania in which even solid firms can be forced into elaborate defensive financial strategies that undermine their balance sheets.

Therein, of course, lies the dilemma; that is, even the official act of approving an application of a commercial firm to acquire a bank seems to carry with it the extension of at least some elements of official oversight

to the acquiring firm in a manner that brings with it—at least by implication—an official blessing of the transaction and the relationship in question. As I see it, this subtle but certain extension of the safety net is not something we should take lightly since we must be prepared to live with the consequences in foul weather as well as in fair. Indeed, at the extreme, the logic of the matter is unavoidable; if the bank cannot be fully insulated from the entity as a whole, the consequences

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Supervisory considerations

In concluding, allow me to make a few brief comments on supervisory considerations most of which are discussed in greater detail in my essay.

- First, while there is a strong case for regulatory reform in banking and finance, it would be counterproductive to seek to legislate such reform until we know how the structure of the system itself will evolve, legislatively or otherwise.
- Second, if a financial structure reform proposal along the broad lines I have suggested were to be put in place, only relatively minor changes in the regulatory apparatus need accompany that process in the first instance.
- Third, I believe that legislation aimed at simplifying and streamlining the administrative and related procedures of the Bank Holding Company Act along the lines included in S.2858, which was passed by the Senate in September 1984, is an important priority in its own right. Indeed, these provisions, especially in a context in which product and service options for banking organizations were broadened, would greatly ease regulatory tasks for banks and for the Federal Reserve alike.
- Fourth, I strongly believe that major banking or financial firms—especially those having direct access to the central bank's payments, liquidity and credit facilities—should be subject to at least a degree of consolidated supervisory oversight by the central bank. Indeed, even with a strengthened Section 23A of the Federal Reserve Act, the nature of intra-company transactions and interdependencies is such that a degree of consolidated supervision of the entity as a whole strikes me as an essential component of any well-designed supervisory apparatus.
- Finally, banking and financial supervisory policy is going to have to move faster and further in the direction of international convergence but also in the direction of insuring that like activities are subject to the same capital and other prudential standards, regardless of where in a corporate entity those activities are conducted or booked.

The Pricing and Hedging of Market Index Deposits

Commercial banks and other financial institutions are currently devising new ways of tailoring their debt instruments to the portfolio needs of their customers. A recent innovation has been deposits with returns linked not to market interest rates but to the performance of indexes or prices in markets other than those for fixed-income instruments. These market index deposits (MIDs) offer a specified portion of any gain in a market index and guarantee a minimum return. Two U.S. banks have recently begun to issue MIDs: Chase Manhattan has deposits linked to the S&P 500 Index and Wells Fargo has deposits linked to the price of gold. This article explains the pricing of such deposits and the means by which risks to the issuing banks can be controlled by hedging.

The new deposits are similar to index and gold warrants issued in the international bond market. These warrants, however, have been available only to large investors. A few mutual funds also provide returns linked to gains in the S&P 500 and offer a floor on the value of shares. In addition, a major investment bank offers a menu of short-term instruments, called PIPs,[1] allowing investors to choose from various combinations of minimum returns and links to foreign currencies and interest rates, equity indexes, and commodities prices. MIDs differ from these other instruments in that they are both available in retail denominations and carry FDIC insurance.[2] While the focus of this paper is on banks issuing MIDs, the analysis also applies to other institutions offering instruments with characteristics of options.

Our analysis suggests that, barring a severe market downturn, banks can offer MIDs without exposing themselves to excessive risk. In principle, they can price and hedge these deposits so that they cost no more than conventional deposits regardless of market performance. To hedge, banks need only purchase the appropriate options, which provide a payoff matching that of an MID. When the right options are unavailable, as is frequently the case in practice, banks may construct synthetic ones. The strategy of hedging with synthetic options, however, has yet to be tested by an extreme market move.

We first outline the hedging of a prototypical MID and the pattern of returns that can be generated by such a deposit. A central choice that the bank must make is to determine the proportion of increases in the index that it will pass on to depositors. We show that the issuing bank faces a trade-off between the maturity, guaranteed minimum return, and proportion of index gain that it can offer at any given cost. We illustrate this trade-off for the case of a deposit linked to the S&P 500. This trade-off will not remain constant over time, and we next demonstrate the extent to which market fluctuations would have affected the terms of a hypothetical MID between July 1983 and June 1987.

We also show the return that a depositor would have

[1]These are described in *Performance-Indexed Paper: An Indexed Money Market Instrument*, by Rajiv Nanda and James Callahan, Salomon Brothers, July 1987.

[2]The minimum for the Chase index deposit is $1,000 and for the Wells Fargo gold deposit, $2,500. Even the "retail" currency

Footnote 2 continued
warrants that Citicorp has recently issued can be exercised only in lots of about $7,000 each, compared to the $55 to $80 value of the option embedded in a one-year $1,000 MID that guarantees only principal.

received over that period from an efficiently priced MID linked to the S&P 500. We contrast this return with the yield that would have been obtained from an investment in an index fund (i.e. one whose performance equals that of the S&P 500) and with an investment in a conventional bank certificate of deposit (CD). Our analysis demonstrates that investors in an MID would have realized returns that were generally between those obtained on a conventional CD and those obtained in the stock market, and with risk characteristics that also fell between these two alternative investments.

We then discuss in greater detail appropriate hedging strategies for the issuing bank. Because the strategies proposed do not perfectly hedge the bank's exposure, we assess the risks to the hedging strategy that might result from unanticipated jumps in the market index. We suggest that the risks to any bank that offers such a deposit can be attenuated *provided the bank is able to execute its hedging strategy.*

Pricing the deposit

An MID will pay at maturity either (1) a guaranteed minimum return, or (2) a fixed proportion of any gain in the market index over the life of the deposit, whichever is greater. The guaranteed return may be positive, zero, or even negative.[3] We call the fixed proportion of market gain the "upside capture."[4] If the MID is efficiently priced and hedged, it will offer terms that will cost the bank neither more nor less than alternative sources of funds of the same maturity.[5]

If a bank were to offer such a deposit without hedging it, then the cost of the deposit would be unknown at the time the bank issued it. Only when the deposit matured, and the value of the market index became known, would the bank know its cost. If the market were to remain constant or fall, the cost of the deposit would be simply the guaranteed minimum return. If the index were to rise, however, the cost could exceed the guaranteed return and, in principle, rise without limit. A bank could reduce the uncertainty about its cost of funds by hedging its exposure to such risk.

The bank could protect itself against a large increase in the index over the life of the deposit by purchasing call options on the index that expire at the same time as the deposit.[6] The calls would have a strike price corresponding to the guaranteed return on the MID. In the case of an MID that guarantees only principal, for example, the strike price would be equal to the initial index value.[7] The payoff on an index option depends only on the value of the index when the option is exercised and is independent of the previous movements of the index. Since the return on an MID similarly depends only on the value of the index at maturity, an option is the ideal hedge instrument. When the appropriate options are difficult to obtain, it may be cheaper for the bank to construct synthetic options by using other financial instruments, such as futures, sometimes in combination with purchased options. We discuss this technique, known as "dynamic hedging," below and in Appendix 1.[8] The price of an option or the cost of a synthetic one will be determined primarily by market volatility, short-term interest rates, and the option's expiration date.

For the deposit to be efficiently priced, the cost of calls purchased must be equal in present value to the potential interest payments saved—specifically, the differential between the conventional CD rate and the guaranteed minimum return on the MID. The size of this differential therefore determines the amount that the bank can profitably invest in options to hedge its deposit. The number of options the bank can purchase in turn determines the amount of upside capture it can profitably offer depositors. The upside capture will therefore depend negatively on both the guaranteed return and the price of a call option.[9]

Suppose a bank wishes to raise $1000 in one-year funds by issuing either a 6 percent one-year CD or a one-year MID with a guarantee of principal only, that is, with zero guaranteed interest. The present value of the interest payment on the conventional CD would be $56.60 ($60/(1.06)). For the same cost, the bank could offer an MID and hedge by purchasing $56.60 worth of calls with a strike price equal to the current index value. If the price of one such "at-the-money" call were $113.20 per $1,000 of the underlying asset, the

[3]By guaranteeing a floor on the return that the depositor will receive, the bank is effectively offering its depositors "portfolio insurance." Portfolio insurance is discussed in Mark Rubinstein, "Alternative Paths to Portfolio Insurance," *Financial Analysts Journal*, July/August 1985, pp. 42-55.

[4]Upside capture is sometimes called the "participation rate."

[5]More precisely, the bank should equate marginal costs across all funding sources of any given maturity. For example, the marginal cost of 6-month funds from an MID should be the same as that of 6 month funds from any other source.

[6]A call option confers on its purchaser the right, but not the obligation, to purchase at the strike price the underlying index. Settlement of an index option consists of a cash payment representing the difference between the current index value and the strike price. Options, including index options, are discussed in Laurie S. Goodman, "New Option Markets," this *Quarterly Review*, Autumn 1983, pp. 35-47.

[7]The precise relationship between the guaranteed return and the strike price is given in Appendix 2.

[8]However, the realized cost and payoff of a synthetic option no longer has the desirable property of being independent of the path that the index follows before expiration.

[9]The exact formula for the upside capture is provided in Appendix 2.

bank could purchase half a call. Because it could thus hedge only half the deposit, the bank would offer an upside capture of only one-half. If the index then rose over the year, the bank would exercise its half of a call to receive a payoff just sufficient to pay the MID depositor. If the index fell, the call would expire worthless while the depositor would be owed no interest. In either case, the MID would cost the bank the same as the conventional CD.

In principle, given MIDs that are efficiently priced, the relationship among upside capture, guaranteed return, and maturity is precise. Chart 1 shows the various amounts of upside capture that could be offered on an MID that would cost the bank the same as a conventional CD paying a 6 percent annual return. The three curves show the combinations of guaranteed annual return and upside capture for maturities of 6, 12, and 36 months.[10] On any point on any of the curves, the bank's cost for the MID is the same 6 percent annual rate. The lower the guaranteed return or the longer the maturity, the higher the upside capture.

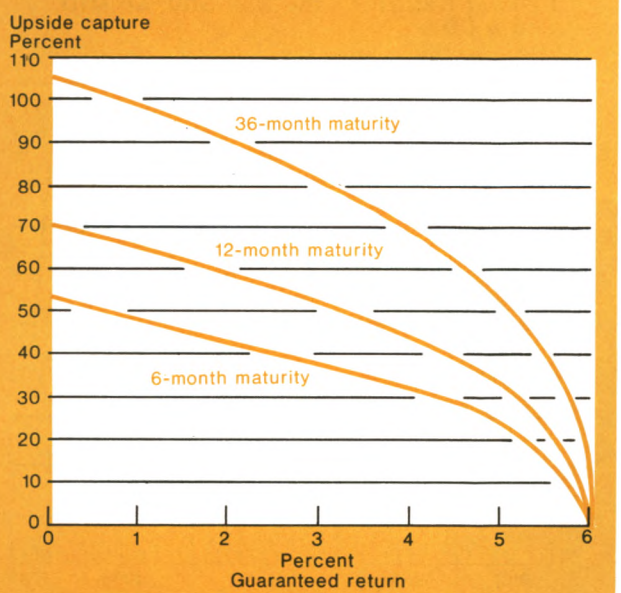
For each curve, upside capture falls to zero as the guaranteed return approaches 6 percent. If the bank guarantees a return of 6 percent—its assumed marginal cost of funds—it cannot offer any additional return linked to the index. For any given maturity, a lower guaranteed return implies a larger interest differential relative to a conventional CD and a larger sum to allocate to the purchase of options, and thereby greater upside capture. Given the guaranteed return, a longer maturity also allows greater upside capture, since the savings from the interest differential rise faster with time to expiration than do call prices.[11]

The top curve shows that if maturity is long enough, an MID can offer more than 100 percent of the gain in the stock index and still guarantee no capital loss. Such an MID, however, is not a way to beat the market. Since stock index gains represent only capital appreciation, the MID holder does not receive the dividends from the stocks underlying the index. Hence, the expected return to the depositor will be lower than that on an index fund. Chase Manhattan, for example, introduced an MID for large investors that initially offered 115 percent of the S&P 500 over three years with a guaranteed minimum return of zero.[12] Given a dividend yield of 3.5 percent on the S&P 500, the index would have to rise more than 30 percent a year for the Chase account to outperform an index fund. Since the index is unlikely to do so well for three years, investors in the account are sacrificing some expected return to protect the value of their principal.

[10]The example assumes that the CD rate and dividend yield are 6 percent and 3.5 percent, respectively, and that market volatility on the S&P 500 is 17 percent. These assumptions are consistent with actual market conditions in the first half of 1987.

Chart 1

Upside Capture, Guaranteed Return, and Maturity



Note: The results are computed as described in Appendix 2 using the Black-Scholes model. We assume a dividend yield of 3.5 percent and a marginal cost of funds of 6 percent.

Deposit behavior over time

To get a sense of the effect of actual market conditions on MIDs, we can observe how these deposits would have behaved over time had they been issued in the past. Such a demonstration serves to illustrate the risk and return characteristics of an MID in comparison with those of alternative instruments. In this section, we track the behavior of hypothetical 90-day MIDs with zero guaranteed return, assuming they had been issued each month from July 1983 through June 1987. First we illustrate the upside capture a bank could have offered. We then compare the performance of the MID with that of an index fund and a conventional CD.

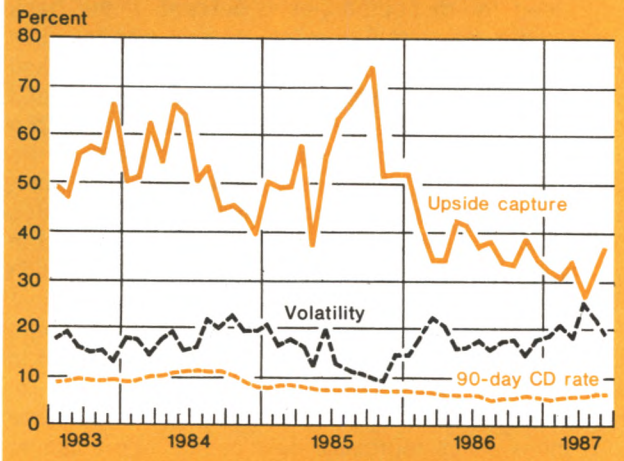
Upside capture—Chart 2 plots the monthly upside capture that a bank could have offered on the 90-day

[11]This property can be shown from the formula in Appendix 2. See also Chapter 5, "An Exact Pricing Formula," in John C. Cox and Mark Rubinstein, *Options Markets* (Prentice-Hall, 1985).

[12]Salomon Brothers has issued SPINs offering the greater of a guaranteed return of 2 percent and 100 percent of the percentage increase in the S&P 500 over four years.

Chart 2

Upside Capture and Its Determinants



Note: The chart shows the upside capture of a 90 day MID with guaranteed return of principal, and its two key determinants: the annual volatility implied by traded call option prices and the interest rate on conventional CDs.

MID with zero guaranteed return. The feasible upside capture is chosen so as to cost the bank the same amount as a conventional 90-day CD issued in the same month.[13] The chart shows two principal determinants of upside capture: the volatility of stock returns and the interest rate on the conventional CD. The CD rate and upside capture are both generally high at the beginning of the sample period and low towards the end. This pattern reflects the fact that when CD rates are high, the bank's interest savings allow the purchase of more call options. Month-to-month variation in the upside capture, however, is dominated by movements in volatility,[14] which has a major influence on the price of the relevant call option. The chart also shows that a bank offering efficiently priced MIDs would be expected to change the terms of the deposit—at least one term among the guaranteed return, upside capture, and maturity—quite sharply over time.

Risk and return—Although an efficiently priced MID will cost the bank the same as a conventional CD, the yield that a depositor actually receives will not, in general, be expected to equal the CD rate. Indeed the MID would be expected to yield a return that is higher on average than that on a CD, but one that is more variable. Chart 3 plots the annualized returns on: (1) the S&P 500 with dividends reinvested,[15] (2) the 90-day MID (with the same upside capture as in Chart 2), and (3) a 90-day CD. The returns are computed ex-post, that is, they represent the yield that an investor would have realized over 90 days, rather than the yield the investor had expected at the time of the investment.

The chart illustrates vividly the differences between returns on the alternative investments. The role of the MID in putting a floor on the returns is apparent from the fact that the MID line never dips beneath zero. The cost of this floor protection is shown clearly by the fact that the MID investor would receive only around one-half of the positive yields that a stock market investor would obtain. It should be stressed, however, that had the market fallen over the period, rather than risen, the MID investor would have benefited more frequently from the floor protection provided by the MID. Between July 1983 and March 1987, the mean ex-post annualized yield on the efficiently priced MID was 9.3 percent, compared to 19.1 percent on the S&P 500, and 8.5 percent on the 90-day CD. The standard deviation for

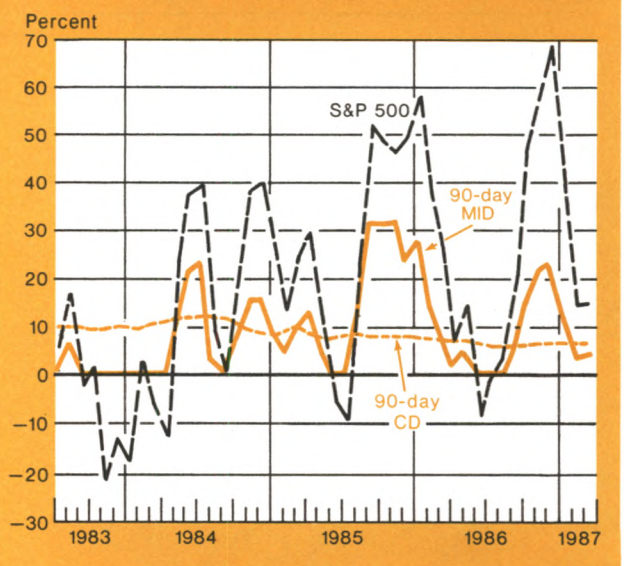
[13]The feasible upside capture is computed iteratively using the principle described in the previous section (and specified precisely in Appendix 2), together with the Black-Scholes formula.

[14]The volatility measure is an average for the month of the volatility implied by current call option prices and the Black-Scholes formula.

[15]Equivalently, the chart plots the yield that would be obtained by investing in an S&P 500 index fund.

Chart 3

Ex-Post Return on the S&P 500, an MID, and a CD



Note: The figure shows ex-post 90-day returns on the S&P 500 including dividends, a conventional CD, and an MID with no guaranteed interest rate.

the MID return was 10.1 percent, less than half that for the S&P 500, which was 23.0 percent.[16]

Choice of hedging instrument

A bank issuing a market index deposit could hedge its risk exposure with a number of alternative instruments, used separately or in combination with each other. To hedge a deposit linked to a stock index, the bank could use the stocks comprising the index, index options, index futures, or options on index futures. To hedge a deposit linked to a commodity price, the bank could use the actual commodity, commodity futures, or options on commodity futures. We discuss below the advantages and disadvantages of these alternative hedging instruments.

Listed options—The hedging instruments that are the simplest conceptually would be exchange-traded European options[17] with maturities and strike prices matching exactly the terms of the deposit. If such options were available, the bank using them would be exposed to no hedging risk other than the credit risk of the exchange. The Chase and Wells Fargo deposits, for example, are issued weekly and should be hedged with European calls expiring each Tuesday, the day on which the deposits mature. While some listed index options are European, they expire at most once a month and are not available for maturities longer than five months, with most of the trading concentrated in the nearest months.[18] Listed options on index futures are American, expire only quarterly and are not available for longer than three quarters. Strike prices for either type of option on the S&P 500 are available only in increments of five index points. The mismatch in maturities or strike prices would make the use of listed options more expensive than is necessary for the hedging bank's purposes. Hedging with an option expiring after the deposit matures, for example, would mean paying for some of the remaining time value of the option.

Over-the-counter options—The bank could hedge with over-the-counter European options, which might be tailored to have exactly the right maturities and strike prices. This approach, however, is likely to be infeasible because of the lack of liquidity in this market. The bank would have to find suitable option writers each time it issued a deposit.

Stocks or commodities—In the absence of appropriate options, the bank could create synthetic options by holding a portfolio of stocks or commodities and adjusting its position in response to price movements. Using a method known as "dynamic hedging," the bank could, in principle, replicate the risk-return profile of any option by taking varying positions in the underlying asset and cash. In the case of an index option, the underlying asset would be the portfolio of stocks making up the index. In the case of a commodity option, the asset would be the physical commodity. We illustrate the operation of dynamic hedging in Appendix 1.

A shortcoming of dynamic hedging is that the method works imperfectly in practice. As we explain in the next section, the method is subject to tracking error and execution risk, which allow only an approximate replication of options. How close the approximation is depends on the skill of the hedger and the state of the market. Moreover, positions are revised so frequently in dynamic hedging that transactions costs are significant. One practitioner has estimated that the transactions costs involved in replicating a one-year option on the S&P 500 with stocks would amount to 56 basis points.[19] In commodity markets, transactions costs are likely to be even higher.

Futures—Synthetic options could be created out of futures instead of the underlying asset. Futures usually have the advantage of liquidity; the markets in the S&P 500 index futures and in gold futures are both highly liquid. As a result, it is relatively cheap to transact trades. In the case of the S&P 500, for example, dynamic hedging implemented with futures is estimated to entail transactions costs only one-third those of hedging with stocks.[20] Futures, however, are one market removed from the market on which the relevant index or commodity price is based. Since arbitrage between markets is imperfect, some mispricing of futures relative to the underlying asset is to be expected. Moreover, this mispricing—or "cash-futures basis"—works against the dynamic hedger. Despite this limitation, however, futures tend to be the preferred instrument for dynamic hedging because of advantages in liquidity and transactions costs.

[16]These numbers can also be compared to an ex-post mean annual yield of 9.1 percent on a 90-day MID with a guaranteed minimum return of 1 percent. In this case, the standard deviation was 9.3 percent.

[17]A European option permits exercise only at the expiration date. By contrast, an American option may be exercised on or before expiration.

[18]Since American options allow early exercise, they may be more expensive than European options with otherwise identical terms. For purposes of hedging an MID, however, early exercise would be necessary only if options with the same maturity as the MID were unavailable. Hence, if both types of options had the right maturity, the bank would prefer the European. Of course, if maturities cannot be matched precisely, American options would be preferable to European options, since the former can be exercised as deposits mature. European options include those on the Institutional Index (on the American Stock Exchange) and the S&P 500 (on the Chicago Board Options Exchange).

[19]See Rubinstein, "Alternative Paths."

[20]See Rubinstein, "Alternative Paths."

Risks of dynamic hedging

Dynamic hedging has become a familiar technique in portfolio insurance, and there is now some experience with its performance under moderate market conditions. The technique entails buying more of futures or the underlying asset as prices rise, and selling off as prices fall. Buying high and selling low in this way necessarily implies capital losses. In the absence of transactions costs, these losses should equal in present value the price of the option being replicated. However, two specific types of problems arise with option-replicating strategies: (1) tracking error and (2) execution risk.[21] We discuss these two problems in terms of hedging with futures for MIDs.

Tracking error—Tracking error occurs when the hedger fails to hold the right positions in futures that will replicate the call option. The exact positions are calculated from an options-pricing model. We consider below three conceptually distinct reasons why the hedger might fail to hold the correct positions: (1) inadequacies of the model used, (2) variations in the cash-futures basis, and (3) incorrect forecasts of index volatility or short-term interest rates. One practitioner estimates the cost of tracking error from the three sources together for hedging with index futures to be typically about 20 basis points.[22] This cost is in addition to transactions costs, which, as we have pointed out, are also significant in dynamic hedging.

First, the assumptions underlying the options pricing model may be violated, in which case the model may fail to simulate the actual market precisely. Second, the cash-futures basis is such that futures generally trade at a premium when prices are rising and at a discount when prices are falling. Since the dynamic hedger buys as prices rise and sells as prices fall, this systematic mispricing adds to the cost of the strategy.

The third source of error is incorrect estimation of volatility or interest rates. If volatility is underestimated at the time the MID is priced, the deposit will end up costing more than anticipated. The hedger will be buying at high prices and selling at low prices more frequently than anticipated, thereby incurring greater capital losses than expected. On the other hand, if volatility is overestimated, the hedger will make larger trades than are warranted by price movements, and the MID will still end up costing more than necessary. In Chart 4, we show the losses the bank would incur if it incorrectly estimated volatility in hedging a 90-day deposit linked to the S&P 500 with zero guaranteed minimum return. The relationship is not quite linear even for an at-the-money option. However, over a wide range of volatilities, the bank would lose 20 basis points for each 1 percent error in the volatility estimate.[23]

Similarly, if short-term interest rates are initially underestimated, the deposit will end up costing more than anticipated. Unlike volatility changes, however, interest rate changes are easily observed, so the hedging program can in principle be revised to replicate the appropriate option at the lowest cost possible.

Execution risk—Execution fails when the hedging bank is unable to adjust its portfolio sufficiently rapidly in response to price movements. This risk is illustrated in the final section of Appendix 1. Clearly the problem is most severe when the hedger is obliged to make large transactions at the same time that the market price is changing rapidly. When the option is deep-in- or deep-out-of-the-money, or when the expiration date of the option is distant, the hedge adjustments required by the synthetic option are generally small. However, when the asset is close to maturity and near-the-money, the logic of dynamic hedging will imply large portfolio changes.

[21] Appendix 1 provides an illustration. For an introductory exposition, see Mark Rubinstein and Hayne Leland, "Replicating Options with Positions in Stock and Cash," *Financial Analysts Journal*, July/August 1981, pp. 63-72. Since option-replicating strategies involve considerable amounts of trading, the hedger may also be exposed to problems that might arise in existing settlement and payments systems.

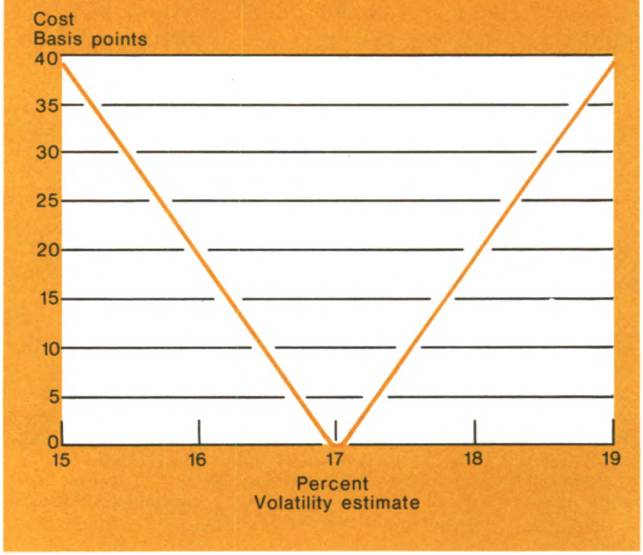
[22] This estimate assumes the hedging program is executed well. See Richard Bookstaber, "Does Execution Matter?" Morgan Stanley Fixed Income Research Special Report, 1987.

[23] The costs portrayed in Charts 4 and 5 were computed using the Black-Scholes option-pricing formula.

Chart 4

The Cost of Incorrectly Estimating Volatility

When the true value is 17 percent



Intuitively, these large portfolio changes result from the requirement of the technique that, just before the expiration of the option, the investor be either fully in cash or fully in the index future. The investor should be fully in cash if the option is out-of-the-money, and fully in the index future if the option is in-the-money. If the option is at-the-money immediately before expiration, the portfolio will be 50 percent invested in cash. The bank will then be faced with trading half of its portfolio in a very short period of time.

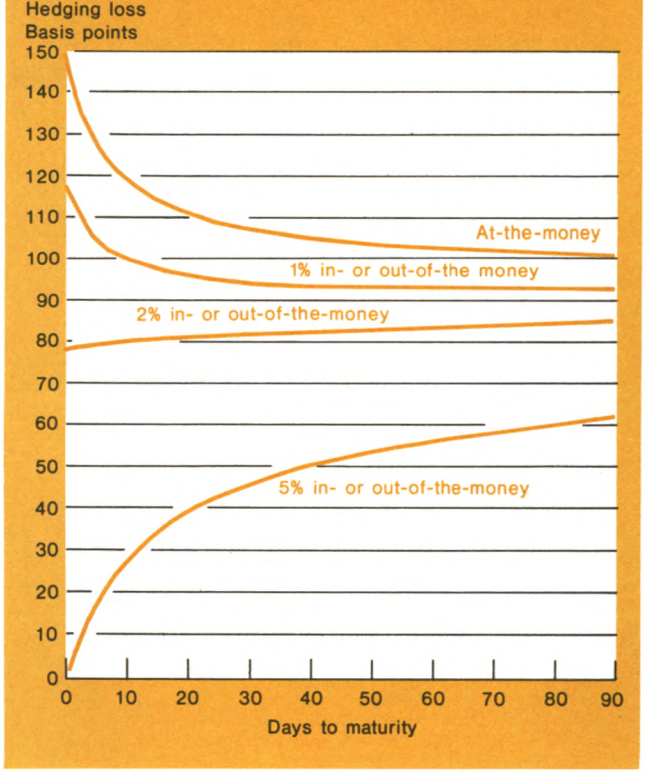
We can calculate the potential costs of execution risk in a "worst case" scenario. We assume that the hedger is completely unable to execute any portfolio transactions at a time when there is an adverse 4 percent shock to the S&P 500 index.[24] Chart 5 shows how the cost varies with time to maturity and "closeness-to-the-money" for a 90-day deposit under current market volatility and interest rates.[25] As we explained above, the largest costs are incurred on an at-the-money option that is close to maturity, and these can be as high as 150 basis points.[26] Options that are "away-from-the-money" suffer lower costs at all maturities. The chart demonstrates that an option that is 5 percent away-from-the-money suffers very little from an unexpected price change that occurs near maturity, because the change makes little difference to the probability that the option will expire in-the-money. The chart suggests that a bank dynamically hedging $100 million of 90-day MIDs outstanding would expect to lose between $400,000 and $1 million in this scenario. Having said this, we should emphasize that the performance of synthetic options has not been tested in market conditions more adverse than those assumed above. It is possible that actual trading losses could exceed the above amounts.

[24]This was the magnitude of the decline in the S&P 500 on September 11, 1986, the third largest single-day decline in history. William Brodsky, Chairman of the Chicago Mercantile Exchange, stated that few portfolio insurers were practicing intraday adjustment at that time. He further noted that few portfolio insurers were able to execute on January 23, 1987, during the 70 minutes when the S&P 500 dropped 6 percent, producing a record trading range for a day.

Chart 5

Execution Risk and Time to Maturity

Cost of an unhedged 4-percent price change



Conclusion

Commercial banks have recently begun to attract funds by offering accounts that return to depositors the greater of a guaranteed minimum return and a proportion of any increase in a market index. Such a market index deposit potentially exposes the issuing bank to considerable risk. We have shown, however, the ways in which the issuing bank can minimize its risk when liquid instruments are available for hedging.

Clearly, investors with access to options or futures markets could to some degree replicate the investment characteristics of MIDs. Such replication, however, would be impractical for small investors. Existing MIDs may appeal to the latter group because they offer straightforward access to options with low transactions costs and FDIC insurance, and because they require minimal effort on the part of the investor.

For MIDs to appeal to larger investors, banks will have to offer more than simple convenience; they will have to provide value added. MIDs could be attractive to some investors, particularly institutions that are not large enough to replicate at reasonable cost the risk-return profile that the deposit offers. Deposits linked to an index on which there are no publicly traded options with

Footnote 24 continued
(See *International Financing Review*, March 21, 1987, pp. 1001-1005.)

[25]The costs are calculated as the difference between the theoretical price of a call option immediately before and immediately after the 4 percent index shock.

[26]Execution risk in dynamic hedging can be reduced by combining futures with purchased options in a technique called "delta-gamma hedging." See *Recent Innovations in International Banking*, Bank for International Settlements, Basel, April 1986, pp. 101-120.

the maturity that the bank offers would therefore represent potentially viable products. In such a case, the bank would be providing portfolio insurance by using dynamic hedging techniques that would be uneconomic to the individual investor. It remains to be seen if this type of wholesale deposit will prove to be more successful than competing financial instruments.

Stephen R. King
Eli M. Remolona

Appendix 1

Hedging the Market Index Deposit: A Simple Numerical Example

With this numerical example, we first show various ways to hedge a market index deposit (an MID) using options, stocks, and index futures. Then we illustrate the execution risk of a hedge that relies on a synthetic option of either stocks or futures.

Pricing the MID

An MID that is properly priced and hedged must cost the issuing bank neither more nor less than alternative sources of funds regardless of index performance.

Consider an MID linked to the S&P 500 Index. Suppose the current value of the index is 300. Divide the time until the deposit matures into two periods. Over the first period, the index can move with equal probability either up to 336 or down to 267. If it moves up to 336, then over the second period it can move to either 376 or 300. If it moves down to 267, then it can move to either 300 or 238. These index movements result in three possible outcomes, as shown in the top panel of Figure A-1. Outcome I represents a gain of slightly more than 25 percent over two periods; in outcome II there is no gain or loss, and in outcome III there is a loss of about 21 percent.

Suppose the marginal cost of bank funds, say the interest rate on a conventional CD, is 8 percent over two periods. Suppose also the MID pays a minimum return of zero (that is, only the principal is guaranteed). Then under outcomes II and III, the MID pays zero while the conventional CD pays 8 percent. For the MID to cost the same as the alternative source of funds under these outcomes, the spread between zero and 8 percent must be the cost of the hedge. Specifically, on a deposit size of D, the hedge must cost $0.08 \times D$ at maturity or $0.08 \times D/1.08$ at the start of the first period.*

One way to hedge would be to purchase call options on the index with the same maturity as the MID and a strike price equal to the initial value of the index.† Under outcome I, the call would be worth 76 index points at maturity (an index value of 376 minus a strike price of 300) and zero under outcomes II and III. The call would end "in-the-money" under outcome I, "at-the-money" under outcome II, and "out-of-the-money" under outcome III. The bottom panel of Figure A-1 shows how the price of this call would move with the index. At the start of the first period, the price of the call would be about 30 index points. If the index rose to 336 at the end of the first period, the price of the call would be about 48 index points, and if the index fell to 267, the price would be zero.‡

Suppose the deposit principal is $3,000 and an index point is worth $10. If the bank held one call against the MID, the proceeds from the call at maturity would allow the bank to pass on to depositors the entire gain in the index should it rise, and to guarantee the principal should the index fall. Under outcome I, the bank would exercise the call at maturity to receive $760 (76 index points times $10 per point), an amount that would be just sufficient to pay on the MID a return equal to the percentage change in the index. Under outcomes II and III, the bank would not exercise, thus losing no money on the index and thereby retaining its ability to guarantee the deposit principal. However, to purchase a call in the beginning would have cost the bank $300 (30 index points times $10 per point), while the spread between the cost of funds and the minimum return specifies a hedge costing only $222 ($0.08 \times \$3000/1.08 \approx \$222$). If the bank held one call against the MID and the call ended out-of-the-money, the MID would turn out to be a more costly source of funds than a conventional CD.

The cost of the hedge requires the bank to purchase

*If r^G is the guaranteed minimum return and r is the cost of funds, the cost of the hedge must be $(r - r^G) \times D$ at maturity or $(r - r^G) \times D/(1 + r)$ at the start.

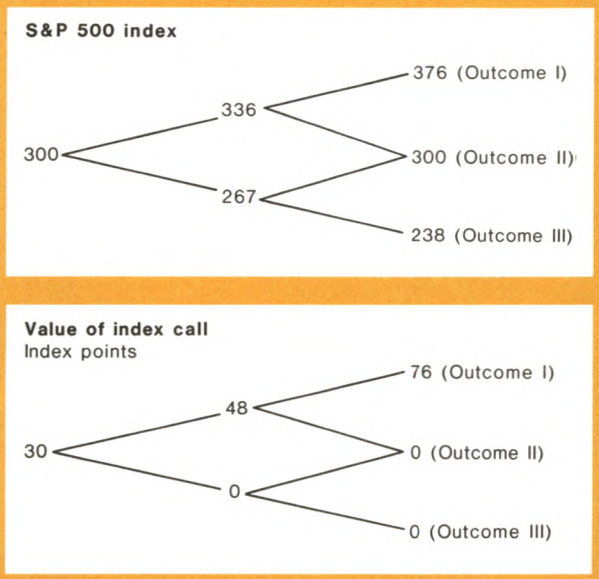
†If the guaranteed minimum return is r^G and the offered proportion of index gain is ϕ, the strike price should be $1 + r^G/\phi$ times the initial value of the index. Hence, in the case where $r^G > 0$, the option price and proportion of index gain have to be solved for simultaneously.

‡Option prices here assume that writers of the index call face the same 8 percent cost of funds and that the stocks underlying the index pay no dividends. The prices are derived using the binomial approach in Cox, Ross, and Rubinstein, "Option Pricing: A Simplified Approach," *Journal of Financial Economics*, Vol. 7 (1979), pp. 229-263.

Hedging the Market Index Deposit *(continued)*

Figure A-1

Index Movements and Value of Index Call



just three-quarters of a call ($222/$300 ≈ 3/4) and thus to offer to compensate the MID depositor for only 75 percent of the gain in the index. Hence the relationship between minimum return and upside capture (or proportion of index gain) can be expressed in terms of (1) the price of an appropriately specified option, and (2) the spread between the bank's marginal cost of funds and the minimum return it guarantees. In Appendix 2, we present the general formula for this relationship.

Hedging with a purchased call

The table shows how the hedge would work on the $3,000 MID offering 75 percent of the gain in the index. Under outcome I, the bank would pay the depositor a return of 19 percent (0.75 times the index gain) or $570. This payment would be fully covered by the exercise of the three-quarters of a call the bank would be holding (3/4 times $760 option value at maturity is $570). Under outcomes II and III, the bank would pay no interest on the MID, and the call would expire with zero value. Given the 8 percent cost of funds, the $222 starting price of three-quarters of a call would cost the bank $240 at maturity (1.08 × $222), an amount equal to the interest that the bank would pay if it took the $3,000 as a conventional CD. Hence, the MID would cost the bank neither more nor less than a conventional CD under any outcome.

Hedging with a stock portfolio

With dynamic hedging, the bank may also hedge by actively trading a portfolio of stocks replicating the S&P 500 Index.§ The idea is to hold a portfolio with the same risk profile as the index call—in effect, to construct a synthetic option. At each point in time, the size of the stock position we need for the synthetic index call is given by the option's "hedge ratio" or "delta," usually computed from an options-pricing model such as Black-Scholes. In our example, the delta at the start of each period is calculated as the ratio of (1) the difference between the high and low values of the index call on the next move, and (2) the difference between the high and low values of the underlying index on the next move.‖ Hence, at the start of the first period, (1) is 48 − 0 = 48, and (2) is 336 − 267 = 69, so the delta is about 0.7 (≈48/69). At the start of the second period, there are two possible deltas. If the index rose to 336, the delta would be (76 − 0)/(376 − 300) = 1. If the index fell to 267, the delta would be (0 − 0)/(300 − 238) = 0.

§One way to do this would be to trade shares in an index fund based on the S&P 500.

‖Again see Cox, Ross, and Rubinstein, "Option Pricing." In general, the delta depends on the interest rate, the current price of the underlying asset, the volatility of the asset's return, the strike price, and the time to maturity.

Cash Flows for a Hedged MID and a Conventional CD

	Starting Date	Maturity Date: Outcome I	Maturity Date: Outcomes II and III
S&P 500 MID			
Take MID	3,000	−3,570	−3,000
Borrow at 8%	222	−240	−240
Buy 3/4 call	−222	570	0
Total	3,000	−3,240	−3,240
Conventional CD			
Take deposit	3,000	−3,240	−3,240

Assumptions: The MID pays 0.75 of the gain in the S&P 500 Index and guarantees the principal. The outcomes refer to Figure A-1 with each index point assumed to be worth $10.

Hedging the Market Index Deposit *(continued)*

Figure A-2 shows how the bank would construct the synthetic option needed to hedge the $3,000 MID offering 75 percent of the market gain. At the start of the first period, a delta of 0.70 applied to three-quarters of a call tells the bank to buy an S&P 500 stock portfolio worth $1,575 (0.70 × (3/4) × $3,000), financing its purchase with funds costing 8 percent.

If the index then rose to 336, the value of the portfolio underlying one index call would be $3,360 (336 index points times $10 a point). A delta of one for three-quarters of a call would then tell the bank to hold a stock portfolio worth $2,520. Since the stock portfolio carried over from the first period would now be worth about $1,760,¶ the bank would buy $760 more of the portfolio, again borrowing the amount for the purchase.

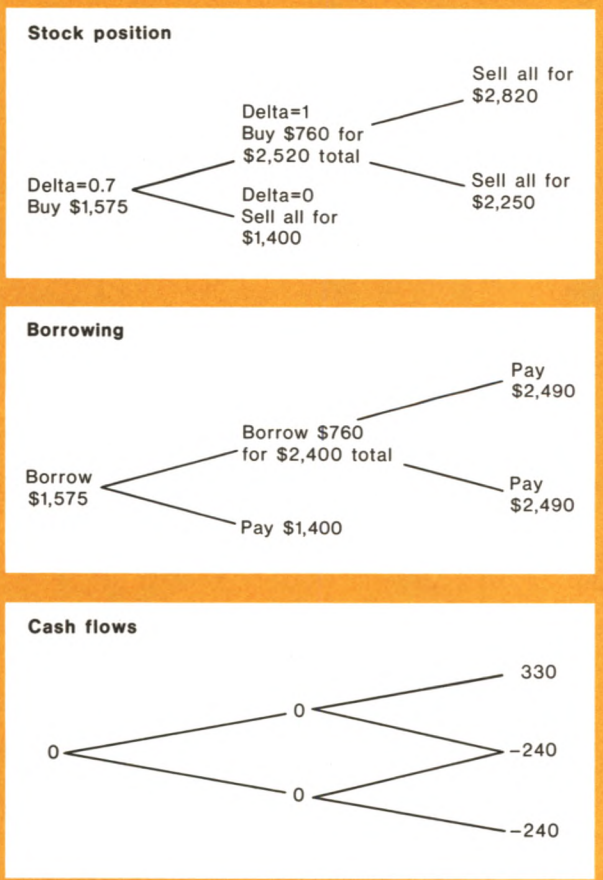
Under outcome I, the bank would end up with a stock position worth about $2,820. At the same time the bank would owe about $1,700 (1.08 × $1,575) from the first loan and about $790 from the second. After the bank liquidates the stocks and pays off the loans, it would have $330 left. Since the interest payment on the MID would be $570, the hedge and the MID would cost the bank $240 net, exactly the cost of a conventional CD. Discounted to the start of the first period, this is also the price of a purchased option, as we saw in the last section.

Under outcome II, the stock portfolio would be worth $2,250. Paying off $2,490 in loans would again leave the bank $240 short. Since the MID would require no interest, the cost of the hedge would exactly match the cost of a conventional CD.

If the index fell to 267 at the end of the first period, the bank would be holding $1,400 in stocks. A delta of zero would then tell it to liquidate its stock position. After using the proceeds to pay its loan, the bank would still owe about $235 at the start of second period or $240 at maturity. Since only outcomes II and III would be possible, the MID would require no interest, and again the cost of the hedge would be the cost of a conventional CD.

Figure A-2

Dynamic Hedging With a Stock Portfolio



Hedging with index futures

The bank may also choose to form its synthetic option out of index futures. Index futures are priced to require no exchange of cash in the beginning, except for the initial margin.** This amounts to setting the price at a premium to the underlying index to reflect borrowing costs (less dividend yield if any). During the course of the contract, each price change is settled in cash.†† The side favored by the price change receives a payment while the other side pays. As shown in Figure A-3, when the index is 300 and the "cost-of-carry" is 8 percent over two periods, a futures contract expiring at the end of two periods would be priced at 324 points (1.08 × 300). If the index went to 336 at the end of the first period, the futures price would be 349 points (1.04 × 336), and the holder would receive the cash equivalent of 25 points (349 − 324). If the index fell to 267, the futures price would be 278 points, and the holder would pay 46 points

¶Recall that we assume no dividend payments.

**The initial margin on an S&P 500 futures contract is $10,000 and each index point is worth $500.

††In practice, this is done daily. The cash settlement is called a "variation margin."

Hedging the Market Index Deposit *(continued)*

(324 − 278). At maturity, the futures price necessarily reverts to the value of the index. A final cash payment is made to reflect the last price change, and the contract expires.

Dynamic hedging with futures uses the same delta that is used for dynamic hedging with stocks. To create a synthetic index call, the bank would start with a delta of 0.70. At this point, a whole futures contract would be priced at $3,240 (at an assumed $10 per index point). However, replicating three-quarters of a call with index futures does not mean buying $1,700 worth of the contract (a delta of 0.70 times three-quarters times $3,240). Because of the cash settlement following each price change, we need to discount for the fact that the futures price reflects a two-period premium. As Figure A-3 shows, the correct amount to buy would be about $1,635 ($1,700/1.04), so that the bank, in effect, would pay only for one period of carrying costs.

If the futures price then rose to 349 points at the end of the first period, the bank would be holding futures worth about $1,760 ($1,635 × 349/324), and it would receive $125 in cash ($1,760 − $1,635) from the price change. The new delta of one would tell the bank to buy about $855 more futures for a total of about $2,615 (three-quarters of a call times $3,490). Under outcome I, the bank's futures position would be about $2,815 at maturity. The bank would receive $200 in cash ($2,815 − $2615) as final settlement. At the same time, the earlier cash settlement would have grown to about $130 (1.04 × $125), so the bank would come out $330 ahead. It would then pay $570 on the MID for a net cost of $240, exactly what a conventional CD would cost. Under outcome II, the futures position would be about $2,250. The bank would pay a final cash settlement of roughly $370. This time the MID would require no interest payment. With the earlier cash settlement, the net cost of the MID would again be $240.

If the futures price fell to 278 points at the end of the first period, the bank's futures position would decline to about $1,405, requiring a cash payment of $230 ($1,635 − $1,405). The new delta of zero would tell the bank to sell all its futures. The sale would be carried out without any further exchange of cash. At the end of the second period, the cash payment made earlier would cost the bank about $240 (1.04 × $230). There would be no interest payment on the MID and no other gains or losses from the hedge. Again the net cost of the MID would be the same as that of a conventional CD.

Figure A-4

Index Movement on Maturity Day

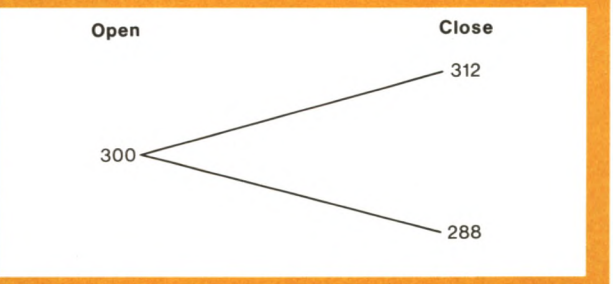
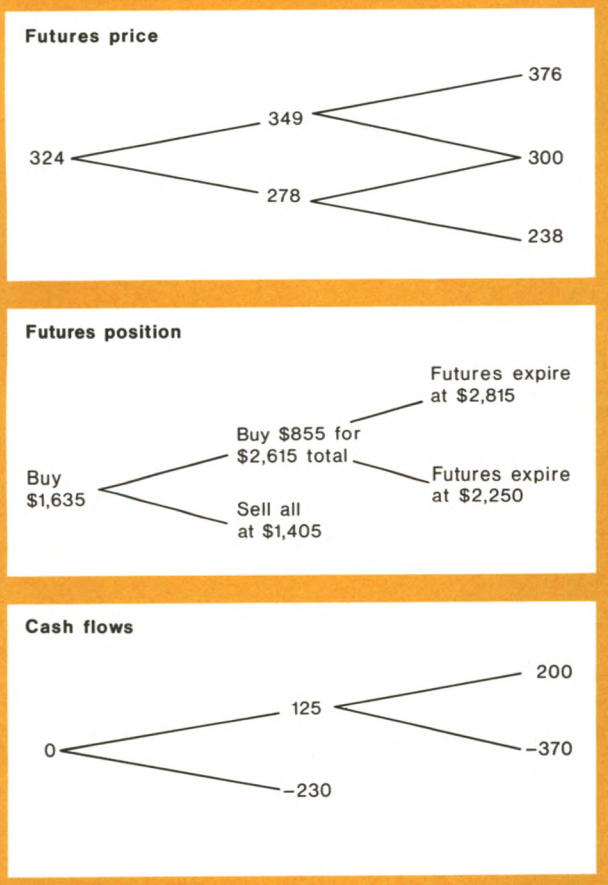


Figure A-3

Dynamic Hedging With Index Futures



Hedging the Market Index Deposit *(continued)*

Execution risk

In existing markets, large changes in either stock or futures positions are hard to execute when prices are moving swiftly. Thus a dynamic hedger faces execution risk when the delta happens to be very sensitive to prices during a period of unusually wide price swings. In this situation, the delta would require a large hedge adjustment at the very time that prices are moving too fast to allow the hedger to execute a large trade. The delta is most sensitive to prices when the option to be replicated is both near maturity and at-the-money.

In order to illustrate execution risk when the delta is most sensitive to prices, let us suppose that we have the same $3,000 MID as before. But this time, suppose that on the maturity date, as shown in Figure A-4, the index opens at 300 and can close at either 312 or 288 (with the MID linked to the closing value).§§ Hence, the trading day opens with the synthetic option being at-the-money. At this point the delta is one-half and the bank should hold (0.5) × (0.75) × $3,000 = $1,125 in stocks or futures for its dynamic hedge. Suppose that the bank is able to implement this investment position at the start of the day, but that during the day, prices move too quickly for the bank to execute any further adjustment.

If the index rose to 312, the bank would be holding a position worth $1,170 ($1,125 × 312/300), for a gain of $45 ($1,170 − $1,125). The MID, however, would require an interest payment of $90. The net loss to the bank would be $45 or 1.5 percent of the deposit principal. If the index fell to 288, the bank would be holding a position worth $1,080, for a loss of $45. Since the MID would require no interest payment, the net loss would still be 1.5 percent of principal. In theory, the accumulated cost of dynamic hedging|||| from the first day of the MID to the day of maturity would have already amounted to the cost of a purchased option. Hence, the loss on the last day would be an additional cost due to the failure of execution.

§§This is a rise or fall of 4 percent, somewhat smaller than the magnitude of the fall in the index on Thursday, September 11, 1986.

||||As the previous sections show, this cost arises from the fact that the strategy of buying stocks or futures as prices rise and selling as prices fall amounts to buying "high" and selling "low." In the absence of transactions costs, these capital losses cause the cost of dynamic hedging to equal the cost of an equivalent option.

Appendix 2

The General Pricing Formula for the MID

To hedge MIDs with maturity T years and guaranteed minimum annual return r^G, the bank must explicitly or implicitly purchase index calls with the same maturity and with a strike price corresponding to the current index value, guaranteed minimum return, and upside capture or proportion of index gain. The price of such an option will be a function of the current index value S, the strike price K, the annual volatility σ, the cost-of-carry r^C, and the time to maturity T.* The function is increasing in all its arguments but the strike price. We can write the cost of one option per dollar of the deposit as

$$C(S,K,\sigma,r^C,T)/S$$

where C(.) is a standard call price formula for the case in which the strike price is

$$K = S(1 + ((1+r^G)^T - 1)/\phi)$$

*In the case of a stock index, r^C is equal to the short-term interest rate less the dividend yield. For a commodity option, r^C is the sum of the short-term interest rate and the cost of physical storage.

and ϕ is the upside capture to be offered.

The amount of options the bank can profitably hedge with will depend on the interest it would otherwise pay on funds with the same maturity (and denomination) as the MID. The MID will be priced efficiently relative to a conventional CD if the cost of the hedge in proportion to the deposit exactly equals in present value the difference between the interest cost of a conventional CD r^D and the guaranteed minimum return offered by the bank r^G. Hence the hedge expenditure per dollar of deposit should equal

$$h(r^G,r^D) = ((1+r^D)^T - (1+r^G)^T)/(1+r^D)^T.$$

The upside capture ϕ is therefore calculated as the ratio that solves

$$\phi = h(r^G,r^D)S/C(S,K,\sigma,r^C,T)$$

where K itself is a function of ϕ, S, r^G, and T. The solution can be written as $\phi(r^D,r^G,r^C,\sigma,T)$ and can be shown to be increasing in the deposit rate r^D and maturity T, decreasing in all its other arguments, and independent of the initial index value S.

Exploring the Effects of Capital Movements on M1 and the Economy

The increased integration of international financial markets and the development of a more open U.S. economy raise the question of whether international factors are now influencing the traditional money-income and money-inflation relationships to a larger degree than in the past. This question takes on added importance because the relationships between money and other economic variables, usually estimated with only domestic variables, have been quite unstable in recent years. Hence, it seemed to be an appropriate time to explore in some detail the possibility that these empirical relationships have been significantly influenced by international factors, in particular by capital movements.

In recent years, financial markets have become more international in scope because participants have become more sophisticated, technological improvements have made information more readily available, and many countries have reduced or removed capital controls. As a result, a greater degree of substitution between domestic and foreign financial assets and the development of new financial instruments could affect the demand for money by offering money stockholders a broader array of financial assets for managing money balances. At the same time, the new instruments and greater substitutability among domestic and foreign instruments could make capital more mobile among countries. This might strengthen the link between interest rates and capital movements, making the demand for money more sensitive to capital flows.

In addition, capital flows and international financial transactions probably play a more important role in determining exchange rate movements. Changes in exchange rates, in turn, by affecting prices and the demand for domestically produced goods, could have significant effects on the growth rate of gross national product (GNP) as well as on the rate of inflation in the United States. Moreover, changes in exchange rates, by driving a wedge between domestic spending and production or income, could distort GNP as a measure of transactions in money demand equations. In addition, GNP might be made a less accurate measure of total transactions if active trading in a broader array of financial instruments is increasing the volume of transactions. Finally, such dramatic changes in international financial flows as have occurred in recent years as a result of the large swings in current account balances might also be viewed in some sense as shock variables that would shift the traditional reduced-form relationships incorporating money growth.

In general, the potential scope for international factors to affect traditional relationships between money and the economy—relationships that had focused only on domestic variables in the past—appears quite large. The more difficult task is to try to quantify some of these international influences. Beyond the already complex problem of measuring these international factors in a meaningful way is the consideration that these relationships have been affected at the same time by other factors, such as domestic financial innovation, deregulation of consumer deposits, and dramatic swings in energy and food prices.

As a result, the channels through which international factors might affect the standard relationships between money and output or prices cannot all be quantified in

this article. The issue is analyzed from several different perspectives, however, and the effects of some of these international factors are identified for relationships incorporating the narrow definition of money (M1). While it is difficult to identify the influence of foreign rates of return or interest-rate differentials on the demand for M1, there is some empirical evidence that international considerations have contributed to making GNP a less appropriate measure of transactions. In conventional reduced-form equations, which relate GNP growth to current and lagged M1 growth, the effects of the large capital flows into the United States in recent years (as proxied by foreign investment as a percent of domestic savings) and of energy and food price shocks appear to have been important sources of instability. A somewhat less conventional reduced-form equation that relates M1 growth to the federal funds rate and GNP also seems to have been affected significantly by the large capital flows into the United States. This seems to be the case even after the possibility that M1 has become more responsive to changes in interest rates in recent years has been taken into account. In the money-inflation reduced-form equation, international factors (operating from capital inflows to exchange rates and import prices) seem to have influenced prices even after money growth, unemployment, and other shock variables have been taken into account.

The next section looks at empirical results using money-demand equations, while the second section incorporates alternative money-income reduced-form equations. The third section analyzes the potential influence of international factors on the money-inflation relationship.

Section I: money demand

In this section, we explore what effects capital movements might be having on the demand for M1 by estimating standard money demand equations over various time periods. We first present standard equations that attempt to control for various domestic sources of instability in the money demand equation and then proceed to investigate the ways in which international capital movements might be affecting the demand for M1.

Corporations potentially could now be using a much wider range of foreign instruments for purposes of investing their excess domestically held money balances on a short-term basis. If so, the conventional money-demand equation may appear unstable because the opportunity cost of holding money might no longer be adequately captured by just the domestic short-term interest rate. Hence, it might be necessary to include some measure of the rate of return on possible foreign investments (or the differentials with respect to domestic assets) as well as the exchange rate. In addition, capital flows might affect the transactions variable in money-demand equations, making GNP an inadequate measure of total transactions in the economy. For example, large capital inflows and current account deficits would cause the demand for goods and services (as measured by GNP less net exports) to grow more rapidly than domestic production (as measured by GNP).

Unfortunately, very little economic literature addresses this question. For the most part, the money-demand literature focuses on domestic variables in explaining the demand for narrow money, M1.[1] The literature on currency substitution has taken a more international approach to money demand by examining how domestic residents adjust the relative amounts of their foreign and domestic money holdings. In more general international portfolio balance models, it is argued that interest rates on foreign assets and the expected exchange rate should theoretically at least be included in the demand for money, regardless of whether domestic residents hold foreign as well as domestic money balances.[2] In other words, even though domestic residents may not hold money balances in more than one currency, they may still economize on their domestic money holdings if the rate of return on foreign financial instruments becomes attractive or if they expect the exchange rate to change.

Before exploring the effects of capital movements on money demand, we first present some results using standard domestic variables. The first equation in Table 1, estimated over the 1959-73 period, provides a benchmark before various innovations and deregulation caused the demand for money to become unstable. When the sample period is extended through 1986, thereby incorporating the 1974 shift in money demand as well as the introduction of NOW accounts into the sample period, the income coefficient drops considerably, to less than half its original size. At the same time, the interest rate coefficient more than doubles in size, and the lagged dependent variable increases by one-third and approaches 1.0 in value (second equation). Now, however, with over ten years of data since the mid-1970s shift in money demand, it is possible to estimate money-demand equations that exclude the pre-shift

[1] See, for example, David Laidler, "The Demand for Money: Theories, Evidence and Problems" (Harper and Row, New York, 1985), and John Judd and John Scadding, "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, September 1982.

[2] John Cuddington, "Currency Substitution, Capital Mobility and Money Demand," *Journal of International Money and Finance*, August 1983. Also see Jaime Marquez, "Currency Substitution and the New Divisia Monetary Aggregates: The U.S. Case," *International Finance Discussion Papers*, No. 257, Board of Governors of the Federal Reserve System, July 1985.

observations (1959 to 1973). The third equation, estimated from 1974 to 1986, shows coefficients for both the real income and interest rate variables that are considerably larger than those reported for the 1959-73 period, suggesting that the demand for M1 has become much more sensitive to these variables than was the case prior to 1974.[3] The coefficient on the lagged dependent variable in the 1974-86 period is also quite large compared to the coefficient estimated for the 1959-73 period, suggesting a slower speed of adjustment.

The fourth equation shows the results when the dollar volume of NOW accounts as a percent of M1 is added to the regression equation (to allow for the possibility that the introduction of NOW accounts caused nontransactions balances to be shifted into M1). It is statistically significant, and its inclusion causes the coefficient on real income to decline in value by about one-half, while the coefficient on the interest rate variable retains its larger value. The fourth equation in a sense represents a benchmark equation that attempts to control for many of the domestic sources of instability in money demand in recent years, namely, the mid-1970s shift in money demand, the introduction of NOW accounts, and the possibility that the demand for M1 has become more interest-sensitive than in the past.

Capital flows, by affecting exchange rates and trade balances to a larger degree than in the past, could be an important additional source of instability for money demand by making GNP (a measure of domestic production) an inaccurate measure of total transactions in the economy. An indirect way of exploring this possibility would be to incorporate in the money demand equation some alternative measures of transactions such as domestic demand (GNP less net exports) or debits (a measure of total transactions, both financial and nonfinancial). Earlier work has suggested that debits would be the more comprehensive measure of transactions.[4]

[3]For theoretical reasons why this might happen, see J. Wenninger, "Financial Innovation, a Complex Problem Even in a Simple Framework," this *Quarterly Review*, Summer 1984. For some econometric results that suggest that the deregulation of consumer deposits might be making the demand for M1 more sensitive to movement in interest rates, see J. Wenninger, "Responsiveness of Interest Rate Spreads and Deposit Flows to Changes in Market Rates," this *Quarterly Review*, Autumn 1986.

[4]Debits are the total volume of withdrawals from checking accounts. Hence, except for those transactions done with currency, debits capture the total amount of transactions done with M1, whether or not these transactions are GNP-related. For more detail, see J. Wenninger and L.J. Radecki, "Financial Transactions and the Demand for M1," this *Quarterly Review*, Summer 1986. In that article it was shown that debits seem to work somewhat better in explaining the rapid growth of M1 in 1985 than did either GNP or

Table 1

Standard Money-Demand Equations*

Equation	Sample Period	Real Income	Real Debits	Three-Month Treasury Bill Rate	Debits as a Percent of GNP	NOWs as a Percent of M1	Lagged Dependent Variable	R^2	RHO
1	1959 to 1973	0.117 (3.7)		−0.012 (2.0)			0.642 (5.3)	0.95	0.49
2	1959 to 1986	0.054 (5.1)		−0.026 (5.3)			0.990 (36.0)	0.95	0.32
3	1974 to 1986	0.152 (6.6)		−0.032 (5.1)			0.935 (25.5)	0.98	0.03
4	1974 to 1986	0.082 (2.9)		−0.030 (5.7)		0.0006 (3.0)	0.938 (30.9)	0.98	0.00
5	1974 to 1986		0.032 (8.8)	−0.029 (6.1)			0.938 (32.8)	0.99	0.00
6	1974 to 1986	0.023 (0.6)	0.028 (3.3)	−0.030 (6.0)			0.934 (31.7)	0.98	0.00
7	1974 to 1986	0.051 (1.5)		−0.030 (6.0)	0.028 (3.3)		0.934 (31.7)	0.98	0.00
8	1974 to 1986		0.038 (3.2)	−0.030 (6.0)		−0.0002 (0.6)	0.934 (31.5)	0.98	0.00

*The equations are estimated in log level form and adjusted for autocorrelation when necessary. The dependent variable is real M1.

Specifically, debits may capture both domestic and international influences that are not reflected in the domestic demand variable. The results incorporating debits are shown in equation 5. This change in specification improves the R^2. Again in this case, the coefficient on the interest rate variable has a value larger than that of the coefficient estimated for the 1959-73 period.

Equations 6 and 7 attempt to use both debits and GNP together in the money-demand equation, either directly in equation 6 or as a ratio in equation 7. In both cases, real GNP is not significant when debits are included. This suggests that debits are capturing not only the transactions associated with GNP but additional transactions as well. In equation 8 we investigate whether NOW accounts still are important in explaining money demand when debits rather than GNP are used to measure transactions. In this case, the NOW-account variable is not significant, suggesting that the rapid growth in NOW accounts might not be an independent source of M1 growth in recent years once the more rapid growth of transactions as measured by debits has been taken into account.

If we consider the accuracy of the equations in predicting M1 growth in 1986, we find that equation 5, which uses debits, underestimates M1 growth by 3.3 percentage points, while equations 3 and 4 underestimate it by 5.3 and 4.6 percentage points, respectively. These results suggest that additional transactions associated with capital flows and foreign exchange may be having an effect on the demand for money by operating through the transactions variable. But since the variable captures many other influences as well, it is not possible to know how important international variables might be.

As noted above, capital movements and changes in exchange rates could also have a more direct effect on the domestic demand for money by affecting expected rates of return. To explore whether foreign rates of return are influencing the demand for money, we included two alternative interest rate differentials in equations 4 and 5. The results are shown in Table 2. The first was the three-month Treasury bill rate less the trade-weighted, short-term, foreign interest rate that we adjusted for expected movements in exchange rates by using the actual change in the trade-weighted exchange rate (these latter two variables are from the Board staff's multicountry model). The other variable was the U.S. long-term interest rate less the German long-term rate that we adjusted for expected changes in exchange rates by using the actual exchange rate. These variables were not significant in either equation, nor were the other measures of foreign rates of return variables we experimented with, such as those constructed with forward rates and ARIMA (autoregressive, integrated, moving average) model predictions of exchange rates. This, of course, does not mean that capital flows are not affecting the demand for M1. It only means that severe econometric problems appear to preclude a method of measurement that relies upon the use of foreign rates of return in money-demand equations.

These econometric problems stem from three sources. First, there is the rather obvious problem of multicollinearity between domestic and foreign interest rates. If capital has become sufficiently mobile that large amounts of funds (not just transactions balances) will be shifted quickly to take advantage of any favorable rate spreads, then domestic and foreign interest rates are likely to move so closely together over time that their individual effects on M1 holdings cannot be estimated.

Second, the demand for money, as noted earlier, has not been stable in recent years. There was a downward shift in the mid-1970s associated with increased emphasis on cash management, and perhaps an upward shift in the early 1980s associated with the introduction of NOW accounts. Such pronounced changes in money demand make it difficult, of course, to detect more subtle changes that might result over time from the increasing internationalization of financial markets, partly because it is not possible to measure very precisely the effects of these other factors.

Third, there is the problem of identifying those exchange rates and foreign interest rates that are rel-

Table 2

Including Foreign Rates of Return in Money-Demand Equations

	Short-Term Differential*	Long-Term Differential*
Equation 4 (From Table 1)	−0.00009 (0.9)	−0.0008 (1.0)
Equation 5 (From Table 1)	−0.00007 (0.7)	−0.0007 (1.0)

*The short-term differential is defined as the three-month Treasury bill rate less the trade-weighted foreign short-term interest rate plus the change in the trade-weighted exchange rate. The long-term differential was defined as the U.S. government bond rate less the German long-term government rate plus the change in the exchange rate. These variables were included separately in each equation. These variables could not be included in log form because large fluctuations in exchange rates often produced negative numbers.

Footnote 4 continued
domestic demand. For some further results using domestic final demand, see J. Wenninger and L.J. Radecki, "Recent Instability in Velocity," this *Quarterly Review*, Autumn 1985.

evant to the study of domestic money demand. Clearly, several exchange rates and rates of interest cannot be included in the money-demand equation because of multicollinearity. Hence, it might be necessary to use some sort of international indexes of exchange rates and foreign interest rates, or to shift the focus to another dominant currency such as the German mark. But even if an appropriate exchange rate could be selected, there is the additional problem of measuring expected changes in that exchange rate.[5] Moreover, if interest rate parity holds, then the expected change in the exchange rate in the forward market is simply the difference between the domestic and foreign interest rates. If money holders basically accept the forward market's expectation of exchange rates, there would be no reason to invest in foreign assets. The same expected rate of return would be realized in either case. Whether or not interest rate parity holds, it does suggest that one commonly accepted measure of exchange rate expectations (those implicit in forward contracts), when combined with domestic and foreign interest rates in a money-demand equation, could cause severe multicollinearity problems by introducing an identity among the independent variables.[6]

In general, it appears that econometric problems probably preclude any effort to identify the effects of capital flows on money demand that involves the direct inclusion of exchange rates and foreign rates of return in money-demand equations. There does, however, appear to be some evidence that capital flows might have affected the demand for money indirectly by making GNP a somewhat less accurate indicator of the volume of transactions that matter for money demand.

Section II: reduced-form results (money and GNP)

The M1-GNP reduced-form equation provides an alternative framework for examining whether the money-GNP relationship has been affected by international variables. Earlier work in this area has concentrated primarily on whether international variables (import prices and exchange rates) have influenced the relationship between money and inflation in a reduced-form context.[7] Clearly, changes in international variables such as an appreciation of the dollar can affect the real side of the U.S. economy as well. That is, not only would a strong dollar help contain inflation by reducing the ability of domestic producers to increase prices, but it would also tend to slow the growth in output if domestic demand is shifted toward foreign-made goods. In the next section of this article we will work with the M1-GNP reduced-form equations in assessing what role capital flows as well as other shock variables might play. In the final section we will use the M1-inflation relationship. The box on the next page contains a brief discussion of the theory behind the two alternative money-GNP reduced-form approaches that are estimated and discussed in this section. The box also includes comments on the use of capital flows as a shock variable in these reduced-form equations.[8]

Table 3 shows the empirical results for the conventional reduced-form equation that relates nominal income growth to current and lagged M1 growth and other variables. Equation 1 is the basic equation, which includes only the money growth and business cycle dummy variables. In subsequent equations, additional shock variables (mid-1970s money-demand shift, energy prices, GNP growth due to inventories, and the proxy for capital inflows into the United States) are added one at a time to the basic equation. The table contains the technical definitions of the variables.

Equation 1 suggests that the part of M1 growth that is due to growth of MA (currency and demand deposits) has a significant effect on GNP growth, while the part of M1 growth attributable to increases in NOW accounts does not have a significant effect. In addition, there appears to have been a rather marked cyclical pattern in the error term during recessions and first years of recoveries. The second equation also includes a dummy variable for the period from mid-1974 through 1978—the period of a widely recognized downward shift in money demand (see references in footnote 1). It is significant and of the expected sign and also has the effect of reducing the size of the coefficient on MA somewhat.

In equation 3, an energy-food-price-shock variable is added, and it also is significant and of the expected

[5]And in the case of the exchange rate, even the interpretation of the variable in the estimated equations would not be clear. On the one hand, the expected movement in the exchange rate is part of the expected rate of return on a foreign investment; on the other hand, unpredictable volatility in exchange rates might affect the basic decision of whether to consider foreign assets at all in managing money balances. For more detail on this in a somewhat different context, see M.A. Akhtar and B.H. Putman, "Money Demand and Foreign Exchange Risk: The German Case, 1972-1976," *Journal of Finance*, June 1980.

[6]See Cuddington, "Currency Substitution."

[7]See Dallas S. Batten and R.W. Hafer, "The Impact of International Factors on U.S. Inflation," *Southern Economic Journal*, October

Footnote 7 continued
1986, pp. 400-412. Also see P. Hooper and B. Lowrey, "Impact of the Dollar Depreciation on the U.S. Price Level: An Analytical Survey of Empirical Estimates," Board of Governors of the Federal Reserve System, Staff Study 103, April 1979; and Charles Pigott and Vincent Reinhart, "The Strong Dollar and U.S. Inflation," this *Quarterly Review*, Autumn 1985.

[8]For earlier work along these lines, see Robert J. Gordon, "Supply Shocks and Monetary Policy Revisited," *American Economic Review*, May 1984; and "The Short-Run Demand for Money: A Reconsideration," *Journal of Money, Credit and Banking*, November 1984.

The theory behind the conventional money-GNP reduced-form approach is quite straightforward. A simple IS-LM model can be used to illustrate this.

(1) $Y = -cr + X$

(2) $M1 = -ar + bY + Z$

where: M1 = narrow money stock
r = interest rate
Y = income
Z = money demand shifts or shocks to money demand
X = autonomous expenditures or real side shocks
a, b, c = structural parameters

If equations 1 and 2 are combined to derive the reduced-form for income, the following equation results:

$$(3)\ Y = \frac{c}{a + bc} M + \frac{a}{a + bc} X - \frac{c}{a + bc} Z$$

Clearly, the money-GNP relationship can be affected not only by any international or domestic variables that would be included as shocks in the X or Z vectors but also by any developments that would affect the key elasticities in the model (a, b, or c). In the first section of this paper, rather clear evidence was presented that the interest elasticity of money demand (a) had increased substantially in absolute value in recent years; hence the multipliers in equation 3 may not have been stable in recent years. In particular, a given M1 growth rate or a shock from the financial side (Z) probably will not result in as large an impact on GNP as in the past, while shocks from the real side (X) would be expected to have larger impacts on GNP.

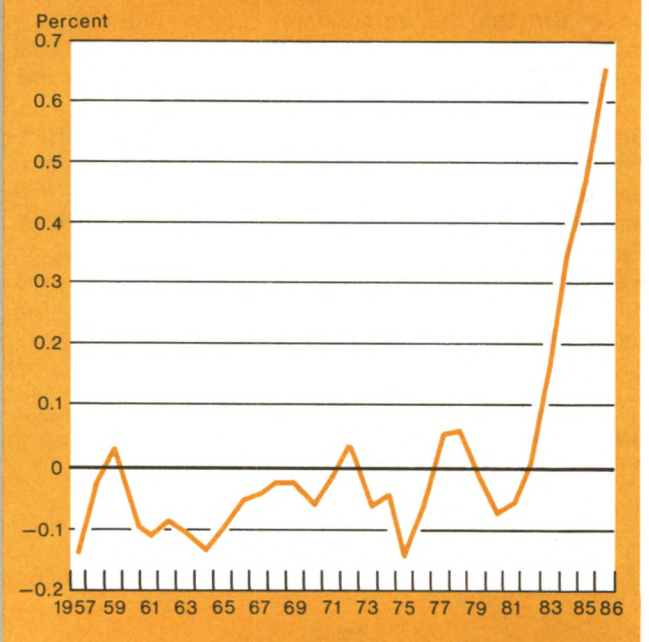
Earlier work has suggested several variables that might be included as shock variables to the money-income relationship.* These include the impact on prices of changes in food and energy prices, the 1974-78 money-demand shift, dummy variables for cyclical variations in velocity (recessions and first years of recoveries), the introduction of nationwide NOW accounts, and the inventory cycle. In addition, if the large capital flows into the United States in recent years caused instability in the money-income relationship, a shock variable that accounts for this general phenomenon should also be included. In this article, net foreign investment as a percentage of net private savings is used as a proxy for the capital flows. It is, of course, difficult to know in some longer-run context what sign to expect on this shock variable because the relationship between capital flows and exchange rates is not a simple one. Over the 1982-85 period, however, large deficits in the U.S. fiscal budget apparently caused U.S. interest rates to be relatively high. The higher interest rates, together with other factors such as safe-haven considerations, attracted capital into the United States and caused the dollar to rise. The strong dollar helped to contain inflation and tended to slow the growth in output as demand was shifted abroad.

Almost all of the variation in this capital-flow shock variable is concentrated in the post-1982 period (see chart); hence any regression results would be dominated by this period, and a negative coefficient would be expected. Moreover, the extremely large change in this variable outside its normal range (from about zero in 1981 to 47 percent in 1985) probably did constitute a major shock to the U.S. economy.† In any case, changes in capital flows at other times could well be associated with different movements in exchange rates, and therefore have a different effect on GNP. For example, if expectations of higher domestic inflation lead to persistent downward pressure on the dollar, the same volume of capital inflows might be associated with a declining dollar. Under those circumstances, foreign exchange market intervention and higher U.S. interest rates might be necessary to sustain the capital inflows. Hence, using this shock variable in the reduced-form equation primarily measures its effect in the post-1982 period. The results do suggest, however, that capital movements could be quite important at times, although the sign on the direction of the effect is specific to this particular episode and should not be viewed as indicating

*For more detail, see J. Wenninger, "The M1-GNP Relationship: A Component Approach," this *Quarterly Review*, Autumn 1984, and J. Wenninger and L.J. Radecki, "Recent Instability in Velocity," this *Quarterly Review*, Autumn 1985. Also see the references cited in footnote 8 as well as John A. Tatom, "Alternative Explanations of the 1982-1983 Decline in Velocity," in *Monetary Targeting and Velocity*, Conference Proceedings, Federal Reserve Bank of San Francisco, December 1983.

†The recent study by the Bank for International Settlements took the position that one of the basic shocks to the financial system that spurred extensive financial innovation was the capital flows created by the large redistribution of current account deficits and surpluses in recent years. For more detail, see "Recent Innovations in International Banking," Bank for International Settlements, April 1986.

Net Foreign Investment as a Percent of Net Private Savings



what might happen in the future.

We also looked at the possible effects of capital flows from the perspective of an alternative reduced-form approach that relates M1 growth to current and lagged changes in the federal funds rate and a measure of transactions (GNP). This equation, developed during the 1970s, was of considerable interest from the perspective of controlling M1.‡ It was not, however, a reduced-form equation in the same sense as the one just derived from the IS-LM model. That equation was formulated in terms of an ultimate objective variable (GNP) being related to an intermediate policy variable (M1). This other equation, in contrast, was viewed as a reduced-form equation that related an intermediate variable (M1) to a policy instrument variable (the federal funds rate), with GNP taken as exogenous in the short run. In a sense, this equation might be viewed as a money-demand equation rather than a reduced-form; the question of interpretation depends on whether the supply of reserves or the federal funds rate is taken to be the variable the Federal Reserve attempts to set "exogenously." At the time this equation was formulated in the early 1970s, the federal funds rate frequently was taken as exogenous and the equation was viewed as a reduced-form equation. In this case, the interpretation of the capital flow variable would be similar to the interpretation given in the money demand section. That is, the strong dollar associated with large capital flows produced a trade deficit that slowed GNP relative to total transactions and consequently caused GNP to understate the demand for M1. Hence, in this reduced-form equation, we would expect the sign on the capital flow variable to be positive because the results are likely to be dominated by the 1982-85 period.

‡For more detail, see R.G. Davis and F.C. Schadrack, "Forecasting the Monetary Aggregates with Reduced Form Equations," in *Monetary Aggregates and Monetary Policy*, Federal Reserve Bank of New York, October 1974. This reduced-form equation was derived from a money-demand equation and a demand-for-reserves equation, with the federal funds rate taken as exogenous.

Table 3

Reduced-Form Results

(Dependent Variable = Quarterly Growth Rate of Nominal GNP)

Equation	MA	N	RY	RC	MD	P	IG	FD	SEE	DW	R^2
1	0.63	0.01	3.16	−2.40					3.6	1.8	0.33
	(3.3)	(0.1)	(3.2)	(2.2)							
2	0.48	0.05	2.73	−2.99	2.66				3.5	1.9	0.38
	(2.5)	(0.3)	(2.8)	(2.8)	(2.8)						
3	0.37	0.23	2.50	−3.45	3.29	0.95			3.3	2.1	0.47
	(2.1)	(1.6)	(2.7)	(3.4)	(3.6)	(4.0)					
4	0.37	0.26	0.91	−2.06	3.21	0.88	0.84		2.5	1.9	0.68
	(2.7)	(2.3)	(1.2)	(2.6)	(4.6)	(4.8)	(8.1)				
5	0.74	0.67	0.11	−2.38	2.76	0.63	0.84	−7.90	2.4	2.0	0.73
	(4.6)	(4.4)	(0.2)	(3.2)	(4.1)	(3.4)	(8.6)	(3.8)			
	M1-4										
6	0.71		0.08	−2.63	2.88	0.68	0.84	−7.97	2.4	2.0	0.72
	(5.0)		(0.1)	(3.9)	(4.7)	(3.9)	(8.7)	(3.9)			
			D								
7	0.87		−5.61						3.8	1.8	0.24
	(5.1)		(4.9)								

MA = sum of the coefficients (current and four lags) of M1 growth due to currency and demand deposits. N = sum of the coefficients (current and four lags) of M1 growth due to NOW accounts. IG = growth rate of GNP less the growth rate of total final demand (excluding commodity credit corporation purchases). P = growth rate of personal consumption deflator less growth of personal consumption deflator excluding food and energy. RY = dummy variable for first years of recoveries. RC = dummy variable for recessions. MD = dummy variable for shift in money demand during 1970s (mid-1974 to 1978). FD = net foreign investment as a percent of net private savings. M1-4 = sum of the coefficients (current and four lags) of M1 growth. D is a dummy variable that is 0 through 1981-IV and 1 thereafter. The sample period is 1960-III to 1986-IV.

sign. Including it results in a sizeable increase in the R^2. The introduction of this energy shock variable reduces the impact that the M1 growth attributable to MA has on GNP and causes the coefficient on the M1 growth due to NOW accounts to increase in size. In the fourth equation, GNP growth due to inventories is added to the equation. This variable is significant and has the expected sign. Including it also results in a sizeable

reduction in the standard error and a large increase in the R^2. Moreover, the introduction of this variable causes the dummy variable for first years of recoveries to become insignificant, suggesting that part of the error pattern in this relationship during recessions and first years of recoveries was due to the inventory cycle.

Finally, in equation 5 we add the ratio of net foreign investment to net private savings to see whether the large capital flows into the United States in recent years were affecting the money-GNP relationship even after the effects of all these other shock variables were taken into account. We find that this variable is significant, and its inclusion results in an improvement in the R^2 and a small further reduction in the standard error. The coefficient on this variable is negative (see box), suggesting that larger capital inflows have been associated with slower growth in nominal income. In other words, the strong dollar associated with the large capital inflows over the 1982-85 period appears to have kept nominal income growth lower than it otherwise would have been given M1 growth and the other shocks that occurred. But as we noted in the box, the relationship between capital flows and exchange rates is not a simple one, and consequently these results should be interpreted with caution.[9]

Including this capital-flow variable has some other effects on the equation. The coefficients on the money supply variables increase considerably, and the size of the coefficient on the energy-price-shock variable is reduced somewhat.[10] Moreover, both the M1 growth due to MA and the M1 growth attributable to NOW accounts are significant and estimated to have about the same impact on GNP growth, suggesting that it would not be necessary to make the distinction. (In other words, it appeared to be an important distinction to make before all the other shock variables were included but not after. Equation 6 confirms this conclusion by showing that there is little change when total M1 is used.)[11] This finding also tends to confirm the results from the money-demand section suggesting that NOW accounts did not appear to be an important explanation for the instability in that relationship in recent years once other factors (additional transactions captured by debits) were taken into account.

Equation 7 shows another version of this basic money-GNP reduced-form equation. This version uses a simpler approach to allow for the instability in this relationship since 1982.[12] It does not include any shock variables; besides M1 growth only a (zero-one) dummy variable for the post-1982 period is included. Hence, it serves as a useful benchmark for assessing the value of the more complex equations that incorporate several different sources of instability. Some striking differences emerge when equation 7 is compared to equation 6, which includes the various shock variables used in this study. Equation 7 has the standard result that the coefficient on M1 growth is close to 1.0 in value, whereas in equation 6 the coefficient is about 20 percent smaller. Overall, the fit of equation 6 appears much better than that of equation 7, with the R^2 about three times larger and the standard error 1.4 percentage points smaller. Hence, there appears to be some benefit in taking account of the individual effects of the various shock variables that have affected the money-income relationship in recent years.

Table 4 shows the recent in-sample errors in predicting GNP growth with the equations in Table 3. Equation 1 has not been very accurate in tracking GNP growth in 1985 and especially in 1986, with an average error of almost 4 percentage points over those two years. Equation 3 suggests that the shocks from energy and food prices are part of the explanation—without these developments, recent M1 growth would have been associated with considerably more nominal income growth than actually occurred (about 1.5 percentage points over 1985 and 1986). And equation 5 shows that the errors for 1985 and 1986, as well as for the entire period, can be reduced somewhat further if the proxy for large capital flows into the United States is included. Without that effect, recent M1 growth would probably have been associated with GNP growth over 1985 and 1986 that was about 1.1 percentage points greater.[13]

[9] It has been pointed out that exchange rate models could only account for at most one-half of the increase in the dollar over the 1982-85 period. For more detail, see Ralph C. Bryant and Gerald Holtman, "The External Deficit: Why? Where Next? What Remedy," *Brookings Review*, The Brookings Institution, Washington, D.C., Spring 1987. For a broader review of exchange rate models, see Peter Isard, "Lessons From Empirical Exchange Rate Models," *Staff Papers*, International Monetary Fund, March 1987.

[10] We experimented with various lag structures for the various shock variables and obtained the best results using just the current quarter's value. Money growth, in contrast, affected GNP growth over about a one-year period.

[11] We also conducted several tests to see whether the larger interest elasticity of money demand noted in the first section had any effect on the stability of the coefficients. By and large, we could not find any evidence, possibly because other elasticities have changed as well, making the overall effect uncertain. In addition, the greater interest elasticity of money demand has been attributed to the

Footnote 11 continued
deregulation of consumer deposits. This has been a gradual process over the last nine years, making it difficult to identify a breaking point to test for structural shifts. For more detail, see J. Wenninger, "Financial Innovation—A Complex Problem Even in a Simple Framework," this *Quarterly Review*, Summer 1984.

[12] K.M. Carlson, "Recent Revisions and GNP Data," *Review*, Federal Reserve Bank of St. Louis, January 1986.

[13] The dollar, of course, has declined considerably since its peak in 1985. However, because of the long lags involved between changes in the dollar and the effects on economic activity, nominal income

The combined effect of energy and food prices and the large capital inflows probably accounted for almost 3.0 percentage points lower nominal GNP growth over 1985 and 1986, leaving about 1 percentage point of unusually weak GNP growth unexplained, with the error concentrated in 1986. By way of comparison, equation 7, which only includes a dummy variable for the post-1982 period, does about as well as equation 5 in tracking GNP growth in 1985, but considerably worse in 1986, with an average error for the two years of −2.6 percentage points.

Next, we will briefly review the results of adding these shock variables to the other reduced-form relationship described in the box. By and large, it appears that the capital flows into the United States in recent years were an important source of instability for this relationship as well. And confirming the results from the money-demand section, this relationship also suggests that M1 growth has become much more sensitive to movements in interest rates in recent years.

Equation 1 in Table 5 shows the results when M1 growth is regressed on GNP growth over the past year and on the percent change in the federal funds rate over the past year. Although these two variables appear significant in explaining M1 growth, the overall fit of the equation is quite poor. Adding a post-1982 dummy variable similar to the one used in equation 7 in Table 3 improves the overall fit of the equation and generally confirms the notion that since 1982 the growth in M1 has been more rapid than past relationships would predict for any given movements in GNP and interest rates—something on the order of 4.5 percentage points more. In equation 3, the shock variables used previously were added to equation 2. Only the shock variables that accounted for the inventory cycle and the inflow of capital into the United States were significant (as suggested in the box, the coefficient on the capital flow variable is positive in this reduced-form equation). At

Footnote 13 continued
growth appears to have been held below what it otherwise would have been well into 1986. By late 1986, however, the fall in the dollar was contributing to more rapid growth in GNP and adding to domestic inflation. As we noted in the box, these results primarily reflect the 1982-85 period when the capital inflows seemed to be associated with a strong dollar.

Table 4

Recent In-Sample Errors in Predicting GNP Growth*
(In Percentage Points)

	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 7
1983	−1.0	−0.7	0.0	0.0	−0.7	2.5
1984	1.2	1.2	1.7	1.5	3.0	3.7
1985	−2.3	−2.1	−1.1	−1.6	−0.3	0.2
1986	−5.4	−4.9	−3.4	−3.1	−1.9	−5.4
Entire Period	−1.9	−1.6	−0.7	−0.8	0.0	0.2

*Equations are from Table 3.

Table 5

Alternative Reduced-Form Results
(Dependent Variable = Quarterly Growth Rate of M1)

Equation	Y	R	D	IG	FD	R*D	SEE	DW	R^2
1	0.26 (1.7)	−3.74 (2.9)					3.8	1.1	0.08
2	O.36 (2.6)	−2.61 (2.2)	4.60 (5.1)				3.4	1.5	0.27
3	0.32 (2.4)	−2.96 (2.7)	0.51 (0.38)	−0.25 (2.1)	10.12 (3.9)		3.1	1.7	0.39
4	0.48 (3.9)	−2.51 (2.6)		−0.24 (2.2)	8.27 (5.2)	−15.72 (4.4)	2.9	2.0	0.49

Y = growth of GNP from four quarters earlier. R = percent change in the federal funds rate from four quarters earlier. D, IG, and FD are the same as in Table 3. Sample period is from 1960-III to 1986-IV.

the same time, the coefficient on the post-1982 dummy variable became insignificant, and the overall fit of the equation improved considerably. Finally, to see whether the responsiveness of M1 to changes in interest rates has increased since 1982, we included in equation 4 the post-1982 dummy variable multiplied by the interest rate variable. The coefficient on this variable is of the correct sign and statistically significant, and suggests that M1's response to changes in the federal funds rate is about six times greater than it was prior to 1982.

Because the Federal Reserve in 1979 reduced the emphasis it placed on the federal funds rate and increased the emphasis it placed on reserves, the results from this type of reduced-form equation should be regarded with caution. Nonetheless, it is encouraging that the results confirmed those of the earlier two sections: it appears that the coefficient on the interest variable has become larger in recent years and that capital inflows have been an important source of instability for this M1-GNP relationship. In addition, this equation is able to track recent M1 growth fairly well on an in-sample basis. For 1986, equation 4 underpredicted M1 growth by 1.5 percentage points. This error is not all that large, although it is still large enough to indicate that the rapid growth in M1 has not been fully explained, even if the effects of shock variables and the greater interest rate responsiveness of M1 are taken into account. Still, if this error is compared to the error of 8.2 percentage points when these other factors are not allowed for (equation 1), the approach used in equation 4 suggests that considerable progress can be made in explaining the recent instability in the money-income relationship.

Section III: reduced-form results (money and inflation)

In this section, we briefly consider whether capital flows have influenced the relationship between M1 growth and the inflation component of nominal GNP. In other words, after we have allowed for money growth, unemployment,[14] energy prices, and the money-demand shift variable used in the previous section, will it be possible to find that the large capital inflows into the United States in recent years have affected the inflation rate? The answer appears to be yes.

In the first equation in Table 6, the inflation rate (as measured by the GNP deflator) is related to M1 growth (over a four-year period as is common practice). M1 growth is significant, but the low R^2 and DW (Durbin-Watson) statistic and the large standard error suggest that variables other than M1 growth probably have played a role in determining inflation. Clearly, with M1 growth measured over a four-year period, there would be some room for shorter-run fluctuations in demand pressure to affect the inflation rate temporarily. To see if this is the case, we added the amount of unemployment in the U.S. economy measured as a four-quarter moving average of the unemployment rate for adult

[14]Here the unemployment rate is used as a proxy for shorter-run variation in demand pressure that could affect the inflation rate temporarily, even as the long-run trend in M1 growth established the more permanent trend in inflation.

Table 6

Reduced-Form Equations for Inflation

(Dependent Variable = Quarterly Growth Rate of GNP deflator)

Equation	M1-16	U	MD	P	FD	DW	SEE	R^2
1	0.74 (6.2)					0.7	2.6	0.31
2	0.88 (7.1)	−0.45 (3.1)				0.8	2.5	0.37
3	0.83 (7.6)	−0.51 (4.0)	3.03 (5.4)			1.0	2.2	0.51
4	0.84 (8.4)	−0.31 (2.5)	3.03 (6.0)	0.65 (4.9)		1.2	2.0	0.60
5	1.32 (12.0)	−0.22 (2.2)	2.28 (5.2)	0.36 (3.0)	−9.41 (6.7)	1.8	1.6	0.73

MD, P, and FD are the same as in Table 3. U is the unemployment rate for adult males (four-quarter moving average). M1-16 is the sum of the coefficients (current and 16 lags) of M1 growth. It is common practice to use longer lags on M1 growth in reduced-form equations for inflation than for nominal GNP. Sample period is from 1960-III to 1986-IV.

males. This variable is also significant and has the expected negative coefficient, and including it improves the overall fit of the equation somewhat. The third equation also includes the mid-1970s money-demand shift variable used in the previous section, and here too it has the correct sign and is significant. Including it results in a sizeable increase in the R^2. The fourth equation includes the energy and food price shock variable that was used in the previous section, and it is also significant and improves the overall fit of the equation. Finally, we incorporate the proxy variable for capital inflows used in the previous section (foreign investment as a percent of domestic savings). It is statistically significant and improves the R^2, DW statistic, and the standard error.

There are, of course, several channels through which capital inflows into the United States could have affected domestic inflation in recent years. The most obvious channel is through exchange rates and import prices. Not only do import prices affect the inflation rate directly, but they also help determine how much domestic producers can raise domestic prices. In addition, strong exchange rates can hold down inflation if domestic demand is shifted toward goods made outside of the United States, creating excess capacity and higher unemployment. Hence, international considerations may be operating through the unemployment rate variable (short-run demand pressure variable) in these equations as well as through the capital flow variable. Whatever the exact channel, the influence appears to have been sizeable in recent years. For example, equation 4 overpredicts inflation by 2.5 percentage points over the last three years, while equation 5 overpredicts it by only 0.4 percentage point (in-sample errors). As we noted earlier in evaluating the results of the other reduced-form equations, these results must be interpreted with caution because the relationship between capital flows and exchange rates (and hence inflation) is not simple, or necessarily stable.

Conclusions

In this article, we explored the possibility that capital movements have significantly affected conventional macroeconomic relationships incorporating narrowly defined money (M1) and other domestic variables. Our work suggests that capital movements might have been an important source of the instability in these relationships over the 1982-85 period when capital inflows were associated with a strong dollar. In the money-income and money-inflation reduced-form equations, these capital inflows appear to have had rather strong effects. In the money-demand equations, however, econometric problems made it difficult to determine whether capital movements have had a direct effect. Nevertheless, we did find some evidence that capital movements could be making GNP a less accurate measure of those transactions that influence money demand.

John Wenninger
Thomas Klitgaard

Financial Consequences of New Asian Surpluses

The shift of international trade surpluses from one country to another carries important consequences for financial markets because residents of various countries invest their surpluses differently. In an ideal world of cosmopolitan individuals, residents of one country might invest internationally in much the same manner as the residents of any other country. But today, national borders still divide individual and institutional investors with disparate investment habits.

The financial consequences of a country's use of its surplus have claimed the attention of international economists at times of major imbalances in the world economy. An earlier generation of analysts studied the transfer problem that arose with the German reparation payments after the First World War. In the 1970s economists investigated the effects of the oil-producing states' methods of recycling their surpluses. Recall that after the oil price increased in 1973, the governments of the Middle Eastern states initially placed their so-called petro-dollars in short-term dollar deposits in a few large banks. This behavior quickened activity in the interbank market, as the large banks re-lent the funds placed with them, and encouraged international lending of dollars at rates of interest tied to interbank rates. Later the oil producers diversified into investments in Europe and gold and thereby put downward pressure on the dollar.

Since Japan became the major surplus country in the 1980s, its investors have influenced financial markets in different ways. Whereas the oil states kept their foreign investments liquid, Japanese investors have preferred more solid foreign placements. Japanese financial institutions, in buying long-term securities to match their liabilities to insurance policyholders and to future pensioners, have fostered the rapid growth of security issuance. Foreign exchange markets have responded to these investors' moves to diversify their security holdings away from the dollar.

While Japanese foreign investment behavior has been closely followed in recent years, the foreign investments of two other Asian countries now bear watching. Taiwan and South Korea have achieved new prominence in international financial markets largely because of their growing current account surpluses: a combined $9 billion in 1985, $20 billion in 1986, and an estimated $25 billion in 1987. This article analyzes the ways in which Taiwan and Korea have managed their surpluses and compares the international investment behavior of these countries to that of Japan. The contrasts that emerge support the conclusion that the international investment behavior of Taiwan and Korea has tended to steepen the dollar yield curve, to strengthen the dollar, and to enhance the role of banks as intermediaries between surplus and deficit countries.

These tendencies are apparent from an examination of the countries' balance sheets. Taiwan has been accumulating assets exclusively in the form of short-term instruments—bank deposits and U.S. Treasury bills. At the same time, Korea has been making payments to foreign banks and others to reduce its debt, 70 percent of which is at floating interest rates. Both strategies—building up short-term assets and paying off liabilities tied to short-term interbank rates—have tended to steepen the dollar yield curve. By contrast, private Japanese capital outflows, mostly into bonds, have tended to flatten the dollar yield curve.

Taiwan has shown a propensity to accumulate dollar assets and, equivalently, Korea to repay dollar liabilities. The currency preference exhibited by investors in both nations sets them apart from Japanese investors who have recently diversified away from dollar assets. Because of this currency preference, the shift of the Asian surplus toward Taiwan and Korea and away from Japan in the wake of the appreciation of the yen has tended to stabilize the dollar. Taiwan, by accumulating bank deposits, and Korea, by repaying bank loans, are both primarily channeling their surpluses into the international banking system. This behavior again distinguishes the Taiwanese and Koreans from Japanese investors, whose massive purchases of securities have spurred security issuance.

Taiwan, with a large reserve build-up, has felt stronger pressures for change than has Korea and recently relaxed controls on capital outflows. Taiwanese investors are in the process of learning how to manage portfolios that include long-term as well as short-term instruments and nondollar as well as dollar foreign assets. Korea will probably alter its behavior more gradually as it continues to repay its debt over the next five years.

Current account surpluses

The remarkable economic performance of Taiwan and Korea is transforming these nations into a major surplus region. Taiwan's current account surplus reached $16 billion at the end of 1986, while Korea's hit nearly $5 billion. These figures appear to be relatively small next to Japan's $86 billion surplus in 1986. However, as recently as 1983, Japan's surplus stood at $20 billion —less than the combined surplus for Taiwan and Korea last year. Moreover, Japan's current account has peaked: in volume terms the trade balance began to deteriorate in 1986,[1] and for the first time since August 1984, the current account surplus declined in dollar terms in May 1987 from the year-earlier figure. By contrast, Taiwanese officials expect their surplus to rise to $18.5 billion in 1987, and the South Korean Planning Board set a goal of $5 billion annual surpluses from 1987 through 1991. Korea's surplus is likely to overshoot the goal since it has reached $4.1 billion for the first half of this year. As shares of national product, the figures are even more striking—20 percent in Taiwan, 5 percent in Korea, and 4 percent in Japan at year-end 1986. Given the rapid growth of the economies of Taiwan and Korea, even maintenance of the surpluses at their current size in relation to national product implies their rapid growth.

Policy choices as well as world economic conditions have improved the current account of both Taiwan and Korea. Both chose to depreciate their currencies in nominal terms against the dollar in 1985 and to keep them relatively stable in 1986, notwithstanding lower inflation rates and, from mid-1986, more or less explicit pressure from the U.S. Treasury to appreciate their currencies. Between the dollar's peak in February 1985 and December 1986 the New Taiwan (NT) dollar was allowed to appreciate by only 10 percent and the Korean won was actually depreciated by 2 percent in relation to the U.S. dollar. Therefore, both currencies depreciated sharply against those of their trading partners in general, and the currencies of Japan and Europe in particular (Charts 1 and 2). Against the yen and mark, the NT dollar depreciated by 32 percent and 35 percent, respectively; and the won, by 40 percent and 43 percent, respectively.

With low domestic inflation in Taiwan and Korea, these depreciations allowed both countries to claim an improved market share in strong currency countries. Between 1985 and 1986, Taiwan's exports to the European Community and Japan increased 35 percent and 24 percent, respectively, while Korea's exports increased 18 percent and 42 percent, respectively. More importantly, Taiwan and Korea claimed an increased share of third country markets, particularly in the United States, both countries' major market, at the expense of Japan and to a lesser extent Europe.

Both countries were able to benefit as much as they did from their depreciations because they had developed a structural advantage over comparable countries. The appreciation of the yen and other currencies against the dollar in 1986 was not associated with higher commodity prices in dollars, and so did not help commodity-exporting countries. But it offered Taiwanese and Korean exporters the opportunity to undercut the prices of the manufactures of countries with appreciating currencies and so to achieve large increases in volume. Both Taiwan and Korea had built a strong manufacturing base: in 1984-85, the share of gross domestic product originating in manufacturing was less than 25 percent for most comparable countries, but 41 percent and 28 percent in Taiwan and Korea, respectively (Table 1). While manufacturing contributes a fair share of Argentina's and Brazil's domestic products, only 18 percent of Argentina's exports, and 41 percent of Brazil's, are manufactured goods. By contrast, 91 percent of exports from Taiwan and from Korea are manufactured goods. As a consequence, Taiwan and Korea were poised to take advantage of the depreciations of their currencies against those of their trading partners.

Taiwan and Korea pursued their competitive strategies against the backdrop of two favorable developments: the depreciation of the U.S. dollar against the yen and other European currencies and the fall in oil and other com-

[1] International Monetary Fund, *World Economic Outlook*, April 1987, pp. 60-61.

modity prices.[2] First, between February 1985 and December 1986 the dollar fell by about 40 percent against the currencies of Japan and Germany. This gave both Taiwan and Korea the opportunity to keep their currencies relatively stable against the traditional reference currency, the dollar, even as the countries depreciated sharply against their trading partners taken as a whole.

The potentially inflationary consequences of this depreciation were damped by the second exogenous factor, the weakness of commodity prices. The drop in crude prices alone resulted in savings of approximately $2.5 billion for Korea and of $1.5 billion for Taiwan in 1986. The drop in oil prices thus explains approximately one-third of the increase in the combined current account surplus. The two countries also realized some terms-of-trade gains with the downswing in prices of food and industrial raw materials.

[2]The fall in interest rates is often considered to be a third favorable development for Taiwan and Korea. (See Philip Bowring, "The Changing Fortunes of East Asia," *The Washington Quarterly*, Fall 1986, pp. 15-21.) However, Korea's savings from lower interest rates, estimated at $400 million, were in fact exceeded by Taiwan's losses, since Taiwan's foreign exchange reserves roughly equaled Korea's external debt at year-end 1986.

Table 1

Percentage of Gross Domestic Product and of Exports Originating in Manufacturing in Selected East Asian and Latin American Countries, 1984-85

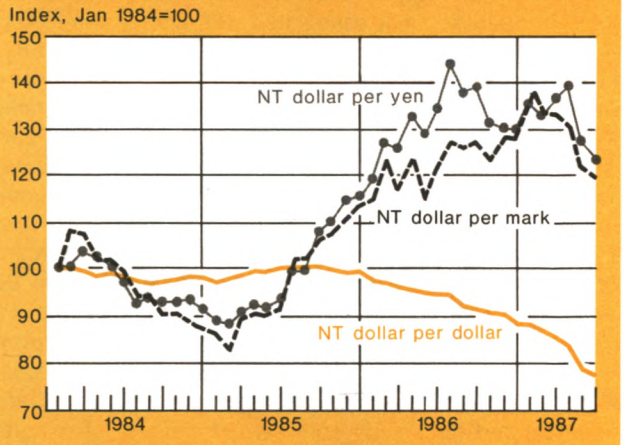
	Manufacturing Gross Domestic Product (Percent)	Manufacturing Exports Total Exports (Percent)
Taiwan	41	91
Argentina	30	18
Korea	28	91
Brazil	27	41
Phillipines	25	51
Mexico	24	28
Thailand	20	35
Peru	20	11
Malaysia	19	27
Indonesia	14	11

Sources: The World Bank, *World Development Report;* Directorate-General of Budget, Accounting, and Statistics, Executive Yuan, *Statistical Yearbook of the Republic of China.*

Chart 1

NT Dollar Exchange Rate Movements

End of month exchange rates

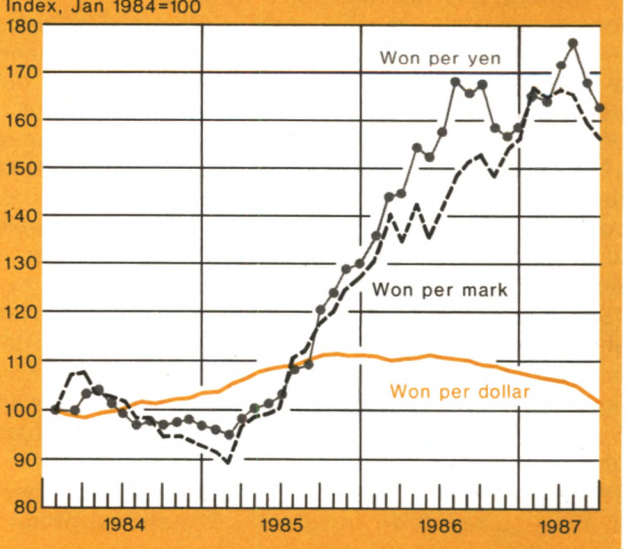


Sources: The Central Bank of China, Financial Statistics Monthly; International Monetary Fund, International Financial Statistics; The Central Bank of China, Financial Statistics (for May figure); The Board of Governors, Federal Reserve Statistical Release H.10 (512) (for June figures).

Chart 2

Korean Won Exchange Rate Movements

End of month exchange rates



Sources: International Monetary Fund, International Financial Statistics; The Board of Governors, Federal Reserve Statistical Release H.10 (512) (for June figures).

Financial management and its consequences

What are Taiwan and Korea doing with their newly found wealth? At the margin, how does their surplus management affect the dollar, its yield curve and banks' role in surplus intermediation? We first examine Taiwan's balance sheet and then turn to Korea's. In each case, we consider the types of instruments accumulated or repaid, their currency composition and location. Our analysis of Taiwan's and Korea's international investments forms the basis of the following contrast of their behavior with Japan's management of its surplus. We draw the contrast to determine the financial effects of the shift of international surpluses within East Asia from Japan to Taiwan and Korea.

Taiwan

Until recently, Taiwan has shown a strong preference for staying liquid by hoarding short-term instruments, mainly dollar-denominated and held for the most part in the United States, the United Kingdom, and probably Singapore. The management of funds has been a reflection of official preferences since capital controls have been, until lately, pervasive in Taiwan. The ruling Kuomintang party maintained the controls out of fear of a Communist invasion—an invasion that could lead to capital flight and a shortage of funds for arms purchases—and out of political inertia. The capital controls obliged individuals to exchange export earnings for NT dollars at the central bank. As a result, Taiwan's foreign exchange reserves exploded and came to rival those of Japan and Germany. By a wide margin, Taiwan leads all other countries in the number of months of imports that its reserves represent (Table 2).

Like most other managers of official funds, Taiwan's central bank invested almost exclusively in liquid instruments, specifically bank deposits and short-term government securities. Through 1986, Taiwan's deposits in banks in the Bank for International Settlements (B.I.S.) reporting area[3] and its purchases of Treasury bills in the United States account for almost all of the country's current account surpluses and funds raised in loans from B.I.S. area banks (Table 3).

Despite some liberalization of capital controls since January 1986, there does not appear to have been any private Taiwanese investment in long-term instruments last year. The U.S. balance-of-payments data reveal no diversification into longer-term holdings, and the unexplained uses of Taiwan's surplus leave little scope for such investment in any case. Taiwanese residents, in fact, made net sales (albeit small) of U.S. Treasury coupons in 1986, while purchases of U.S. corporate bonds continued to be negligible. The U.S. balance-of-payments data are consistent with the modest amount —$344 million by May 1987—in foreign investment funds.

The measures to permit capital outflows put in place in 1986 remained quite restrictive. Investors were limited to placing $5,000 per year outside the country, through one of five trust funds administered by local banks. The funds were only permitted to buy into government, bank, and later corporate debt securities, with limited potential for capital gains. Further, the minimum term for trust investments—initially two years and later reduced to six months—limited the volatility of foreign outflows at the expense of investors' flexibility. Moreover, individual investors did not have access to the forward market to hedge their investment positions.

In the event, by the time Taiwanese investors were offered the trust accounts, Taiwanese assets had

Table 2

Foreign Exchange Reserves of Some Countries*

	December 1984	May 1987	
	Billions of U.S. Dollars	Billions of U.S. Dollars†	Number of Months' Imports‡
Japan	22.3	63.6	4.5
Taiwan	20.0	60.0§	27.3
West Germany	35.0	57.3	3.4
France	19.1	28.4	2.3
Britain	7.0	25.7	1.6
Italy	19.1	22.0	2.4
Switzerland	14.7	19.4	4.7
United States	6.7	14.2	0.3
Spain	11.4	14.5	4.8
Singapore‖	10.3	12.8	5.1
Norway	8.6	12.0	5.4
China	16.7	10.8	3.2
Korea	2.7	3.3	1.2

*When gold is included, Taiwan's reserves do not appear to be so large relative to those of other nations.

†Except Spain (February 1987), Singapore (December 1986), and China (March 1986).

‡1985 goods and services.

§As of June 8, 1987.

‖Includes gold.

Sources: International Monetary Fund, *International Financial Statistics*; The Central Bank of China, *Financial Statistics*.

[3]Up to the end of 1983, the B.I.S. reporting area covered banks in Austria, Belgium-Luxembourg, Canada, Denmark, France, the Federal Republic of Germany, Ireland, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, the United States and the offshore branches of U.S. banks in the Bahamas, the Cayman Islands, Panama, Hong Kong and Singapore. From end-1983, the reporting area also includes banks in Finland, Norway, and Spain; non-U.S. banks engaged in international business in the Bahamas, the Cayman Islands, Hong Kong and Singapore; and all offshore banking units in Bahrain and the Netherlands Antilles. From end-1986, the reporting area includes the Japanese offshore banking center.

become particularly attractive. By mid-1986, the U.S. Treasury was making no secret of its desire that the NT dollar appreciate.[4] Speculative capital inflows doubled the stock market price index between August 1986 and May 1987 and reduced the premium of the black market exchange rate over the administered "effective" rate to practically nothing by July of this year (Chart 3). Taiwanese investors also reduced the amount that they held in foreign investment funds from $1.4 billion in July 1986 to $0.3 billion by May 1987. Taiwan's holdings of foreign-exchange assets, as captured in B.I.S. and U.S. data, came by the end of 1986 to be concentrated almost exclusively in the central bank, whereas in 1984 and 1985 official reserves fell short of measured total Taiwanese assets by about $5 billion (Table 4). In response, the government took steps in early 1987 to limit capital inflow so that no more than U.S. $10,000 could be brought into the country at any one time.

Taiwanese investors sacrificed yield for liquidity through 1986 but showed some interest in longer-term instruments in 1987. In the first quarter alone, $0.2 billion of Taiwanese funds were invested in U.S. Treasury bonds. Although small in absolute terms, this investment occurred over a relatively short period of time and indicates a significant change from past behavior. Moreover, this lengthening of the maturity of holdings does not appear to have been a response to the recent steepening of the dollar yield curve that only began in April. Thus the purchases should be interpreted as evidence of the Taiwanese learning to invest in instruments of longer maturity. While the decline in U.S. bond prices in April and May would have imposed unrealized losses on those who bought bonds in the first quarter, the associated steepening of the dollar yield curve only increased the incentive to extend maturities.[5]

[4]Hobart Rowen, "U.S. to Ask Taiwan, South Korea to Allow Currencies to Rise," *The Washington Post*, July 30, 1986.

[5]Taiwanese investors may have suffered a capital loss (unrealized) of approximately U.S. $20 million on their first quarter investment in Treasury coupon bonds. For Taiwanese purchases of Treasury bonds

Table 3

Taiwan's Sources and Uses of Funds

(In Billions of U.S. Dollars)

	1981	1982	1983	1984	1985	1986	1987-I
Sources of funds	0.9	2.0	6.1	6.2	8.6	20.1	6.1
Current account surplus	0.5	2.2	4.4	7.0	9.2	16.1	5.0
Bank borrowing*	0.4	−0.2	1.7	−0.8	−0.6	4.0	1.1
Uses of funds	0.9	2.0	6.1	6.2	8.6	20.1	6.1
Increased bank deposits*	1.2	1.2	4.7	5.4	6.7	14.4	4.7
(Nonadjusted increase in bank deposits)	(1.2)	(1.2)	(4.7)	(5.3)	(6.9)	(14.6)	(4.8)
(Valuation effect)	(0.0)	(0.0)	(0.0)	(−0.1)	(0.2)	(0.2)	(0.1)
Net purchases of U.S. Treasury securities	0.3	0.2	1.1	0.6	1.2	4.8	1.1
Bills	0.3	0.2	1.1	0.6	1.1	4.8	0.9
Coupons	0.0	0.0	0.0	0.0	0.1	0.0	0.2
Unexplained uses	−0.6	0.6	0.3	0.2	0.7	0.9	0.3

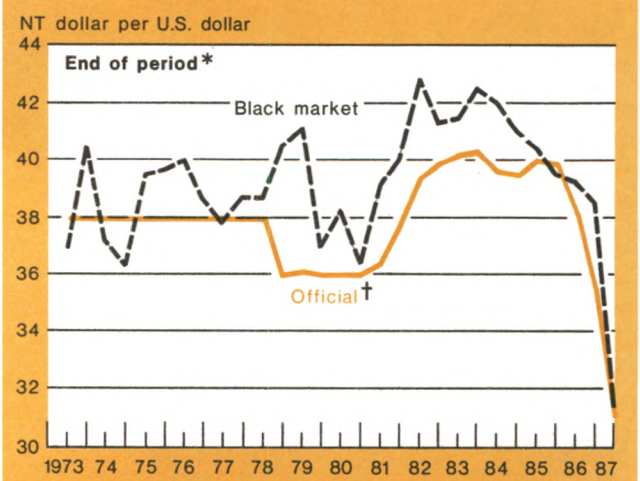
*Exchange adjusted; pre-1984 figures are estimates.
Totals may not add owing to rounding.

Sources: B.I.S., *International Banking Developments*; Department of the Treasury, *Treasury Bulletin*; The Central Bank of China, *Financial Statistics*; International Monetary Fund, *International Financial Statistics*.

Chart 3

Taiwan's Exchange Rates

Official and black market



*June and December of each year, 1987 figure is for July 9; average of bid and ask rates.

†On July 12, 1978, the link of the NT dollar to the U.S. dollar was abandoned and an effective rate created, to be revised periodically.

Sources: International Currency Analysis Inc., World Currency Year Book; International Monetary Fund, International Financial Statistics; The World Journal (for 1987 figure).

The U.S. dollar has enjoyed the status of Taiwan's currency of choice for reasons both economic and political: the parity maintained between the two dollars in 1971-78 and the relative stability in their rate of exchange since then, Taiwan's sale to the United States of half its exports, and its reliance on the United States for arms. It is too soon to observe the diversification into the German mark that was reported in the foreign exchange market in the first half of 1987.[6] That Taiwan's assets have been overwhelmingly dollar-denominated is obvious from a comparison of the change in bank deposits with the exchange-rate-adjusted flows.[7] The difference—the change in the dollar value of deposits owing to changes in exchange rates (the so-called valuation effect)—is very small each year between 1983 and 1987, despite the sharp movements of the dollar against major currencies. This small difference indicates that most of the assets were dollar-denominated. Ideally, to estimate the percentage of assets held in dollars, we would need a breakdown of nondollar assets by currency. Since such a breakdown is not available publicly, we assume that Taiwan splits its nondollar reserves among investments in various currencies in the same proportions as do central banks in general.[8] We estimate that in 1983 more than 95 percent of Taiwan's assets were held in dollars and that this dollar composition remained roughly stable through 1986 (Table 4). The estimates are robust with respect to assumptions about the currency composition of the nondollar assets.

The importance of the role of the dollar is underscored by another recently adopted policy. The only foreign-currency-denominated certificates of deposit that state-owned banks have been allowed to sell to Taiwanese have been U.S. dollar-denominated. This partial deregulation may be seen as an attempt to shift the exchange risk of holding U.S. dollars onto the private sector (and thereby to reduce official reserve growth).

Finally, the geographical distribution of Taiwan's assets indicates a preference for secure locations with low credit risk. In 1986, approximately 40 percent of reserves were held in the United States, 25 percent in the United Kingdom, 5 percent in Germany, only 1 per-

Footnote 5 continued
in the first quarter of 1987, see Department of the Treasury, *Treasury Bulletin*, Spring 1987, p. 72.

Table 4

Taiwanese Assets by Type, Currency and Location

(In Billions of U.S. Dollars)*

	1980	1981	1982	1983	1984	1985	1986
Total Taiwanese assets	5.6	7.2	8.5	14.2	20.1	28.1	47.5
(Reserves)	(2.2)	(7.2)	(8.5)	(11.9)	(15.7)	(22.6)	(46.3)
Type							
Deposits in B.I.S. banks	4.8	6.0	7.2	11.8	17.2	24.1	38.7
Treasury bills in the United States	0.8	1.1	1.3	2.4	3.0	4.1	8.8
Currency composition†							
Percent of Taiwanese assets in U.S. dollars				94.6	95.7	96.5	96.6
Geographical distribution of assets (Percent)							
United States	29.8	29.3	32.6	28.5	24.8	27.7	39.9
Foreign branches of U.S. banks‡	32.5	35.5	30.1	22.1	16.6	14.5	11.4
United Kingdom	7.8	20.1	19.9	19.9	22.6	21.8	22.9
Germany (All foreign branches and subsidiaries of German banks)	2.5 (2.2)	4.0 (2.4)	3.1 (3.2)	2.0 (4.6)	1.5 (5.9)	2.2 (5.1)	4.1 (4.9)
Hong Kong	1.9	1.5	4.6	1.8	4.4	4.3	1.3
Other	25.6	9.6	9.7	25.7	30.1	29.5	20.6

*The figures do not capture deposits, if any, with the B.I.S.; totals may not add owing to rounding.

†Federal Reserve Bank of New York estimates, assuming that 53 percent of nondollar deposits are in deutsche marks, 27 percent in yen and 20 percent in pound sterling.

‡Excludes branches in the United Kingdom, Germany, Hong Kong and Taiwan.

Sources: B.I.S., *International Banking Developments*; Department of the Treasury, *Treasury Bulletin*; The Board of Governors, *Federal Reserve Statistical Release E.11 (121)*; Bank of England, *Quarterly Bulletin*; Bundesbank, *Statische Beihefte*, Reihe 3; *Hong Kong Monthly Digest of Statistics*.

[6]It appears that Taiwan's financial authorities are not acknowledging the importance of the yen because of a persistent ambivalence toward Japan. The central bank's bulletin reports no less than 14 currencies' exchange rates against the NT dollar, but a yen rate is not given.

[7]The B.I.S. computes these flows from data on currency composition reported by some countries and from its estimates for those countries that do not provide this breakdown. Singapore, for example, does not provide a currency breakdown of its assets and liabilities. To the extent that the currency composition of Taiwan's assets vis-a-vis Singapore differs from that of the assets of countries that do report this breakdown, the flows are inaccurate.

[8]See Akinari Horii, *Evolution of Reserve Currency Diversification*, B.I.S. Economic Papers, No. 18, December 1986. We simplify further by assuming that all nondollar assets are denominated in deutsche marks, yen or pound sterling.

cent in Hong Kong, and 10 percent in foreign branches of U.S. banks. Most of the remaining reserves were probably held in Singapore.[9]

Korea

While net creditor Taiwan is building its assets with its surplus, net debtor Korea is paying off its liabilities with its surplus. However, many of the financial effects of a reduction in liabilities are equivalent to those of an accumulation of assets.

Korea has used its surplus to repay its external debt, of which 70 percent was at floating rates, and more than 80 percent dollar-denominated between 1983 and 1986. It appears that Korea employed all of its current account surplus and more for this purpose because the country reduced its assets held with B.I.S. banks (Table 5). In May 1986, Korea interrupted its sovereign borrowing and soon after started prepayments. A proposed $0.5 billion syndicated credit was withdrawn and two note issuance facilities totalling $0.3 billion were cancelled; estimated prepayments of credits totalled $0.5 billion in 1986. While paying off liabilities tied to short-term interbank rates represents a net contribution of short-term funds to the international banking system, Korea has also acquired some long-term assets. Korea purchased $1.3 billion of Treasury coupon bonds in 1986. So Korea ventured to lengthen the maturity of its assets in 1986 while Taiwan, on the present showing, waited until 1987 before so doing.

The small valuation changes in Korea's external liabilities to B.I.S.-area banks indicate that most of these liabilities were dollar-denominated. Our estimates[10] show that 86 percent of Korea's debt in 1986 was dollar-denominated. This share remained fairly stable over the years and even appears to have declined in 1984 with the appreciating dollar and to have risen in 1985 with the depreciating dollar (Table 6). These trends reveal an active management of the type of liabilities acquired, since the valuation effect itself would have resulted in a rise in the share of dollar liabilities in 1984 and a decline thereafter. In any case, with the major share of Korea's debt in dollars, repayments on its $45 billion debt will tend to support the dollar.

The changing distribution of Korea's bank liabilities probably reflects the growing importance of Japanese banks in the syndicated loan market and the market for outstanding loans. Between 1983 and 1986 U.S. banks steadily lost market share in bank lending to Korea; U.K. and German banks maintained their share, while other banks, including Japanese banks, increased their share considerably.

Taiwan and Korea in contrast to Japan

We have seen that the current account surpluses of Taiwan and Korea have flowed into international financial markets largely in the form of short-term dollars, mostly through the banking system. But the growth of Taiwan's and Korea's surpluses has its counterpart in the leveling off of the Japanese surplus and, prospectively, in its shrinkage. The consequences of this shifting of the Asian surplus are the steepening of the dollar yield curve, the strengthening of the dollar, and the partial restoration of the role of banks in intermediating global current account imbalances. These consequences

Table 5

Korea's Sources and Uses of Funds

(In Billions of U.S. Dollars)

		1987	
	1986	QI	Year
Sources of funds	6.4	1.9	
Current account balance	4.7	2.0	5.0*
Decreased bank deposits†	1.7	−0.1	
Uses of funds	6.4	1.9	
Debt repayments†‡	5.1	2.0	5.9
(Nonadjusted decrease in external debt)	(3.5)	(1.7)*	(4.5)*
(Valuation effect)	(1.6)	(0.3)	(1.4)
IMF	0.3	0.1	0.3
Non-IMF	4.8	1.9	5.6
B.I.S. banks	2.5	1.2	
Net purchases of Treasury securities	1.3	0.3	
U.S. Treasury bills	0.0	0.1	
U.S. Treasury coupons	1.3	0.2	
Unexplained uses	0.0	−0.4	

*Official Korean estimates.

†Exchange adjusted.

‡Estimated from total debt figures. We assume (a) the currency composition of nondollar, non-IMF debt is the same as that of debt to B.I.S. banks, (b) the composition is constant between 1986 and 1987, and (c) Korea repays the IMF in 1987 at the same rate as in 1986.

Sources: The Bank of Korea, *Principal Economic Indicators*; Department of the Treasury, *Treasury Bulletin*; World Bank, *World Debt Tables*; B.I.S., *International Banking Developments*.

[9]According to an account of a report issued in August 1986 by the Control Yuan, a government accounting agency, most of the reserves were held in the United States, the United Kingdom, and Singapore. See Carl Goldstein, "The Question That Gets You Thrown Out," *Euromoney*, February 1987, pp. 31-32. This same account reports that the nondollar portion of Taiwan's reserves was 88 percent some years ago.

[10]The shares of different currencies in Korea's nondollar liabilities are assumed to be similar to the shares of Korea's non-U.S. exports sent to Japan and Europe. The assumption differs from that made for Taiwan since we focus here on a different side of the balance sheet. In any case, the estimates are robust with respect to different assumptions about the relative shares of nondollar liabilities.

follow from the differing ways in which Taiwan and Korea, on the one hand, and Japan, on the other, manage their surpluses.

In contrast to Taiwan's accumulation of short-term dollar assets and Korea's repayment of LIBOR-priced debt, Japan has invested its surplus in longer-term instruments. Indeed, more than the entire 1986 current account surplus of $86 billion was used to acquire long-term foreign securities. According to the Bank of Japan, investment in long-term foreign securities by private Japanese investors reached $102 billion in 1986. Short-term dollar borrowing funded most of the excess of long-term investment over the current account surplus. Thus Japan was not only placing its entire surplus at long maturity but also borrowing at short maturity to place even more funds long. The effect has been to flatten foreign yield curves. Even with all the increase in official reserves in the first half of 1987, the private Japanese purchase of $58 billion of long-term foreign securities still exceeded the current account surplus of $44 billion. In effect, the Bank of Japan bought dollars, accepting the currency risk, and placed them in short-term-instruments; private Japanese investors borrowed short-term and bought long-term foreign securities. Consequently, Japan as a whole continued to use its surplus to buy long-term securities.

Again in contrast to Taiwan and Korea, Japan has come to invest abroad in nondollar assets to a very considerable extent. Large and growing discrepancies between Japanese portfolio investment in the United States and Canada as recorded by the Bank of Japan, on the one hand, and by the U.S. Treasury and the Bank of Canada, on the other, sound a warning that great precision in specifying the nondollar share is not possible. Data published by the Bank of Japan show that portfolio investment in the United States claimed about a 50 percent share of Japanese portfolio investment (Table 7). To this must be added Japanese purchases of dollar bonds in the Eurobond market, which attracts some one-fifth to one-third of Japanese portfolio investment (included in the subtotal for Europe other than the United Kingdom on Table 7). The dollar share of Eurobonds bought by Japanese investors is taken to be the dollar share of all Eurobonds issued in

Table 6

Korean Liabilities by Type, Currency and Location

	1980	1981	1982	1983	1984	1985	1986
Total external debt (Billions of U.S. dollars)	29.8	33.4	37.8	40.9	43.2	48.0	44.5p
Type							
Percent of debt at floating rates*	60.9	64.1	67.1	68.3	69.3	69.5	69.5e
Currency composition†							
Percent of Korean liabilities in dollars				87.3	84.3	86.1	86.0
Geographical distribution of debt to B.I.S. area banks (Percent)							
United States	42.3	44.5	51.3	35.1	31.4	28.0	22.9
Foreign branches of U.S. banks‡	4.6	7.7	6.2	3.5	4.1	2.6	0.9
Hong Kong	19.4	23.1	28.1	22.1	23.7	24.1	26.0
United Kingdom	22.5	22.2	20.5	11.2	9.7	10.0	10.7
Germany	3.6	2.7	2.0	1.1	1.0	1.1	1.7
(All foreign branches & subsidiaries of German banks)	(2.0)	(2.4)	(3.0)	(3.6)	(7.5)	(5.0)	(4.7)
Other	7.5	−0.2	−8.0	27.0	30.2	34.2	37.8
Memo: Reserves (Billions of U.S. dollars)	2.9	2.7	2.8	2.3	2.8	2.9	3.5

*Includes all of short-term debt, private nonguaranteed long-term debt, IMF credit and that part of public and publicly guaranteed long-term debt that is at variable rates.

†Federal Reserve Bank of New York estimates, assuming 49 percent of nondollar debt is in yen and the rest in deutsche marks.

‡Excludes branches in the United Kingdom, Hong Kong, Germany and Korea.

pPreliminary.

eEstimated assuming (a) Korea repays the IMF in 1987 at the same rate as in 1986, and (b) the percentage of non-IMF debt at variable rates is the same as in 1985.

Sources: B.I.S., *International Banking Developments*; Department of the Treasury, *Treasury Bulletin*; The Board of Governors, *Federal Reserve Statistical Release E.11 (121)*; FR2502S; Bank of England, *Quarterly Bulletin*; Bundesbank, *Statische Beihefte* Reihe 3; Census and Statistics Department, Hong Kong, *Hong Kong Monthly Digest of Statistics*; *World Debt Tables*.

1985-1986, 63 percent. So the dollar share of Japanese portfolio investment may be estimated at two-thirds from the Japanese data. The U.S. Treasury data show a much smaller share of portfolio investment in the United States, about 40 percent in 1985 and only 25 percent in 1986. Taken together, the U.S. and Canadian data suggest a reduction in Japanese flows into the dollar in 1986, as do partial data assembled by the Japanese Securities Dealers Association. By all evidence, Japanese investors place a substantially smaller fraction of their international portfolio in dollars than do Taiwanese and Korean investors.

Finally, Japan's surplus has bypassed bank intermediation by flowing primarily into securities, although private Japanese investors do borrow at short term from banks in order to invest in long-term securities. By contrast, nearly all of Taiwan's and Korea's surpluses were channeled through the banking system. At the margin, a shift of surplus their way has thus increased the role of banks in the intermediation of global surpluses.

Table 7

Japanese Portfolio Investment Abroad by Market

(As a Percent of Total Japanese Portfolio Investment Abroad)*

	1985	1986
A. OECD countries	92.3	94.8
1. United States	52.9	48.4
(Source: Treasury Bulletin)	(38.1)	(24.7)
2. European Community countries	30.9	39.8
2(a) United Kingdom	10.4	12.5
3. Other OECD countries	8.6	6.5
3(a) Canada (Source: Statistics Canada)	(3.5)	(7.0)
B. Communist bloc	1.2	0.8
C. Other countries	0.7	−0.2
D. International institutions	3.8	1.4
E. Unallocated	2.0	3.2
Total	100.0	100.0

*Totals may not add owing to rounding.

Sources: The Bank of Japan, *Balance of Payments Monthly*, April issue; Department of the Treasury, *Treasury Bulletin*; Bank of Canada, *Statistics Canada*.

The future

Both the size of Taiwan's and Korea's surpluses and their management of those surpluses depend on how the countries respond to pressures to appreciate their currencies, to cut tariffs, to reduce quantitative restrictions on imports, and to license foreign providers of services, especially financial services. Both countries feel external pressure from the U.S. Treasury, U.S. Trade Representative and others, as well as domestic pressure from rapidly growing money supplies, though these pressures bear on Korea less weightily. The pressures are compounded in net creditor Taiwan's case by the consequences of currency appreciation and monetary control measures for the position of the central bank; the appreciation of the won, by contrast, has eased the domestic burden of repaying Korea's dollar debt. Both countries face a protectionist threat to their export success; both may manage their surpluses to fend off the threat.

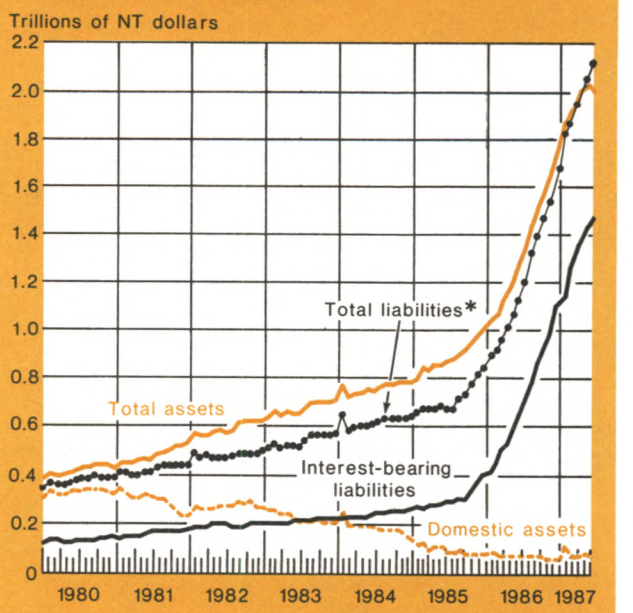
Taiwan

The explosion of Taiwan's money supply, the echo of the explosion of Taiwan's reserves, has forced the government to consider policies that will reduce the surplus or will encourage outward investment. Money, including cash and bank deposits, grew by a half in 1986; currency in the hands of the public alone rose 26 percent last year. Thus far, the liquidity has helped push up prices of equity and land but not as yet consumer or wholesale prices. Indeed, as of May 1987, the indexes of both were still falling.

In response to these pressures, the authorities have

Chart 4

Assets, Domestic Assets, Liabilities and Interest-bearing Liabilities of the Central Bank of China



*Excluding "other items" residual.

Source: The Central Bank of China, Financial Statistics Monthly.

raised the value of the NT dollar. It has risen a few tenths of a NT dollar per week, so that one U.S. dollar now buys only 30 NT dollars, as compared to 40 in 1985. Thus, the NT dollar has appreciated by over 25 percent. This appreciation should at least slow the growth of the current account surplus. In fact, reports have already emerged that some marginal exporters are in difficulty and that others are attempting to produce higher quality exports that command higher prices in the United States.

The central bank has also sought to absorb the liquidity created by the reserve inflows. Starting from a base of zero outstanding in late 1985, interest-bearing certificates of deposit that are sold to commercial banks came by May 1987 to represent more than one-third of the total liabilities of the central bank. Increased time deposits by banks and savings bonds bought by the public have also absorbed liquidity. In February, sales of interest-bearing instruments by the central bank actually exceeded the reserve inflow of almost $3 billion, and reserve money fell. For the rest of this year through May, however, the central bank has only partially offset the reserve inflow. As a result, money supply growth has only decelerated to the 25-30 percent range this year.

The measures adopted by the authorities to respond to U.S. and domestic pressures have in turn created problems for the central bank—problems that have encouraged the bank to revise its view of private capital outflows. The appreciation of the NT dollar has produced unrealized losses by reducing the NT dollar value of the stock of foreign reserve assets while leaving the value of the central bank's local liabilities unchanged. We estimate the valuation losses from the appreciation of the NT dollar in the 17 months between December 1985 and end-May 1987 to be in excess of $9 billion at the current exchange rate. At the same time, the increasing proportion of interest-bearing liabilities has slowed the growth of the central bank's net interest income. Set against net interest earnings—estimated interest received on foreign reserves less interest paid on domestic liabilities—the valuation losses led to overall losses in the 17 months in excess of $7 billion.

The implication of these losses for the central bank's overall position is the erosion of the surplus that it accumulated from years of issuing currency and other non-interest-bearing liabilities against interest-bearing foreign exchange reserves and other assets. The last liability column on the central bank's published balance sheet, "other items," which appears to include paid-in capital and retained earnings, peaked in September 1985, just before the recent appreciation began. Since then, the "other items" residual has declined from the equivalent of about $5 billion through zero in April to a negative $3 billion at end-May 1987 (Charts 4 and 5). It appears, then, that the central bank no longer has a surplus with which it might cover losses resulting from further appreciation.

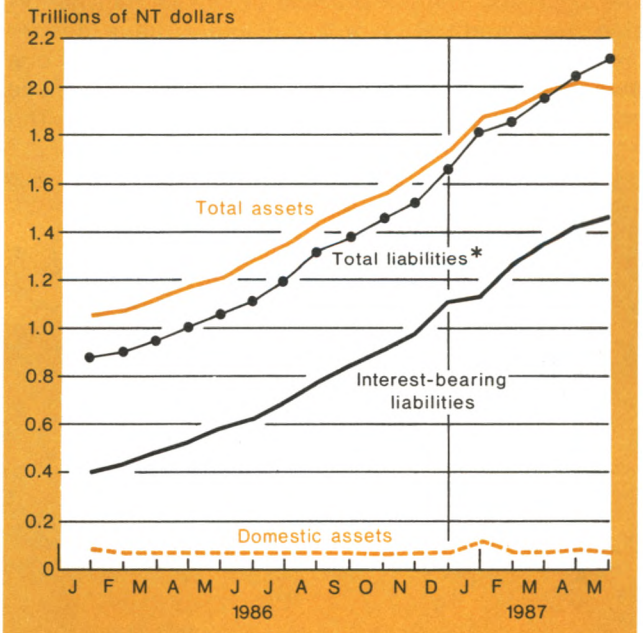
With the sharp 4.5 percent appreciation of the NT dollar in May, the central bank's assets, expressed in NT dollars, actually fell. That is, despite the growth of the central bank's liabilities (excluding "other items") by over $2 billion (over 3 percent), corresponding to the purchase of a like amount of foreign exchange, valuation losses drove the local value of total assets down.

It should be noted that the losses remain unrealized. Only a massive outflow of private capital would more than offset the current account surplus and force a reduction of reserves and thereby a realization of losses. On a cash-flow basis, the central bank is averaging a surplus of well over $100 million per month, so budgetary transfers have not proven necessary.

Against this background, then, came the partial loosening of restrictions on capital outflows in July. Henceforward, private investors can send funds abroad without limit to buy any foreign assets, including real estate and

Chart 5

Assets, Domestic Assets, Liabilities and Interest-bearing Liabilities of the Central Bank of China



*Excluding "other items" residual.

Source: The Central Bank of China, Financial Statistics Monthly.

stocks. Foreign investment exceeding U.S. $5 million will still require prior approval by the central bank, just as investment exceeding U.S. $1 million will require prior notification of the central bank. Investors will also have access to the forward market. That the change in policy was a response to the pressures outlined above, rather than a conversion to abstract liberal principles, is evident from the tightening of restrictions on capital inflow.

The effects of partial liberalization on the use of Taiwan's surplus, and consequently on the dollar yield curve, the exchange rate of the dollar and the importance of bank intermediation of surpluses, may now ultimately depend on portfolio choices made by private Taiwanese investors. The two weeks following the lifting of the controls witnessed modest private outflows of no more than $200 million. Private Taiwanese behavior is hard to predict, and for a time official decision making may dominate the management of Taiwan's foreign assets. There are grounds for arguing, however, that the private foreign investment behavior of the Taiwanese will differ from that shown by Japanese investors since the early 1980s, when exchange controls were relaxed in that country.

Compared to Japanese investors earlier in this decade, private investors in Taiwan have very different domestic investment experience on which to draw as they approach the new problem of how to manage foreign investment. Not only did Japan have deeper financial markets relative to national product, as one would expect of a richer country, but also Japanese financial assets were of much longer term (Table 8). The difference in the relative size of bond markets is most striking: a bond market hardly exists in Taiwan today, while the fiscal deficits after the first oil shock produced a large bond market in Japan by 1980. Even Korea has a bond market that is relatively larger than that of Taiwan; this difference may account for net debtor Korea's acquisition of Treasury coupons in 1986 before net creditor Taiwan's first sizeable acquisition in 1987. In any case, Taiwanese investors have more to learn about managing a portfolio of bonds than Japanese investors did. Of course, would-be investment managers and advisors are anxious to speed the learning.

The lesser importance of institutional investors in the savings process in Taiwan relative to Japan may lengthen the learning process. In relation to national income, the liabilities of life insurance companies in Japan are five times those of life insurers in Taiwan. Further, such liabilities have grown faster than total financial assets in Japan since Japan's relaxation of exchange controls. It remains to be seen whether life insurance will take off in Taiwan, even with the recent granting of licenses to five U.S. insurance companies. In Japan, relatively few managers of institutional portfolios, in trying to match contractual long-term liabilities, learned to buy foreign bonds; in Taiwan relatively more investors with perhaps less well-defined horizons must learn to buy into even professionally managed foreign bond funds.

Taiwanese investors may prove more ready buyers of foreign equity than foreign bonds. The value of outstanding equities in Taiwan is four times the value of outstanding bonds (Table 8). The capitalization of the

Table 8

Relative Importance of Bonds, Equities and Money in Japan, Taiwan, and Korea

(Amount Outstanding as a Percent of GNP)

	1980			1984			1985			1986		
	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea
Bonds*	62	3	7	78	4	17	81	5	19	84	5	19
Equities	33	15	12	56	17	8	62	17	9	89	20	14
Money†	86	87	47	92	120	50	93	140	55	99	157	55
Total	181	105	66	226	141	75	236	162	83	272	182	88
Memo:												
Total liabilities of life insurance companies	11	2	3	15	3	7	17	4	9	19	4	10

*Includes government and corporate bonds; includes bank debentures.

†Defined as domestic liabilities of monetary institutions less bank debentures issued by them.

Source: International Monetary Fund, *International Financial Statistics*; Bank of Korea, *Monthly Statistical Bulletin*; The Central Bank of China, *Financial Statistics Monthly*; The Central Bank of China, *Financial Statistics*; B.I.S., *International Banking and Financial Market Developments* (for foreign liabilities of Japanese banks); Bond Underwriters Association of Japan, *Bond Review*; Tokyo Stock Exchange, *Annual Securities Statistics*, The Bank of Japan; *Economic Statistics Annual* and International Finance Corporation.

Taipei stock market in relation to Taiwan's national product approaches the relative capitalization of the Japanese stock market in 1980 when a much richer Japan began to relax its exchange controls. Especially in the face of surging foreign stock markets, Taiwanese investors may take less than the five years it took Japanese investors to become substantial buyers of foreign equities.

Wealthy Taiwanese individuals will probably continue to favor investment in real estate, especially in housing in the United States, a form of wealth valued not only for itself but also as a first step to possible immigration. Heretofore, funds for this purpose could be raised by underinvoicing exports to the United States and traveling to the United States to buy houses and apartment buildings. This route may continue to be favored by tax-evaders, but otherwise such investment may find legitimate channels. It is still very hard for the Department of Commerce to obtain reports on such investment, so it may not be captured in the U.S. net investment position. Indeed, when such investment precedes immigration and naturalization, it does not remain foreign investment.

Another reason to expect Taiwanese investors to respond to relaxed exchange controls differently from their Japanese counterparts is that the level of concern over bilateral trade balances and trade practices at the present time far exceeds that of the early 1980s. The reason for the difference, of course, is the widening of the current account deficit of the United States. While Japanese automakers invested in the United States early on in the 1980s because of the particular constraints on their exports, Taiwanese exporters confront a more broad-based risk.

Taiwan faces not only the threat of legislation mandating a reduction of its bilateral surplus with the United States but also, perhaps more fundamentally, the possibility of finding itself outside of a free trade zone in the Americas. The United States is negotiating a free trade pact with Canada, has already extended special treatment to manufactures from the Caribbean, and has an active two-way trade with Mexico that integrates Mexican labor into U.S. industry. Taiwan may find that the best means of prospering in a more hostile world trading environment is the use of its current surplus to make direct foreign investments that will unite its industry with North America's and hasten the transfer of technology. Similarly, direct investment in southern Europe and perhaps Southeast Asia may provide some assurance of continued access to the European and Japanese markets.

Taiwan has of late made some efforts to promote direct investment abroad. Private industry is being provided with tax and loan incentives to invest abroad, and increased efforts are being made to arrange joint foreign ventures, especially with U.S. firms. The Taiwanese government sponsored a business group that visited the United States in June, investigating prospective joint ventures with U.S. firms in steel, machinery, chemicals, energy, and other industries. Though such efforts are in the early stages, some projects are further along. A proposed collaboration with Wang Laboratories would raise $500 million of capital: 10 percent from Wang Laboratories, 30 percent from the government of Taiwan, and 60 percent from private Taiwanese investors. Other joint ventures that are being organized designate Taiwanese firms—to date, all of them controlled by Taiwan's government—as minority stockholders. According to a forecast published by the Taiwanese Economic Ministry in March of this year, new Taiwanese investment in the United States is expected to double from last year to $80 million this year, and reach $400 million by 1991. This is likely to prove an underestimate.

Korea

Korea has not announced significant measures to loosen its capital controls and is not likely to do so for two reasons. First, since it is devoting most of its surplus to debt reduction, it is not following Taiwan's example in creating a conspicuous foreign currency reserve position and thus has felt less external pressure. Korea's status as a debtor country may shield it against some protectionist moves; the trade bill passed by the House of Representatives allows the President to waive mandated reductions of bilateral trade surpluses in the case of heavily indebted countries. Korea must weigh the potential cost of forgoing this exemption by reducing its gross debt against the benefits of improved market reception and lower spreads. Second, because reserve growth has been moderate, excessive liquidity and a speculative stock market have posed fewer problems in Korea than they have in Taiwan. Korea's money supply (M1) increased by 16.6 percent last year, as compared to 10.8 percent a year earlier, and its growth has not accelerated significantly this year.

Tightly controlled management of Korea's surplus is likely to persist, at least until considerable progress is made in reducing the debt. The Korean Ministry of Finance expects the country to reduce its debt to under $40 billion by the end of this year; continued current surpluses would permit $5 billion or more of debt reduction per year. Keeping domestic interest rates at double-digit levels and appreciating the won, the Korean authorities have had to direct the Korean conglomerates to repay cheaper foreign credits.

Korea will, however, permit direct foreign investment to protect and to further its access to its foreign markets, particularly the United States. In pursuing this

strategy, Korea has some advantages that have given it an early lead over Taiwan: assets controlled by Korean-owned firms in the United States at end-1985 totalled $1.9 billion while those controlled by Taiwanese firms were $0.5 billion. Korea's advantages lie in its more concentrated industrial organization and more extensive bank branch network. Emblematic of the difference in industrial organization is the achievement by Korea's major conglomerates of a certain brand recognition in the United States while the largest Taiwanese firms are only now trying to break out of their role as suppliers of U.S. firms and to achieve this recognition. Korea's banking system is represented in the United States by 21 branches and agencies, with a total of $1.1 billion in domestic commercial and industrial loans outstanding as of December 1986. Taiwan's banks have only 4 branches, with total commercial and industrial loans of $0.2 billion.

Korea's foreign direct investment in North America is accelerating. Outlays for newly established or acquired enterprises in the United States rose from $14 million in 1985 to $130 million in 1986; investment in already established operations cannot be disclosed by the Commerce Department without revealing the dimensions of a limited number of particularly large deals. Hyundai Motor, South Korea's largest vehicle maker, is already building an assembly plant in Canada that is scheduled to begin operation in 1988, and may also establish a car plant in the United States. Textile companies are also increasing their overseas manufacturing bases. At the end of 1985, seven textile companies invested $2.7 million abroad; in 1986, the number of companies jumped to eighteen, and the investment, to $8.4 million.

Foreign direct investment does not bulk large on Korea's international balance sheet since the country leverages the actual outflow with foreign borrowing. A case in point is a $100 million syndicated loan that Hyundai Auto Canada, Inc., signed on July 14, 1987. The borrowing carried the guarantee of the parent. In this manner, Korea does much of the financing of its foreign operations off the national balance sheet, a practice that permits a faster fall in gross national debt than would be possible if foreign direct investment were funded by the parent. Since many calculations of net indebtedness—for example, those of the International Monetary Fund and the World Bank—exclude foreign direct investment, Korea can lower its net debt so measured by funding its foreign direct investment offshore. One of the sources of funds for the U.S. subsidiaries is the commercial paper market, where the U.S. subsidiaries of four Korean conglomerates had $207 million in commercial paper outstanding at end-September 1986. Not only is the borrowing off Korea's balance sheet, but it is also off the balance sheet of banks that write the letters of credit backing the commercial paper. Thus, bank exposure to Korea has not fallen by as much as the decline of on-balance-sheet assets might suggest.

Like the Taiwanese, the Koreans are becoming an important new immigrant group. Last December Korea doubled to $200,000 the amount of foreign exchange that a household may carry abroad to establish a business.

Conclusions

To date, Taiwan and Korea have so disposed of their international surpluses as to make the shift of the Asian surplus in their direction important for financial markets. In their investment practices, they resemble less Japanese investors than a certain type of U.S. investor, one who has a strong liquidity preference, a strong taste for home-currency assets, and a strong aversion to anything but the safest of investments.

In the medium term at least, Taiwan cannot be expected to continue its accumulation of assets exclusively in the form of short-term dollar-denominated instruments; Korea, however, can be expected to continue to repay bank loans. We have reason to believe that both countries will favor foreign direct investment relatively more than Japan has, especially in the western hemisphere. Nevertheless, making a foreign direct investment is a relatively time-consuming process, and as a consequence, both countries will probably continue to lengthen the maturity of their portfolio investments. In the process, a smaller portion of their surpluses are likely to flow through the banking system.

The recent relaxation of capital controls in Taiwan is likely to lead to a substantial demand for dollar-denominated assets, especially after foreign financial institutions are allowed to set up brokerage and advisory services in Taiwan. Whether Taiwanese individuals and firms will show much of a propensity to diversify out of the dollar remains to be seen. Arguing in favor of diversification is the opportunity loss of holding dollars over the last two years. Arguing against diversification is the possibility that the dollar's depreciation has run its course. In addition, Taiwan's continued military and political reliance on the United States may inhibit diversification. Korea still has a large dollar debt to repay if it is to eliminate most of its gross debt and become, as it plans to, a creditor nation by 1994. Yet it currently appears to be, if anything, ahead of schedule. The investment behavior of the two nations thus far suggests that their management of surpluses may continue to provide support for the dollar.

Rama Seth
Robert N. McCauley

Japan's Growth Performance over the Last Decade

From 1980 through early this year, Japan's economy expanded at an average annual rate of 3¾ percent. Although this pace exceeds that of any other industrial nation, Japan's performance has been generally viewed as disappointing. Economic growth has been substantially below the 5 percent annual rate it achieved during the second half of the 1970s, and only about 40 percent of the growth rate in the decade before the first oil shock. Moreover, domestic demand expansion has fallen significantly short of overall economic growth—a gap reflected in Japan's large and growing external surpluses with the rest of the world.

The reasons for the growth slowdown and its implications are currently the subject of widespread controversy. It is generally acknowledged that a substantial slowing from the exceptionally rapid rate of expansion during the 1950s and 1960s was inevitable; as the economy matured, the impetus from "catching-up" to other industrial countries would eventually diminish. What is not clear, however, is the extent to which this process can account for the recent slowing in Japanese growth. According to one view, the deceleration of rates of expansion during the 1980s reflects a decline in Japan's capacity for growth that can be principally attributed to continued economic maturation. Many observers, however, take issue with this view and argue instead that policies restricting domestic demand have played a significant role in depressing economic activity. They believe that an acceleration of both output and demand growth in the coming years is necessary if Japan is to utilize its labor and capital resources fully and reduce its external imbalance.

This article examines the slowdown in Japan's growth, assessing the economy's performance over the last decade and the implications that it holds for the future. After a description of the changing trends in output and domestic demand since the 1960s, the analysis focuses on the estimation of the economy's potential or capacity rate of growth and the factors underlying it. Such estimates provide a useful standard for evaluating the actual performance of output as well as domestic demand, because in the long run both must grow at the same rate as potential.

The results indicate that Japan's current potential growth rate is in the range of 4-4½ percent annually, significantly lower than it was in the 1970s, but considerably above the actual average performance since 1980. Both the normal maturation of the economy and restrictive demand policies appear to have played a significant role in the growth experience of Japan since the mid-1970s. The slowdown in potential growth substantially reflects a decline in rates of capital formation and technological progress as the economy has matured. Nonetheless, since 1980, a policy of sustained fiscal austerity contributing to sluggish domestic demand growth has placed a substantial drag on economic activity.

The Japanese growth experience: an overview

The pattern of Japan's growth changed dramatically in the mid-1970s (Chart 1). From the mid-1950s to the early 1970s real gross domestic product (GDP)[1] grew

[1]Real gross domestic product measures all goods and services produced in Japan. GDP was considered a more appropriate standard of growth than the alternative real gross national product.

at a remarkable rate of over 10 percent annually, at least twice that of other major industrial economies. Following the first oil price shock, however, the trend rate of output growth fell sharply, to an annual rate of 4.2 percent over 1976-86. Furthermore, recorded growth has continued to decelerate over this decade, from roughly 5 percent during the latter half of the 1970s to 3.7 percent over 1980-86; over the past two years (1985-I to 1987-I), the economy's rate of expansion has declined to 3.3 percent per year.

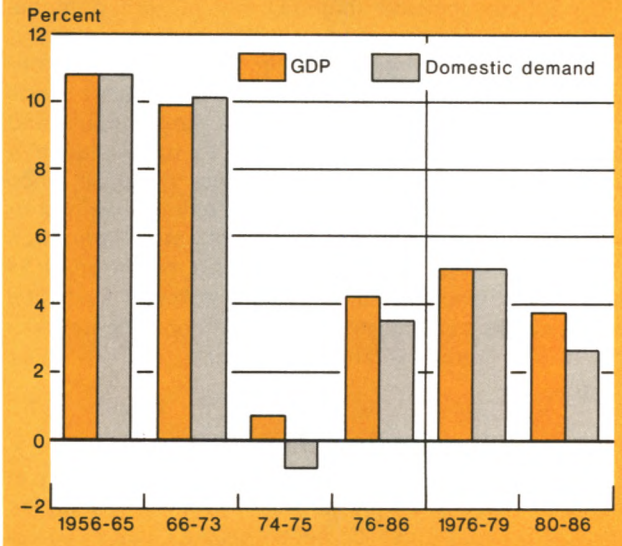
Substantial as the deceleration of output growth rates has been, domestic demand growth has slowed even further. Throughout the 1950s and 1960s domestic demand grew on average at the same pace as output. However, beginning in the early 1970s, demand growth began to fall short of output, a pattern that has become increasingly pronounced since the late 1970s. Indeed since 1979, Japan's domestic demand has, on average, lagged a full percentage point behind the pace of output growth. As a result of these developments, Japan's external payment (current account) surplus has widened dramatically to over 4 percent of GDP in 1986.

Footnote 1 continued
a measure of all goods and services produced by Japanese residents, including income derived from production based abroad.

Chart 1

Real Domestic Demand and GDP Growth

Annual rates of change, 1980 prices



Sources: OECD, Economic Outlook; and IMF, International Financial Statistics.

This striking decline in underlying trends of output and demand, confirmed by formal statistical analysis,[2] has generated a wide range of views about its causes and implications. One explanation, suggested by the timing of the shift in growth rates, attributes the slowdown to the two major oil price increases of 1974 and 1979. Indeed, these oil price shocks were substantially responsible for the subsequent cyclical downturns in real growth in Japan as well as other major industrial countries.[3] Japan experienced its first recession of the postwar era in 1974 in the aftermath of the sharp rise in oil prices. A similar but more modest slowdown in growth took place following the second energy price shock.[4]

Nonetheless, there are reasons to doubt that, aside from their temporary cyclical impacts, the oil price shocks could be responsible for the large persistent decline in Japan's trend rate of growth over the past decade. Germany and several other European countries are also heavily dependent on oil imports, yet their growth over the last decade has not slowed nearly as rapidly as that of Japan. The deceleration of trend rates of output and demand growth since 1973 has ranged between 1 and 3 percent for OECD nations; Japan's trend rate of output growth has declined by close to 6 percent. Furthermore, while most industrial economies rebounded to their prior rates of growth during the cyclical recovery in the second half of the 1970s, Japanese growth peaked at a level less than two-thirds of its average over the decade prior to 1974.

[2]To identify structural change in growth patterns, the logarithm of gross domestic product and total domestic demand were regressed on a time trend from 1966-I to 1985-IV. Standard statistical tests were employed to test for structural homogeneity between subperiods of the sample. Statistically significant shifts in the slope of trend lines for output and demand can be detected during the mid-1970s; no further significant shifts are identified following 1975. Application of a likelihood ratio test developed by Quandt (R.E. Quandt, "Tests of the Hypothesis That a Linear Regression Obeys Two Separate Regimes," *Journal of the American Statistical Association*, Vol. 55 (1980), pp. 334-339) identified 1974 as the year structural change took place in both demand and output.

[3]In *Economics of Worldwide Stagflation* (Harvard University Press, Cambridge, Mass., 1985), M. Bruno and J.D. Sachs provide an excellent synthesis of much of the literature regarding energy price shocks and their effect on macroeconomic performance in the industrial world.

[4]Japan's growth slowdown following the second oil shock was relatively mild in comparison with that of other industrial economies. This is often attributed to the flexibility exhibited in Japanese labor markets during this period. See Bruno and Sachs, *Worldwide Stagflation*, for an interesting contrast between the labor market adjustment (and policy response) in Japan and the United Kingdom following the second oil shock and the performance of the two economies. In "Japan's Macroeconomic Performance since the First Oil Crisis: Review and Appraisal," Carnegie-Rochester Conference Series on Public Policy, Vol. 20 (1984), R. Komiya and K. Yasui provide an in-depth analysis of the economy's performance during the two oil price shocks.

It appears, then, that other factors, more specific to Japan, have played the key role in the decline in its underlying growth trend. Almost certainly, an important contributor has been the maturation of Japan from its relatively underdeveloped state immediately after the Second World War to the world's second largest industrial nation. As with many developing economies, Japan's rapid expansion during the initial stage of its industrialization was in large part a reflection of the substantial gaps between its own capital stock and technology and those of the more mature industrial economies. In the process of "catching up," Japan's performance was enhanced considerably by factors that include the integration of superior technologies from abroad into production, the rapid growth of the capital stock from an initially low base, and efficiency gains from reallocation of the labor force from low productivity sectors (agriculture and nonfarm self-employment) to high productivity manufacturing industries.

However, contributions from such sources tend to diminish and eventually are exhausted as an economy matures, leading to a decline in its growth capacity. Indeed, Edward Denison and William Chung, in a study of Japanese growth from 1951 to 1971, estimate that over two-thirds of national income growth was due to transitory factors associated with Japan's rapid industrialization.[5] In their analysis they predicted a steady deceleration in Japan's trend growth rates during the 1970s and beyond as the maturation process continued. The experience of West Germany also provides a historical parallel to the slowing of Japanese growth. West Germany began to rebuild its economy after the Second World War (although its initial position was higher than that of Japan) and sustained an annual growth rate exceeding 7 percent during the 1950s and early 1960s. However, the maturation of the West German economy was largely completed by the mid-1960s, and growth rates subsequently fell, to an average of 4 percent annually during 1966-73 and less than 3 percent over the past decade.

These considerations strongly suggest that factors related to maturation are responsible for much of the slowdown in Japan's growth during the past decade. The maintenance, until recently, of low unemployment rates and apparently high levels of factor utilization rates despite a significant slowing in growth is consistent with this view of Japan's performance.

The divergence of domestic demand from output growth during the past decade cannot easily, however, be accounted for by the forces of maturation. Indeed, many observers contend that the weak performance of demand has played a significant independent role in the deceleration in output growth. According to this view, the slowdown in demand has decreased output growth below its potential and has led to the accumulation of excess capacity not reflected in published indicators of the cyclical position of the economy.

The historical record suggests that restrictive macroeconomic policies have contributed to the deceleration in domestic demand growth during the past decade. A monetary contraction aimed at reducing rising rates of inflation during the early 1970s was a key factor in the slowdown in domestic demand, at least through 1977. This was offset somewhat by an expansion in fiscal policy during the period 1976-79. Since 1979, however, fiscal policy has turned sharply towards a contractionary stance while monetary policy can be seen as broadly neutral. The general government deficit as a share of GDP has fallen from a peak of 5.5 percent in 1978 to less than 1 percent in 1986, as public sector demand has slowed sharply. At the same time, monetary authorities have continued to moderate expansion in their favored monetary aggregate (M2 + CDs). This measure of broad money has grown by 8.3 percent per year since 1981, compared to 11.7 percent during 1976-80.

To argue that demand factors have been significant does not, of course, imply that maturation forces have been of little consequence; indeed both seem to have influenced Japan's performance. It is important, however, to quantify their relative contributions to the slowdown in order to assess the economy's recent performance. This task requires a standard against which actual growth performance can be assessed, in particular a measure of an economy's potential growth in capacity. In the next section, we provide estimates of Japan's potential growth over the past two decades. These estimates are arrived at by measuring the sources of Japanese growth and analyzing their evolution over time. Once the factors that have contributed to growth are quantified, longer-term processes determining underlying rates of output and demand growth become apparent. In addition, the understanding of Japan's historical experience that emerges from this analysis provides insights into the nation's prospects for growth in the coming years.

Estimating potential growth

An economy's potential rate of output growth measures its maximum sustainable rate of expansion. This rate is determined by the growth in productive resources (capital and labor), together with the rate of advance in their productivity. Over time, output growth that is persistently below potential will lead to the buildup of excess capacity, whereas growth persistently in excess of potential will tend to raise factor utilization rates

[5] E. F. Denison and W. K. Chung, *How Japan's Economy Grew So Fast* (Brookings Institution, Washington, D.C., 1976).

above their normal levels and fuel inflationary pressures. Thus, maintaining the economy on its potential growth path is generally viewed as a desirable macroeconomic policy goal. In addition, potential rates of growth provide a standard for assessing the growth of domestic demand: an economy can maintain a stable external balance (relative to GDP) only if domestic demand grows at the same rate as output.

Actual growth rates in an economy vary around potential as a result of any number of factors that temporarily affect demand or supply. During a cyclical downturn, for example, output normally declines as unemployment rates rise and a portion of the capital stock is rendered idle. Generally, the resultant slowdown in income growth leads to a corresponding decrease in demand. During recovery, output and demand growth will likely exceed potential as underutilized resources are brought back into the production process. Therefore, when viewed over a long enough horizon, an economy's average rate of growth can be expected to reflect its potential.

This insight provides the basis for a standard approach to measure potential. Once actual growth rates are smoothed over several business cycles, the average between successive peaks can be employed as an estimate of capacity growth rates.[6] However, as our discussion thus far suggests, an approach of this type may be misleading when applied to Japan's experience over the past decade. To the extent that persistently weak demand depressed the economy's rate of expansion, averaging rates of actual output growth, even after adjusting for fluctuations around trend, may significantly underestimate the true potential for growth.

A more fundamental approach, employed here, considers the sources of Japanese growth and their change over time. This approach is particularly relevant for the case of Japan because the sources of potential growth have likely undergone a considerable change as maturation has proceeded. In particular, the economy's labor input (total man-hours worked) has risen substantially more rapidly over the past decade than during the prior 1967-73 interval (Table 1).[7] In contrast, labor productivity growth has undergone a remarkable decline since the mid-1970s. Clearly, the causes of this decline need to be identified if Japan's potential growth is to be determined.[8]

Table 1

Output and Productivity Growth (Annual Rates of Change)

	1967-73	1976-86	1976-79	1980-86
Real gross domestic product (GDP) (Constant 1980 prices)	9.2	4.2	5.0	3.7
Labor productivity (GDP per man-hour)	8.7	3.0	3.2	2.9
Total man-hours worked	0.5	1.2	1.8	0.8

In the approach taken here, we consider the relationship linking an economy's rate of output growth to its capacity to accumulate labor and two important components of labor productivity growth: the rate of capital accumulation and the rate of growth of general technological progress.[9]

$$\text{Output growth} = (\text{capital stock growth})S_K + (\text{labor input growth})\,S_L + \text{rate of technological progress.}$$

S_K and S_L measure the elasticity of output with respect to capital and labor respectively. Since production is reasonably approximated by a constant returns to scale technology, these elasticities can be interpreted as the respective output shares of the factors. Technological progress measures the average productivity increase of the labor and capital inputs in this framework and incorporates all components of growth not due to the measured accumulation of these factors.

As we explain in detail in the accompanying appendix, measuring potential output growth involves two steps. In the first, a relationship between the actual level of output and existing factor inputs, adjusted for rates of utilization, is estimated. This allows us to determine the underlying rate of technological progress and the elasticities necessary to account for each factor's contribution to potential growth. For example, if the elasticity of output with respect to capital is estimated at one-

[6]For a detailed discussion of this as well as alternative approaches, see L. Christiano, "A Survey of Measures of Capacity Utilization," IMF Staff Papers, No. 1, 1981, pp. 144-198.

[7]Part of the sharp increase in labor force growth during the second half of the 1970s reflects a cyclical recovery following the recession of 1974-75. However, even if we incorporate these effects, we find a significant shift in trend rates of growth of total man-hours worked. The causes of this shift are discussed in the appendix.

[8]Another approach, based on estimating Okun's law relationships for Japan, was investigated, but it proved to be unreliable because of the unstable relationship between labor input growth and productivity since 1974.

[9]This approach is similar in methodology to that taken by J.R. Artus in "Measures of Potential Output in Manufacturing For Eight Industrial Countries 1955-78," IMF Staff Papers, Vol. 24 (1977), pp. 1-35, and similar in spirit to the growth-accounting approach pioneered by Denison. See E. Denison, *Accounting for Slower Growth: The United States in the 1970s* (Brookings Institution, Washington, D.C., 1979).

half (as our analysis suggests), then every one percentage point growth in the capital stock contributes 1/2 percent to output growth. In the second step of this procedure, these parameters, together with estimates of the underlying trend rate of capital accumulation and the increase in the labor input, are used to estimate Japan's potential growth and its primary sources.[10]

The results, summarized in Table 2, suggest that there has been an ongoing and substantial deceleration in Japan's potential growth rate during the past two decades, from about 9 percent per year during 1967-73 to roughly 4 1/2 percent over 1976-86. Moreover, Japan's potential growth has continued to decline over the last decade, falling from estimates of 5 percent during 1976-80 to 4-4 1/2 percent in recent years. Although these estimates reflect the particular assumptions underlying the analysis and should not be viewed as precise measures of potential, the general pattern of decline was consistently displayed under a wide variety of conditions and appears to present a reliable indication of the evolution of Japan's capacity for growth.[11]

[10]No attempt is made to account for Japan's potential growth rate during 1974-75. Large structural shocks brought on by the first oil shock likely lowered the level of the economy's potential output during this period and may temporarily have altered the potential growth path. Although measurement of this effect is important for determining the current level of potential output, it does not bear significantly on our estimates of potential growth rates over the decade following 1975.

[11]In a recent IMF study that employs a comparable approach (C. Adams, P. Fenton and F. Larsen, "Potential Output in the Major Industrial Economies," Staff Studies for the World Economic Outlook, forthcoming), the authors identify a qualitatively similar pattern of decline in Japan's potential growth rate. Their estimates differ, however, particularly in regard to the contribution of the sources of potential growth. This inconsistency reflects the different assumptions on which the two studies are based.

Table 2

Composition of Japanese Potential Growth 1967-86 (Annual Rates of Change, 1980 Prices)

	Potential Growth Rate	Labor Input	Capital Input	Technological Advance	Potential Labor Productivity Growth Rate
		(Percent Contribution to Potential Growth)			
1967-73	9.0	0.1	6.5	2.4	8.8
1967-69	10.8	0.1	6.1	4.6	10.6
1970-73	7.8	0.1	6.8	0.9	7.6
1976-86	4.5	0.5	3.2	0.8	3.4
1976-80	4.9	0.5	3.7	0.7	3.8
1981-86	4.1	0.5	2.8	0.8	3.0
Memo: alternative estimate of potential*					
1981-86	4.6	0.5	3.3	0.8	3.5

*In determining the potential rate of capital accumulation through this approach, we assume that the historical patterns of investment and savings ratios over 1966-80 are maintained.

The sources of the potential growth slowdown

The deceleration in Japan's potential growth over the past two decades can be attributed to two major sources. The most important has been a substantial slowing in the rate of capital accumulation from a growth rate of 13 percent during 1967-73 to roughly 6 percent during 1976-86. As a result, capital's contribution to potential declined by more than 3 percentage points, accounting for over two-thirds of the deceleration in potential growth. In addition, the rate of technological progress has declined. Advances in average factor productivity contributed about 2 1/2 percent to potential growth per year from 1967 to 1973, but have since fallen to just under 1 percent. Together these factors account for the entire deceleration in potential growth rates, more than offsetting a modest positive contribution to potential from the acceleration in the growth of total man-hours.

Both the slowdown in technical advances and decline in rates of capital formation are largely attributable to maturation. In particular, the gains from labor reallocation and from the closing of the technological gap between Japan and other industrial nations have largely been exhausted. An end to this "catching-up" process appears behind the decline in rates of technological advance. In addition, the working of longer-term factors consistent with an economy's natural development—rising depreciation rates and diminishing returns to capital—can explain the major part of the decline in rates of capital formation.

Japan's potential growth fell from close to 11 percent to below 8 percent over 1967-73, a reduction that our estimates suggest is entirely attributable to a slowdown in technological advances. As noted earlier, our measure of technological growth is essentially a residual incorporating all components of potential growth not embodied by measured changes in labor and capital. Consequently, the sources of Japanese growth related to the nation's efforts to catch up, including the more efficient allocation of resources, the incorporation of new technologies, and the improvements in factor quality, are likely to be captured in the large estimate of technological advance during this period. The sharp decline in rates of technological advance over 1967-73 might then be interpreted as a reflection of the rapid closing of the technological gap between Japan and other industrial nations.[12] This view is reinforced by the fact

[12]Because of the approximate nature of our measures of factor inputs and rates of capacity utilization, estimates of technological progress based on a residual must be viewed with caution, especially for the shorter subperiods of our sample. In particular, the implausibly

that during the mid-1970s the contribution from this component stabilized to a level comparable to those of other industrial countries.[13]

The more moderate slowing of potential growth that has continued since the mid-1970s is essentially a reflection of an ongoing deceleration in rates of capital accumulation. The decline in capital's contribution to potential growth that has offset a more modest increase in labor force growth is also largely explained by the maturation of the economy. However, restrictive fiscal policies appear to have contributed significantly to the slowdown during the 1980s.

To understand the factors underlying these trends, note that the rate of capital accumulation is effectively determined by four components: the savings rate of an economy as measured by the rate of national savings to GDP; the portion of national savings flowing to domestic investment (rather than abroad); the portion of gross investment available for new capital formation as opposed to replacement; and the ratio of output to the capital stock itself.

Footnote 12 continued
abrupt slowdown in technological progress estimated from 1968 to 1973 should not be taken literally. Instead, it is probably more appropriate to take these estimates as indicative of trends rather than precise levels.

[13]The IMF study cited earlier (Adams, Fenton and Larsen, "Potential Output") arrives at the same conclusions. Their estimate of Japan's current rate of technological growth (1.6 percent per year) is well within their current range of estimates (3/4 to 2 1/4 percent) for the major industrial economies.

Table 3

Determinants of Japan's Rate of Capital Accumulation* (In Percentage Points)

	1968-73	1976-80	1981-86
Annual growth of capital stock	13.2	6.8	5.3
Net investment as a share of gross investment	53.3	45.5	38.1
Gross investment as a share of national savings	83.4	80.8	74.9
National savings as a share of gross domestic product	31.4	30.1	33.2
Gross domestic product as a share of the capital stock	95.0	61.6	55.5

*Estimates of capital stock growth and net and gross investment flows are based on our estimates of the potential rate of capital accumulation as described in the appendix. The total growth capital stock growth is equal to the product of the underlying components (expressed in fractions).

$$\text{Percent Growth of the Capital Stock} = \frac{\text{Net Investment}}{\text{Gross Investment}} \times \frac{\text{Gross Investment}}{\text{National Savings}} \times \frac{\text{National Savings}}{\text{Output}} \times \frac{\text{Output}}{\text{Capital Stock}}$$

Trends in the determinants of capital accumulation are presented in Table 3. As the table suggests, both the net to gross investment ratio and the output-capital ratio (the first and fourth items in the identity and Table 3) have exhibited a pattern of persistent decline, accounting for nearly all of the decline in rates of capital accumulation from the late 1960s through 1980. In contrast, national savings rates and the economy's utilization of its domestic savings remained fairly stable until the 1980s and hence were not significant factors in capital's declining contribution to potential growth in the 1970s.

Underlying this slowdown are two forces that naturally tend to lower rates of capital accumulation as an economy matures. First, as an economy industrializes, its capital stock is likely to grow relative to other factors of production. Eventually this process will lead to diminishing returns in output for a given addition to the capital stock, and consequently the ratio of output to capital will fall. However, a declining output-capital ratio requires that an increasing share of output be allocated to investment in order to maintain constant rates of capital accumulation. Thus, if an economy maintains stable investment and savings shares, rates of capital formation (and consequently rates of output, savings and investment growth) will eventually exhibit a pattern of decline.

The second factor that has contributed to the slowdown in rates of capital formation is the general tendency for a greater share of investment to be devoted to replacing depreciating capital over time. Depreciation expenditures can be expected to rise as an economy's capital stock grows; they generally absorb a larger share of gross investment expenditures in more mature economies. Based on measures of consumption of fixed capital from published national income accounts, depreciation as a share of gross fixed capital formation currently stands at about one-half in Japan compared to two-thirds for the United States. The estimates used to measure potential growth indicate that depreciation expenditures as a share of gross investment have nearly doubled over the past two decades and are a major factor in the decline of the net to gross investment ratio.

Investment demand and capital accumulation in the 1980s

While these longer-term forces have continued to play

a role in the slowing of potential growth during the 1980s, the deceleration in the rate of capital accumulation has been augmented by a sharp decline in the rate at which Japan utilizes its domestic savings. The rate at which the economy utilized savings fell steadily from 1979 to 1985, more than 15 percent from peak to trough (Chart 2).[14] This decline is reflected in the increasing share of Japan's savings exported, via widening current account surpluses, over the period.

Conceivably, the increasing tendency to invest savings abroad could also indicate maturation, in particular an underlying decline in the profitability of domestic investment opportunities. However, the observed pattern of the components of investment demand during this period suggests that maturation cannot provide the major explanation for this phenomena. Trends in private investment demand growth offer no evidence of a generalized fall in returns to capital; private investment demand growth has accelerated in recent years although interest rates have risen and other components of domestic demand have slowed. In contrast, there has been a sharp contraction in public sector capital outlays that has resulted in a slowing of aggregate investment demand growth. Taken together, these trends suggest that at least part of the deceleration in rates of capital accumulation during the 1980s can be traced to restrictive demand policies.

[14]The ratios in Chart 2 are presented in real terms (all variables are in 1980 prices), reflecting our concern with their relation to real rates of capital formation. The nominal counterparts of these ratios are of somewhat different magnitude but exhibit a similar decline in the utilization rate of domestic savings during the 1980s.

Chart 2

Japanese Savings and Investment*

*All series are measured in 1980 prices.

Source: Economic Planning Agency, National Accounts.

Table 4

Components of Japanese Investment Demand Growth 1968-85

	1968-73	1976-86	1976-80	1981-86
Total non-residential fixed investment	13.3	4.6	5.0	4.2
Public sector	13.5	1.8	5.0	−0.8
Private sector	13.2	5.9	5.0	6.7
Export-oriented*	5.7	15.5	18.7	12.3
Other*	14.2	4.1	3.6	5.6

*Fiscal year figures. Export-oriented industries include general and electrical machinery, transportation equipment and precision instruments. Figures for 1968-73 do not include precision instruments. Most recent period encompasses 1981-85.

Sources: OECD, *Economic Outlook;* Japan Economic Research Center, *Five Year Economic Forecast*, various years; and Federal Reserve Bank of New York estimates.

Evidence for this interpretation is presented in Table 4. Total nonresidential fixed investment (our input to potential capital accumulation) has grown more slowly during the 1980s, both in relation to the experience of the second half of the 1970s and the decade prior to 1974. However, after expanding at a rate roughly similar to that of private sector investment from 1968 to 1980, public sector investment contracted by 0.8 percent per year over 1981-86. Private investment demand, in contrast, grew by 6.7 percent during this time, a faster pace of growth than that recorded from 1976 to 1980. Thus, a major component of this decade's lower rates of utilization appears to be tied to fiscal policy actions that increased the national savings rates, in part by directly depressing rates of capital formation.

In addition, a shift in the composition of private investment demand can be observed. Private investment expenditures have been increasingly directed toward export-oriented sectors where investment demand has grown more than twice as rapidly as in other sectors. To some extent this shift reflects a structural change in the Japanese economy in the direction of low-energy-intensive production following the first oil price shock. However, the continued divergence of investment growth between domestic and export-oriented industries is at least consistent with the view that the slowing in public sector demand may have depressed aggregate investment demand in recent years. It also raises the issue

of how the significant changes in the foreign environment facing the Japanese economy during the 1980s have impacted on domestic investment behavior.[15]

Because the evidence suggests that trends in investment demand may not have reflected accurately Japan's potential for capital accumulation in recent years, we consider an alternate measure. In this approach, the historical utilization rate of domestic savings is employed as a long-term constraint on the economy's ability to accumulate capital. While the use of this measure has virtually no impact on our estimates of potential growth before 1980, the results, presented in Table 2, suggest that Japan might have been able to grow at a rate of slightly more than 4½ percent over 1981-86 if it had continued to utilize its savings according to historical trends.

Japan's recent economic performance

Our estimates of the economy's potential clearly imply that the deterioration in Japan's output growth performance since the mid-1970s is primarily the result of a slowing in potential growth rates. Indeed, output and demand grew somewhat faster than their long-term paths during the second half of the 1970s. However, recent years have witnessed a slowing in output and particularly demand in relation to potential. As a result, significant imbalances currently exist in the economy, implying a very different pattern of growth in the coming years.

The economy's performance is illustrated in Chart 3, where domestic demand and output growth are related to the economy's estimated potential growth path over the past decade. From 1976 to 1979, average growth of both demand and output exceeded potential. This result is not surprising, however, because at least initially, Japan was recovering from its most severe downturn of the postwar period. Because of the sharp cyclical swings experienced during the early 1970s, a period in which over-expansion in 1972-73 was followed by recession in 1974-75, the economy's actual performance during the 1970s masks the steady slowing of potential growth rates throughout the decade as well as the return by 1977 of the economy to its long-term growth path.

During the 1980s Japan's potential rate of growth continued to decline, although at a slower rate than over the prior period. However, the economy's actual growth slowed even more substantially. Output lagged behind our lower bound estimates of potential by about three percentage points during the decade as a whole. Domestic demand grew even more slowly, falling nearly nine percentage points relative to potential and nearly six percentage points relative to actual output over the same period.

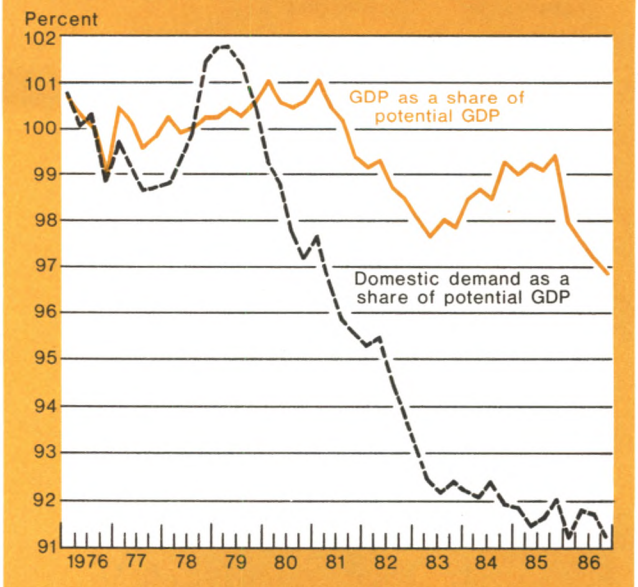
It is reasonably clear from these trends that the marked slowdown in demand growth relative to its long-term path was a substantial and persistent drag on activity throughout the 1980s. As indicated earlier, the shift to a policy of fiscal austerity undertaken in 1979 was a major factor behind the weakening demand performance. Spurred by a contraction in public sector investment, total public sector demand has grown at an annual rate of less than 1 percent since 1979, compared to 6.1 percent over 1976-79. In contrast, private demand growth has been considerably more robust; indeed household savings rates have actually declined, and since 1980, private investment demand has expanded more rapidly than its average of expansion during 1976-79.[16]

[15]The increase in foreign demand for Japanese goods brought on by the depreciation of the yen relative to the dollar during the 1980s has likely, through the accelerator effect, stimulated domestic investment demand, particularly in export-oriented sectors. On the other hand, the higher interest rates abroad that accompanied the shifting composition of demand may have slowed domestic investment demand by stimulating the export of domestic savings and pushing up the domestic cost of capital.

[16]Private consumption demand has slowed during the 1980s relative to its rate of expansion during the second half of the 1970s. However, this development is due in large part to the rapid growth in government tax revenues. Household consumption as a share of disposable income has risen steadily in recent years, averaging close

Chart 3

Japanese Output and Demand Gaps*



* All series are indexed, 1976=100. Note that output and demand may not have been equal to potential in 1976; hence the magnitudes of these gaps should not be taken literally.

The slowing of domestic demand growth would have led to a much more substantial shortfall of actual relative to potential output had it not been for the substantial rise in external demand for Japanese output during the 1980s. The effects of increased external demand for Japanese goods, offsetting the sluggish performance of the economy's domestic demand, enabled the economy to grow at rates close to its potential for much of the decade and kept excess capacity at fairly modest levels—at least until the last year. The impact of rising external demand was particularly important from 1983 to 1985, when output grew faster than potential at the same time that the gap between domestic demand and potential output continued to widen. Japan's external sector contributed 1.5 percent to output growth per year from 1980 to 1985, more than three times its average contribution over the previous two decades.

Our analysis of the economy's recent performance has several implications for the pattern of Japan's growth in the future. First, the estimates presented here suggest that Japan's capacity for growth in the coming years is roughly equal to its average rate of expansion during 1976-86. While the slowdown in potential that has taken place over the past decade makes it unlikely that the economy can return to the growth performance it achieved during the late 1970s, there is scope for an acceleration in output growth beyond that recorded recently. Our estimates indicate that growth in excess of 4 percent per year, roughly 1/2 percent faster than Japan's average performance since 1980, can be sustained without risking an acceleration of inflation.

A more radical expansion in the rate of domestic demand growth will be required, however, if the economy is to expand at full capacity. The recent pattern of considerably slower growth in demand than output clearly cannot be sustained because it would require that exports consume an ever increasing share of Japanese output. Therefore, at some point, Japan's external position must stabilize. Even if Japan's external surpluses remain at their current levels relative to GDP, an acceleration in demand growth to rates consistent with current rates of potential will be necessary to prevent the accumulation of excess capacity. By itself, this finding implies that demand must grow by roughly 1 1/2 percent above its average performance since 1980.

Footnote 16 continued
to 84 percent from 1981 to 1986 (compared to 80 percent from 1976 to 1980).

Most observers would agree, however, that some reduction in Japan's net exports to output ratio must occur in the coming years. Such a reduction would require a negative contribution from the external sector during the adjustment period. Under these conditions, a rate of domestic demand growth that is in excess of the economy's potential and considerably faster than demand's performance over the past decade will be necessary to maintain output on its long-term path while facilitating external adjustment.

Conclusion

There seems to be little doubt that both the normal maturation of the economy and restrictive demand policies have been important factors in the slowdown in Japanese growth since the mid-1970s. As a result of natural declines in rates of capital formation and technological progress associated with Japan's maturation, potential growth rates have steadily fallen during the past two decades. At present, potential growth appears to be in the range of 4-4 1/2 percent annually, less than half the rate over the period 1967-73. Actual average growth performance over the last six or seven years has fallen short of even the lower bound of the economy's potential.

Perhaps more importantly, domestic demand growth in Japan has been significantly weaker than overall growth, largely reflecting a policy of sustained fiscal austerity. The fiscal drag on economic activity has been offset, to a substantial extent, by a stimulus to demand from the historically unprecedented foreign trade surpluses.

In the coming years, Japan will be faced with the difficult challenge of correcting the accumulated external imbalances of the past while attempting to achieve or maintain growth near potential levels. Our estimates suggest that a moderate increase in the rate of output growth above recent performance can be sustained without the risk of fueling inflationary pressures. However, performance at full capacity alone will not be sufficient to ensure adjustment of external sector imbalances. A more dramatic and prolonged acceleration of domestic demand growth, well in excess of the pace in recent years, will be necessary if Japan is to make substantial progress in reducing its foreign trade surpluses.

Bruce Kasman

Appendix: Estimating Japanese Potential Growth

This section describes the methods used to estimate Japan's potential growth. Potential growth is considerably harder to measure than to define because of the difficulty of accurately quantifying its basic determinants and identifying their underlying trends.

The analysis is based on a standard "production-function" relation between the level of the economy's output and its capital and labor resources. Returns to scale and factor shares are taken to be constant, an assumption usually found to be a reasonable approximation at this aggregate level.*

$$Q_t = Ae^{r_1 t} (c_t K_t)^{\alpha} L_t^{1-\alpha} \qquad (A.1)$$

where: Q_t = actual level of output
r_1 = time trend of technological change
K_t = capital stock
L_t = labor input (total man-hours worked)
c_t = utilization rate of the capital stock
α, $1-\alpha$ = factor shares of capital and labor, respectively.

A major difficulty in applying this method is that any measure of aggregate factor inputs is, at best, a rough approximation. In order to represent an economy's productive process by a single equation, various inputs and outputs are aggregated into a few composite variables. In addition, the analyst must rely on proxies to account for changes in the degree of intensity of the factors used. In Japan's case, this procedure is made particularly difficult by the inapplicability of the common proxies (unemployment rates and rates of capacity utilization).

Fairly standard techniques were employed to measure factor inputs. The capital stock, defined as all nonresidential structures and machinery, is measured through a simple perpetual inventory method that considers gross fixed nonresidential investment as the economy's addition to its capital stock.† Obviously the capital stock is not always utilized at its normal rate, and some adjustment to measure the actual input of capital in each period is required. After experimenting with different techniques to estimate the utilization rate of capital, we chose a weighted average of growth during the past four quarters relative to average growth rates during the past two and a half years.‡ We assume that normal utilization rates are achieved when this ratio equals one. The economy's labor input is estimated by total man-hours worked in all industries, and our estimates of technological change are captured by time trends that incorporate all systematic components of growth not measured by capital stock and labor input growth.

Quarterly data from 1966-I to 1985-IV were used in the estimation process. A primary consideration in the estimation was the identification of structural shifts in factor shares and trend rates of technological change. Tests for structural stability of the relationships suggest a single break within the sample period at the end of 1973. The best-fitting equation estimates for equation A.1 are presented in Table A.

These estimates fit the data well, as the satisfactory goodness-of-fit statistics attest. In addition, the parameter estimates proved to be stable with respect to small changes either in our choice of sample period or in the assumptions required to measure the capital stock and its rate of utilization. The results suggest that no significant change has taken place in the production technology of Japan over time. Estimates of capital's share of output increased from 50 to 54 percent over the two

*A production technology that assumes constant factor shares for capital and labor is known as "Cobb-Douglas." It also implies constant elasticities of output with respect to each productive factor. The Cobb-Douglas function is often employed when estimating potential growth because it allows for a clear-cut identification of the individual sources of potential growth.

†The capital stock, measured in 1980 prices, is increased by gross fixed nonresidential investment (INV) minus an assumed 8 percent annual rate of depreciation. The formula for the change in the capital stock, on a quarterly basis, is $K_t - K_{t-1} = I_t - .02\ K_{t-1}$, where: $I_t = .3INV_{t-1} + .5INV_{t-2} + .2INV_{t-3}$. Denison and Chung's estimate of net capital in 1955 was used as a benchmark.

‡Other estimates of capacity utilization rates, including indexes of operating ratios compiled by the Japanese Ministry of International Trade and Industry (MITI), were employed but did not perform as well as the chosen measure in estimation.

Table A

Regression Estimates of Japan's Production Function*

	1966-I to 1973-IV	1974-I to 1985-IV
Ln A	−.832	−.871
	(−6.6)	(−5.4)
α	.503	.539
	(4.8)	(7.04)
r_1	.016	.002
	(3.4)	(2.30)
r_2†	−.0003	—
	(4.2)	
Summary statistics		
R^2	.974	.920
SEE	.009	.005
Rho	.699	.846
DW	2.19	1.94

*All equations are estimated with Cochrane-Orcult correction for first order serial correlation. The estimated form was obtained by dividing equation (A.1) by the labor input and taking logs: $\ln (Q/L) = \ln A_t + \alpha \ln(cK/L) + r_t$. T-statistics are in parentheses.

†r_2 is a second order time-trend variable that captures the decelerating rate of disembodied growth during the first half of the sample period.

Appendix: Estimating Japanese Potential Growth *(continued)*

subperiods of the sample. However, the underlying rate of technological progress exhibits a substantial slowdown, evidenced by the significance of a negative second-order time-trend variable from 1966 to 1973 that reflects a steady downward trend in the rate of technological progress during this period.

These estimates of factor shares and underlying rates of technological change provide a means to account for the sources of potential growth. For example, our estimate of a factor share of capital in the vicinity of 0.5 indicates that every 1 percent rate of growth in the economy's underlying rate of capital will contribute 0.5 percent to potential growth rates. A similar calculation can be made for labor; these estimates provide the basis for the contribution of factors presented in Table 2.

Obviously an estimate of Japan's potential rate of capital and labor inputs is required to complete the analysis. The potential level of the labor input was determined by regressing the log of total man-hours worked on a time trend. As in the case of production technology, a break in trend is identified at the end of 1973. The annualized trend rates of growth for total man-hours worked were 0.2 percent over 1966-73 and 1.1 percent from 1974 to 1986.

Two factors might account for this sharp increase in total man-hours worked: a rise in female participation rates and a reversal of the trend towards lower average hours worked in the economy. The rise in female participation rates can be explained by a combination of economic and cultural factors at work throughout the industrial world, reflecting longer-term shifts in labor inputs. In contrast, the increase in average hours worked in Japan is less easily explained and appears unique among major industrial nations. While this shift raises questions about the relationship between recent trends and Japan's underlying labor force growth, we refrained from an in-depth study of the labor input because it has not played a significant role in the slowing of output growth rates during the past two decades.§

Two techniques were used to estimate the potential rate of capital accumulation. First, time trends for total nonresidential fixed investment demand were estimated in a fashion similar to that used to estimate total man-hours worked. Our findings enabled us to estimate the potential rates of capital accumulation presented in Table 3. We also employed an alternative measure because it was not clear that the fitted trends in investment demand accurately captured the economy's potential for capital accumulation in recent years. In this approach, Japan's national savings were viewed as a relevant constraint for the economy's potential to accumulate capital. Consequently, trends in nonresidential fixed investment demand were reestimated using the historical rate at which savings flows were utilized in that sector. This alternative procedure produced no change in the estimated rate of capital accumulation through 1980, but raised the estimate for 1981-86 by one percentage point above that based on simple trend-fitting.

Our estimates of Japan's potential growth rate and its sources from 1967 to 1986 can be found in Table 2. No attempt was made to present estimates of Japan's potential growth rate over 1974-75 for two reasons: estimates for this period were not essential to our analysis, and standard estimation procedures could not easily account for the large structural shock to the economy's level of potential output.

§K. Hamada and Y. Kurosaka, "Trends in Unemployment, Wages and Productivity: The Case of Japan," *Economica*, Vol. 53 (1986), Supplement, provides a more detailed discussion of trends in Japan's labor input.

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