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This Quarterly Review *is published by the Research and Statistics Group of the Federal Reserve Bank of New York. Remarks of* E. GERALD CORRIGAN, *President of the Bank, on trends in international banking in the United States and Japan begin on page 1. Among the staff members who contributed to articles in this issue are* A. STEVEN ENGLANDER *and* CHARLES STEINDEL *(on evaluating recent trends in capital formation, page 7);* A. STEVEN ENGLANDER *and* GARY STONE *(on inflation expectations surveys as predictors of inflation and behavior in financial and labor markets, page 20);* SUSAN HICKOK *(on Japanese trade balance adjustment to yen appreciation, page 33); and* ELLIOT UCHITELLE *(on the effectiveness of tax amnesty programs in selected countries, page 48).*

Two quarterly reports on Treasury and Federal Reserve foreign exchange operations for the periods August through October 1989 and May through July 1989 begin on pages 54 and 61, respectively.

Trends in International Banking in the United States and Japan

Good afternoon, ladies and gentlemen. I am pleased to be able to participate in this most important and timely discussion of Japanese direct investment in the United States with emphasis on developments in the financial sector. Allow me to say at the outset that the views I will express today are my own and should not be construed as necessarily reflecting the official point of view of the Federal Reserve as a whole. Before turning to the particulars of developments in the financial sector, allow me to begin with several more general observations which I believe can provide some perspective on the discussion that will follow:

- First, patterns of direct foreign investment and international capital flows more generally must be viewed in the context of bilateral and global patterns of national savings and investment rates as well as patterns of current account positions. That is, for a country like the United States, which is running large internal and external deficits, the external deficit must be financed by some combination of direct and/or portfolio investment flows from abroad. Thus, so long as there are large imbalances in these macroeconomic relationships, there will have to be — as a matter of simple arithmetic — corresponding capital flows and swings in net foreign investment positions among countries. The bilateral relationship between Japan and the United States is no exception to the inevitability of this arithmetic. It follows, therefore, that the only way the rise in net foreign investment in the United States can be ameliorated is in a context in which underlying economic imbalances are reduced over time. As in most things, at the end of the day, the economic fundamentals are what really count.

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- Second, as a general matter, the free flow of capital and investment across international boundaries is a clear plus for national economies and for the global economy as a whole. Free and efficient flows of capital on an international scale (1) help to promote more open, competitive, and efficient national economies; (2) better allocate savings and investment on a global basis; and (3) may even help to promote greater harmony among nations. Looked at in this light, Japan is in a unique position and has unique responsibilities to assist in the optimal deployment of savings, not just here in Japan, but more generally.
- Third, direct investment, particularly de novo investment in productive plant and equipment, can play a particularly important role in stimulating competition, growth, and improvements in stan-

Remarks by E. Gerald Corrigan, President of the Federal Reserve Bank of New York, before the A.F.I.I. and C.B.I.U.S. Conference on Japanese Direct Investment in the United States, in Tokyo, Japan, October 12, 1989.

dards of living. Indeed, economic history—especially in the postwar period—provides unambiguous evidence that foreign direct investment works to the benefit of all.

Free and efficient flows of capital on an international scale (1) help to promote more open, competitive, and efficient national economies; (2) better allocate savings and investment on a global basis; and (3) may even help to promote greater harmony among nations.

- Fourth, all countries have some limits on the amount or nature of foreign investment they will accept within their national boundaries. Among the industrialized countries, such limits often take the form of restrictions on the extent—if any—of foreign ownership or control of firms or industries that are associated with the production of goods or services that are seen to have national strategic importance. Often, but not always, these restrictions grow out of national security considerations. However, while all governments respect the right of other governments to limit or restrict foreign investment on such grounds, there can be significant differences of opinion as to what constitutes legitimate grounds for such restrictions. For example, over the years we have seen evidence in some countries that suggests that banking—or at least certain core components of banking—can be viewed as falling within the range of commercial activities having special status for these purposes. In short, there can be an exceedingly fine line distinguishing between practices and policies that are motivated, on the one hand, by legitimate national strategic considerations and by protectionist-like attitudes on the other.

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- Finally, in order to provide a workable framework within which individual countries and countries at large can better manage both the politics and the economics of foreign investment, many countries—the United States and Japan included—have come to rely on the principle of national treatment. That principle, in its simplest form, states that, subject to limitations growing out of national strategic considerations, foreign firms should have the same rights, privileges, and responsibilities as domestic firms. In practice, however, the principle of national treatment is subject to many ambiguities since it is not always easy to determine whether such equality of treatment prevails even in de jure terms much less in de facto terms.

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Partly for this reason, the principle of national treatment is increasingly accompanied by an implicit or explicit policy of reciprocity, which in effect says that one country will be willing to provide national treatment to another only so long as the second country provides national treatment to the first. This is the philosophy which was associated with the so-called primary dealer amendment to the omnibus trade bill enacted in the United States in 1987. I personally, and the Federal Reserve generally, resisted that approach, partly on the grounds that a policy of "reciprocal national treatment" can all too easily put us all on the very slippery slope of protectionism. Indeed, this episode should serve as a forceful reminder that we all have an ongoing responsibility to see to it that policies and practices are fully consistent with national treatment and that markets for goods and services alike are open and free to all competitors, foreign and domestic.

With those general observations in mind, allow me to turn now to the financial sector in particular. What I would like to do in this regard is to provide an overview of the extent of Japanese presence in U.S. banking and securities markets and contrast that with the extent of U.S. presence in Japanese markets. That discussion must clearly take place in the context of the explosive growth of Japanese banks over the decade of the 1980s. We all know very well that any list of the largest banks in the world is now dominated by Japanese banks. We also know that the enormous growth of Japanese banks in this decade, and especially in more recent years, has to a very considerable extent been driven by macroeconomic considerations, including the

high savings rate in Japan, the country's massive cumulative current account surpluses, and net changes in dollar exchange rates.

What may not be as widely recognized is the extent to which the growth of Japanese banks has occurred in international banking markets. For example, over the seven years ending in December 1988, assets booked at the foreign branches (and agencies) of Japanese banks have increased almost fivefold. Looked at somewhat differently, there are now almost 100 branches and agencies of Japanese banks in the United States as well as a number of relatively large U.S. subsidiaries of Japanese banks. From still another vantage point, in the few short years between 1984 and 1988, B.I.S. statistics suggest that the share of international banking assets held by Japanese banks grew from about 23 percent to almost 40 percent.

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Turning more directly to comparisons of relative bilateral U.S. and Japanese presence in banking and securities markets, the following picture emerges:

- Judging by the limited data available, it appears that the scope — as measured by employment and capital deployed — of Japanese securities firms' presence in U.S. securities markets is not wildly out of line with the scope of U.S. securities firms' presence in Japan. However, even this qualitative and broad-brushed judgment must be further qualified in that it may not fully and fairly reflect conditions after taking account of Japanese firms' acquisitions of, or minority investments in, U.S. securities firms which have taken place over the last few years.
- The presence of Japanese banks in U.S. markets far exceeds the presence of U.S. banks in Japanese markets. To be specific, there are about twenty U.S. banks with a presence in Japan. In the aggregate, these banks have about $30 billion in assets — a very small market share by any measure. By contrast, there are about three dozen Japanese banks in the United States, and their aggregate banking assets amount to about $370 billion. More generally, and reflecting the openness of U.S. banking markets, foreign banking institutions in the United States now control about one-quarter of the banking assets booked in the United States, with slightly more than half of that total in Japanese banks. Indeed, by this measure of market share, Japanese banks now have about a 14 percent share of the banking market in the United States. And for selected geographic and product markets, the market share of Japanese banks is still larger. Further, if the total banking activities in the United States of major Japanese banks were fully consolidated (that is, to include on one pro forma balance sheet the assets and liabilities of the family of subsidiary banks, branches, and agencies), six such Japanese banks would now appear on the list of the thirty largest U.S. bank holding companies and a couple would be within striking distance of the tenth largest banking organization in the United States. While those comparisons may — as much as anything else — reflect the segmented structure of U.S. banking markets, they are striking none the less.

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Having said earlier that macroeconomic forces such as savings rates, current account positions, and changes in dollar exchange rates can go a long way in explaining the overall growth of Japanese banks over the past decade, the question that naturally arises is can these same macroeconomic forces fully explain the very sizable relative presence of Japanese banks in U.S. markets? The answer to that question is, in my

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For example, one can reasonably point to a number of historical or institutional factors that help explain this situation. As an illustration, Japanese banks probably developed a major strategic interest in U.S. banking markets before U.S. banks developed similar interests in Japanese markets. Similarly, elements of innovation, liquidity, and diversity of financial instruments in U.S. banking markets probably provided Japanese banks with more opportunities and earlier opportunities to do more things in the United States than they or U.S. banks could do in Japan, notwithstanding the similarities between Glass Steagall and Article 65. Finally, it is clear that for a number of years U.S. markets were more open than were Japanese markets. Indeed, the process of significant liberalization and deregulation of Japanese financial and banking markets is only a few years old.

But even these historical and institutional considerations, when added to the macroeconomic factors cited earlier, do not tell the whole story regarding the comparative scope of Japanese and U.S. banking presence in the respective marketplaces.

A further factor that must be considered is the market valuation of the shares of major Japanese and U.S. banks, respectively. Specifically, based on recent experience, the shares of major Japanese banks on the Tokyo Stock Exchange sell at price earnings multiples that are often in the range of fifty or more. By contrast, none of the major U.S. money center banks have P/E ratios of more than ten. This pattern raises two closely related questions: first, what accounts for the dramatically higher market valuation of the shares of Japanese banks, and second, what implications, if any, does this have for the bilateral patterns of banking presence in the two countries?

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I am not well positioned to answer the first question since stock market valuation matters are not an area in which I claim any expertise, even in the United States much less in Japan. I suspect, however, that some of these differences can be traced to tax, accounting, and regulatory considerations. The high internal savings rate in Japan may also be relevant in that the pool of funds available for investment in equities is so large. It is also widely stipulated that Japanese equity market valuations provide a significant premium for unrealized capital gains on real estate and equity holdings. In the case of the Japanese banks, these unrealized capital gains on equity investments are large in part because some of the investments they represent were seed money for industrial companies in the immediate postwar period that have since grown to become industrial giants on a national and global scale. (It should be noted that equity investment limitations governing investments by Japanese banks in industrial companies are technically now quite similar to those prevailing in the United States.)

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does it matter in terms of the competitiveness between Japanese and U.S. banks? The answer to that question is yes, it does matter, and it *may* matter a lot. There are at least three reasons for this. First, even in the face of broadly similar international bank capital standards, it is obviously cheaper — and presumably easier — for the class of banks with high P/E multiples to raise fresh equity in the marketplace. Second, it is also likely that this condition may provide room within which Japanese banks may have opportunities to price individual transactions at spreads that are lower than U.S. banks can justify — a pattern that would not be inconsistent with the low rates of return on assets generally observed at Japanese banks relative to U.S. banks. Finally, these differences in market valuation of shares also result in a situation in which it is easier for Japanese banks to expand in the United States by acquisition while it is virtually impossible for U.S. banks to expand in Japan by acquisition. The economics of the price tag may therefore represent a significant barrier to U.S. banking expansion in Japan. For this reason, it is all the more important that no stone is left unturned in the effort to ensure that all barriers — visible and invisible — to expansion and openness in Japanese banking and financial markets are eliminated.

All of this raises still another very difficult question: namely, is there a point where the extent of foreign banking presence in U.S. markets could give rise to public policy concerns about such presence? In my judgment, the candid answer to that question is yes, such concerns could arise, particularly in the context of any pattern of future behavior that might be viewed by some as an aggressive strategy of expansion through acquisition. I refuse to speculate whether — or under what circumstances — such future concerns might arise, since the initial point of friction — if it ever comes about — is likely to be more political than economic. However, leaving aside any such political considerations, there are other public policy issues which could arise in this context.

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For example, in the United States, concerns about concentration of economic and financial power — particularly in the credit origination process — have been at the heart of the national debate about banking structure for 200 years. While much of the doctrine about concentration has centered on market shares of individual institutions, it is not a major leap in intellectual terms for some to suggest that concerns about concentration should be extended to foreign banks or to foreign banks from a single country. There are also a number of supervisory and "safety net" issues that arise in this context, not the least of which are those relating to the responsibilities of the home country's central bank as lender of last resort should a sizable liquidity problem arise in a foreign country. Finally, there are also the continuing questions whether the second country is really doing all it can in law, in regulation, and in practice to provide the same degree of openness as prevails in the first country — again, the whole question of national treatment or reciprocal national treatment.

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Fortunately, the last several years have seen some major progress in containing these points of concern. The B.I.S. capital standards surely are working in the right direction even though they cannot and do not solve all the problems; the very significant deregulation and liberalization of Japanese banking and financial markets in recent years have clearly helped, even though here too, more needs to be done; the very close and cooperative efforts between official institutions in the United States and Japan are also a clear plus even if progress does not always come as quickly and as smoothly as both sides would hope; finally, the recognition that both countries have a major stake in finding mutually acceptable ways to blunt points of tension has grown, but here too, that recognition is not as widespread as it could be.

In closing, allow me to return to the point where I started: namely, to stress the mutual benefits arising from the free flow of capital internationally and to stress the importance of the economic fundamentals. The most constructive thing we can both do to check points of tension in the bilateral economic and financial relations between our two countries is to pursue policies aggressively that will wind down in an orderly way the macroeconomic imbalances I referred to earlier. We all lost a good friend recently with the passing of Governor Mayekawa, a man greatly respected throughout the world for his vision and his contributions to international harmony. Not the least of his accomplishments was the report bearing his name that was aimed at encouraging basic structural changes in the Japanese economy.

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Looking ahead, I know others will take up this important work just as I know we will continue to make progress in our efforts to better harmonize competitive conditions in our respective countries. I am also

acutely mindful of the pressing need for substantial reform in economic policy in the United States, just as I am sensitive to the need to achieve a still higher level of cooperation and coordination in policies and practices that relate to the structure, operation, and supervision of our banking and financial markets. None of this will be easy, but the stakes for us and for the world economy are so very large that we have no choice but to find the will and the way that ensure success.

Evaluating Recent Trends in Capital Formation

Since 1984 real gross nonresidential fixed investment by nonfarm business has grown at a 7 percent pace, considerably faster than in earlier periods. Its share of real nonfarm business output has averaged over 14 percent in the 1980s, well above its norm for the last generation (Table 1, columns 1 and 2). Some analysts have argued that this strong investment performance reflects an improved business climate and is likely to provide long-term gains in productivity and competitiveness.[1]

A more sobering conclusion emerges from an analysis of capital stock and depreciation data provided by the Department of Commerce.[2] The pickup in investment is highly correlated with an increase in the estimated depreciation of the capital stock. Subtracting investment that merely replaces aging capital leaves a more modest level of net investment and capital formation (Table 1, columns 3 and 4). This rate of net capital formation is below the average of the postwar period. The key factor in this rising depreciation rate is the shifting of investment to shorter lived capital goods. A shift towards capital that has to pay for itself over a shorter lifetime may raise the measured short-term contribution of capital to output but lower the contribution over the longer term.

[1]See, for example, John A. Tatom, "U.S. Investment in the 1980s: The Real Story," Federal Reserve Bank of St. Louis *Review*, vol. 71, no. 2 (March-April 1989), pp. 3-15.

[2]The most recent data are presented in John C. Musgrave, "Fixed Reproducible Tangible Wealth in the United States, 1985-88," *Survey of Current Business*, vol. 69, no. 8 (August 1989). Historical data are published in Department of Commerce, Bureau of Economic Analysis, *Fixed Reproducible Tangible Wealth in the United States, 1925-85* (Washington, D.C.: Government Printing Office, June 1987).

Commerce Department measures of net and gross capital stock growth tell similar stories. These two capital stock measures are alike in reflecting the scrappage of older capital equipment but differ in the time pattern they use to depreciate older capital. The *gross* capital stock represents the cost of replacing all installed capital equipment currently in use. Capital goods are subtracted from the gross capital stock only at the end of their estimated service lives. The *net* capital stock, by contrast, subtracts estimated depreciation from the capital stock on an ongoing basis. Despite these differences, the two capital stock measures provide a qualitatively similar picture of the slowdown in capital accumulation. Both the gross and net capital stock are growing at a weaker pace than in the 1960s and 1970s (Table 1, columns 5 and 6). Moreover, the growth in capital per worker is quite low (Table 1, columns 7 and 8). These data do not support the view that rapid capital accumulation is supporting output or labor productivity growth more strongly now than earlier in the postwar period.

At first glance, the slowdown in the growth of the gross capital stock seems at odds with the acceleration of gross investment. However, capital that has been scrapped at the end of its service life is subtracted from gross investment to calculate the change in the gross capital stock. The shift to shorter lived capital in recent years has increased the rate of scrappage and reduced the rate of growth of the gross capital stock.

The relationship between net investment and the growth of the net capital stock is closer than that for the two gross series. Essentially, net investment equals the change in the net capital stock. Net investment has

fallen off as a share of output in the 1980s, and net capital stock growth has also weakened.

In some respects the contrasts between measures of gross investment and capital stock growth are even more striking for the manufacturing sector than for all nonfarm business (Table 2). After falling sharply in the early 1980s, gross investment has been growing at a robust pace since the mid-1980s. The two capital stock measures, however, show an anemic performance, with growth rates well below those of earlier periods. In part, the weak manufacturing data reflect the relative weakness of the manufacturing sector in this expansion. However, the strong growth in gross investment since the mid-1980s, even when combined with the loss of manufacturing jobs, does not begin to restore per capita capital formation to 1960s levels (Table 2, columns 7 and 8). The stagnation of employment in the sector is not being offset by an accelerated rate of capital growth.

The conflicting messages conveyed by different measures raise the question: Which set of data offers the most reliable view of the country's economic performance? If one accepts the gross investment data as indicative of the confidence in, and future prospects for, economic growth, then an optimistic view is justified. If one focuses instead on capital stock growth, then a more conservative evaluation of prospects is in order. Clearly, the answer is important for analyzing the long-term performance of the American economy. If the optimistic view is correct, then the economy may be able to grow out of the external and federal government deficits without a reduction in living standards or a loss of government services. If the pessimistic view is correct, then the nation should, at the least, look for policies to stimulate capital formation.[3]

Although economic theory suggests focusing on capital input as an indicator of capital's contribution to output, using capital stock data as a measure of the flow

[3]See, for example, M.A. Akhtar, "Adjustment of U.S. External Balances," Federal Reserve Bank of New York *1988 Annual Report*.

Table 1

Indicators of Capital Formation in the Nonfarm Business Sector

	1 Growth in Gross Investment	2 Gross Investment as Share of Output	3 Depreciation as Share of Output	4 Net Investment as Share of Output	5 Growth in Gross Capital Stock	6 Growth in Net Capital Stock	7 Growth in Gross Capital per Worker	8 Growth in Net Capital per Worker
1984-88	7.04	14.85	11.41	3.44	3.53	3.20	0.26	−0.06
1979-88	3.90	14.64	11.18	3.46	3.56	3.17	1.45	1.06
1973-79	5.31	13.36	9.60	3.76	3.79	3.53	0.92	0.66
1961-73	5.59	12.69	8.40	4.29	3.74	4.26	1.60	2.11
1948-61	3.01	11.93	8.23	3.69	2.70	3.74	1.70	2.72

Note: Investment, depreciation, capital stock, and output data all refer to the nonfarm business sector and are measured in constant 1982 dollars.
Sources: Department of Commerce, Bureau of Economic Analysis, for investment and capital stock data; Bureau of Labor Statistics for data on labor input.

Table 2

Indicators of Capital Formation in Manufacturing

	1 Growth in Gross Investment	2 Gross Investment as Share of Output	3 Depreciation as Share of Output	4 Net Investment as Share of Output	5 Growth in Gross Capital Stock	6 Growth in Net Capital Stock	7 Growth in Gross Capital per Worker	8 Growth in Net Capital per Worker
1984-88	5.90	9.51	8.91	0.60	1.80	0.85	0.80	−0.14
1979-88	0.92	10.52	9.10	1.42	2.47	1.63	3.05	2.20
1973-79	6.30	11.44	8.31	3.14	3.87	3.44	2.54	2.12
1961-73	5.09	11.11	7.49	3.62	3.98	4.31	2.61	2.91
1948-61	1.09	10.53	7.65	2.88	3.37	3.43	3.16	3.20

Note: Investment, depreciation, capital stock, and output data all refer to the manufacturing sector and are measured in constant 1982 dollars.
Sources: Department of Commerce, Bureau of Economic Analysis, for investment and capital stock data; Bureau of Labor Statistics for data on labor input.

of capital services poses several problems. These difficulties have led some economists to recommend gross investment as an indicator that is theoretically imperfect but superior in practice to the commonly used measures of the capital stock.[4] For this reason, this article considers a broad set of capital input indicators from both a theoretical and practical viewpoint.

Mindful of the apparent contradictions in the data, we begin by discussing the theoretical role of capital in economic growth, the conceptual basis for measuring the input of capital, and the strengths and weaknesses of the various approximation techniques used to measure the aggregate capital input. The potential pitfalls of some widely used measures are illustrated in a simple example. Next, we present alternative capital input data and discuss their implications for economic growth. Finally, we compare the ability of a number of capital input measures to explain economic growth over the last thirty years, arguing that if a measure correctly reflects the contribution of capital to output growth, its movements ought to be reflected in the movement of output.

Our analysis suggests that while no single capital input measure dominates all others, the various capital stock measures more accurately characterize recent and prospective economic performance than does gross investment. The higher gross investment rate has not raised capital input per head at a pace comparable to that in the 1960s. Any positive contribution to growth made by the shortening of the average life span of capital will wear off quickly as the composition of the capital stock is stabilized. Any improvement in trend labor productivity growth (especially in manufacturing) in the 1980s is more likely due to enhanced technology, greater competition, and a better skilled labor force than to more rapid capital accumulation.

The data show that the contribution of capital to overall economic growth is about the same as, or slightly lower than, it was throughout the postwar period. In manufacturing, however, the contribution is markedly lower. There is little to indicate that the current pace of capital formation will propel the economy along a higher trend output path, unless technology is embodied in new capital to a much greater degree than the data can capture. The analysis suggests that if capital formation is to help accelerate growth, it will require added domestic savings.

These conclusions are not dependent on a particular measure of capital formation. An important message of the data is the broad similarity in the movements of many capital input measures and the rough equality of all such measures in explaining economic performance. Economists have spent much effort refining theoretical and empirical measures of the capital input. The resulting estimates depend heavily on strong theoretical assumptions and fragmentary disaggregated data. From a policy perspective, it is reassuring to note that straightforward, readily observed measures of the capital input — such as the net and gross capital stocks — move in line with more sophisticated measures based on disaggregated data.

Measurement of the capital input[5]

The Commerce Department makes two estimates of real nonresidential capital stock. The gross capital stock is the sum, valued at reproduction cost, of all installed plant and equipment. New capital and old capital of the same type are valued equally. The net capital stock deducts accumulated depreciation from the gross stock estimate. New capital is weighed more heavily in the net stock estimate than is old capital of the same type, because it has accumulated less depreciation.

The gross and net capital stock estimates do not necessarily represent estimates of the capital input — the contribution of capital to production. This is the product of the quantity of capital and its marginal product. As the existence of two official measures suggests, the quantity of capital is difficult to measure because of the heterogeneity of the capital stock and the difficulty of summing capital of the same type but of different ages ("vintages").

The marginal product of a capital good cannot be measured directly, just as the marginal product of labor is often difficult to identify. The measurement practices used reflect two different approximations. The first and theoretically preferable approach is to treat capital analogously to labor. Just as the marginal product of labor can be inferred from workers' wages, so can the marginal product of capital be inferred from the cost of renting capital. However, the measurement of capital's marginal product in this way is harder than the corresponding calculation for labor because rental markets for capital are thin.

In theory, rental rates and the cost of capital can be deduced from financial and tax data, but these calculations are difficult to make and their precision is always uncertain. Capital goods have lifetimes stretching over several years. The contribution to output needed to recover financing costs will depend on tax rates and

[4]See Frank de Leeuw, "Interpreting Investment-to-Output Ratios," Bureau of Economic Analysis, Discussion Paper no. 39, March 1989; and Maurice FitzGerald Scott, *A New View of Economic Growth* (Oxford University Press, 1989). Scott proposes a theoretical justification for focusing on gross investment.

[5]A recent technical study of this subject is E. Bjørn, *Taxation, Technology, and the User Cost of Capital* (Amsterdam: North-Holland, 1989).

benefits, expected capital gains, and the effect of wear and tear on the capital good's productivity over the years. A further complication is the possibility that the operating characteristics of installed capital may not be altered to reflect changed financial and tax considerations.

Because the reliability of cost of capital calculations is uncertain, a much simpler approximation is often used. The marginal product of each type of capital is assumed to be stable and the services of capital are assumed to be in proportion to the quantity of capital in use.

Even with this simplification, measurement of the capital input is not entirely resolved. Determining how the flow of services from capital changes over time poses additional problems. A lightbulb, for example, produces roughly the same light towards the end of its life as at the beginning. Knowing the number of lightbulbs in operation is a good guide to the services provided by the lightbulbs, irrespective of their ages. The change in the productive stock is simply the number of new lightbulbs installed less the number retired at the end of their service life. An automobile, by contrast, is likely to require some servicing and repairs as it ages, adding expenses that would have to be subtracted from the automobile's product. Because of the decline in the automobile's net marginal product over time, it is not sufficient to sum the number of automobiles operating in order to estimate their contribution to production. One would have to know the age distribution as well.

The Bureau of Economic Analysis (BEA) makes both types of calculations. The use of the gross capital stock as a capital input measure formally requires the "one-hoss-shay" assumption that the productivity of a piece of capital does not diminish over its service life. Capital goods are assumed to provide a constant flow of services until the end of their normal lifetime, when they are scrapped.[6] The use of the net capital stock as a capital input measure requires the assumption that the straight-line depreciation calculated by BEA reflects an actual loss of productivity. Ultimately, analysts face an empirical question: Which measure best approximates the time pattern of a capital good's productivity over its lifetime?

Summing either the gross or net capital stocks across types could provide exact proxies for the aggregate capital input if all types of capital had equal productivity or if the mix of the capital stock and the productivity of each capital type remained unchanged. These conditions, however, rarely exist. Short-lived capital has to recover costs over a shorter span than long-lived capital and hence, other things equal, has to yield a higher gross return per year. Investment in short-lived capital goods has exceeded that in long-lived goods in recent years, shifting the capital mix towards shorter lived goods.

As neither the equal productivity or unchanged mix assumption holds in reality, the crucial issue is the size of the error that will result from using simple capital aggregates, such as net or gross capital stocks, to approximate service flows. Intuitively, the error would emerge because high-productivity capital is down-weighted relative to low-productivity capital in the simple aggregates. Simple algebra, summarized in the Appendix, indicates that the weighting error is directly proportional to the difference in marginal productivities and growth rates of different capital types and inversely proportional to the relative sizes of the different capital stocks.[7] Nevertheless, one additional factor works to mitigate the biases introduced by these effects. The faster growing capital type may be growing faster because its price is falling, suggesting that its marginal productivity is also falling. The faster growth rates could reflect the less productive uses to which the capital is put.

A simple simulation illustrates some elements of the mix problem. It presents the rationale for using gross investment as a proxy for capital service flows and also proposes two other capital service measures that deal more directly with the mix shift problem. Our hypothetical economy produces output using only capital. The capital is of two types: short-lived capital with a five-year service life and long-lived capital with a twenty-year service life. Both types emit services at a constant rate throughout their lives; that is, we are assuming a "one-hoss-shay" economy.[8] We also assume that there is no change in the marginal productivity of either capital type over time. In addition, both capital types are equal in present value terms — the present value of the services emitted by one dollar of short-lived capital is equal to the present value of the services emitted by one dollar of long-lived capital. We also assume that the economy's real interest rate is fixed at 4 percent. Given these assumptions, the annual service flow from a $100 investment in short-lived capital is $22.46, and from a $100 investment in long-lived capital, $7.36.[9]

[6] The actual procedure is slightly more complicated since scrappage is assumed to follow a probability distribution around a mean lifetime for each category of capital. In general, though, we have little way of knowing whether BEA assumptions about the service lives of capital and the discard patterns of businesses are accurate.

[7] The intuition behind the latter relationship is that if one type of capital dominates the capital stock, the growth of services will be dominated by the growth in this asset.

[8] Substituting the assumption that the flow of services falls 20 percent per year from short-lived capital and 5 percent per year from long-lived capital leads to no substantive change in the analysis.

[9] These service flows are calculated by assuming that the flows are received at the end of the year and that the present discounted

By assumption, gross investment is fixed at $100. Initially, 75 percent of investment is in long-lived capital. In the initial steady state, the net capital stock amounts to $762.50, of which $50 is short-lived capital and $612.50 long-lived capital.[10]

We then alter the composition of the gross investment flow permanently, placing $40 in the short-lived form. Since short-lived capital depreciates more rapidly than long-lived capital, the switch results in an increase in depreciation and a decline in net investment and the net capital stock (Chart 1). The gross capital stock also declines, because the shift to shorter service lives increases the fraction of the capital stock that reaches the end of its service life in any year. In the long run, the net and gross capital stock stabilize, depreciation falls back to $100, and net investment is again zero.

In the short run, the flow of capital services behaves quite differently from the net and gross capital stocks. The increase in short-lived capital initially results in an increase in the capital input because short-lived capital emits services at a higher rate than long-lived capital. Eventually, the smaller stock of capital overcomes this effect, and the flow of capital services falls to a new equilibrium rate below its initial level.

Neither the gross nor the net capital stock perfectly reflects the time path of the capital input during the transition period. Both fail to reflect the initial pickup in capital services from the switch to shorter lived capital, and although they give correct qualitative signals in the long run, they greatly exaggerate the actual decline in capital services. This problem with the aggregate capital stock data has led some analysts to advocate gross investment as a measure of the capital input. They reason that while gross investment does not accurately reflect the time path of the capital input, at least it does not make any egregious errors.[11]

Nevertheless, confidence in this measure appears misplaced. Our example was contrived to put gross investment in its best light as an indicator. The investment mix went instantly from one steady state to another. In the real world, where investment growth can vary markedly from one period to the next, it is implausible that the flow of actual capital services would be well represented by investment.

Furthermore, better measures of the aggregate capital input than gross investment can be readily constructed. Depreciation is one such measure; it correctly increases when the investment mix shifts to shorter term assets. Although depreciation provides the same misleading long-term signal as gross investment, returning to its previous equilibrium of $100, it captures the dynamics of changing service flows much better.

Another alternative is to recompute the net capital stock by assigning each type of capital a weight that is the inverse of its mean service life, rather than assigning all forms of capital equal weights as is done in a conventional calculation.[12] This reweighting reflects the

Footnote 9 continued
value of the flows equals $100. A similar simulation can be found in de Leeuw, "Interpreting Investment."

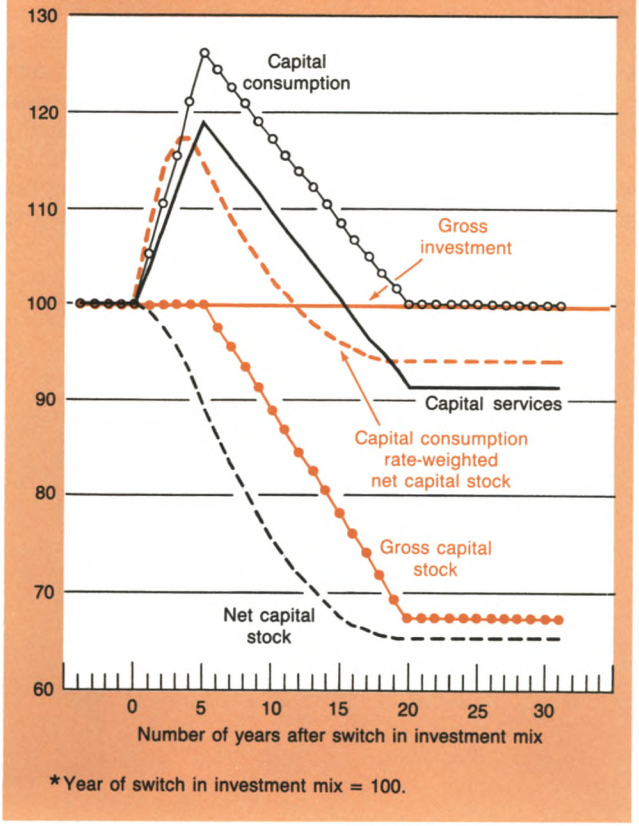
[10]This net capital stock is calculated on the basis of straight-line depreciation. The results show little change if we replace the straight-line assumption by "true economic depreciation," the decline in the value of an asset as it ages.

[11]See de Leeuw, "Interpreting Investment." This author also emphasizes the need to consider all physical investment (residential and nonresidential, public and private) and investment in research and education to explain economic growth.

[12]A similar calculation was done for gross investment in Arnold J. Katz, "An Analysis of Trends in the Intensity of U.S. Capital Formation and Their Determinants," *Journal of Policy Modeling*, vol. 8 (Fall 1986), pp. 433-70.

Chart 1

Measures of Capital Services, Capital Input, and Investment



*Year of switch in investment mix = 100.

assumption that short-lived capital has a higher marginal product than longer lived capital. It may be viewed as a simple first approximation to a full-blown user cost calculation. In the simulation, the reweighted net capital stock provides a good proxy to the capital input: it correctly increases when the investment mix shifts, and its long-run equilibrium level is below its initial equilibrium.

The conclusions we draw from the simulation are that the criticisms of the net and gross capital stocks as measures of the capital input can be valid, at least for analysis of short-term movements in the capital input. Gross investment may provide a marginally better index of capital services during periods of extreme shifts in the investment mix, but depreciation and the reweighted capital stock appear to provide better approximations to the actual path of the capital input. Thus, if the changing composition of investment and capital is truly the key to understanding the flow of capital services, the latter two measures are preferable to gross investment.

In the real world, the mix problem is likely to be less severe than in this simulation. First, the actual shift in the mix has been somewhat less striking. In the late 1960s the service life of the installed U.S. nonresidential capital stock was about twenty-one years; the recent figures still put the average service life at more than seventeen years (Table 3).[13] In the simulation the service life of installed capital falls from sixteen and one-quarter years to eleven years over a twenty-year period, about twice as fast a rate of change as actually occurred. Second, to the extent that the shift to shorter lived capital in the United States was prompted by tax motives (such as the investment tax credit and the acceleration of depreciation allowances) or by relative price changes associated with improved technology (such as the price declines for computers and telecommunication equipment), it would be less likely to contribute to an acceleration of capital service flows; long-lived capital may have been replaced by short-lived capital of comparable productivity. The shortened service lives would normally have led to an increase in the marginal productivity of the capital stock, but the tax advantages and relative price changes could have led to the installation of less productive short-lived capital.

[13]We derived an estimate of the average service life of installed capital by dividing gross capital stock estimates by depreciation.

Table 3

Service Life of Installed Capital

(Years)

	All Nonfarm Business	Manufacturing
1988	17.5	18.5
1985	18.2	18.8
1980	19.0	19.2
1975	20.2	19.9
1970	21.0	20.2
1961	22.3	20.4

Source: Federal Reserve Bank of New York calculations based on Bureau of Economic Analysis data.

Empirical estimates of capital formation

Lacking a universally accepted capital input measure, we consider several such measures before drawing any firm conclusions. Table 4 computes the growth since 1961 of various measures of the capital input for all U.S. nonfarm business, and Table 5 makes the same calculations for manufacturing. The alternative real capital input measures are:

1) Gross capital
2) Net capital
3) Depreciation
4) Reweighted net capital
5) Bureau of Labor Statistics (BLS) index of capital services
6) Gross investment
7) Gross investment, chain-weighted.

As noted above, the gross capital stock estimate does not take into account accumulated depreciation on existing capital, while the net capital stock does. Recall also that gross investment is not equal to the change in the gross capital stock, because scrappage is not deducted from gross investment.

Gross capital, net capital, depreciation, and gross investment are all taken from BEA data. Depreciation is included because it represents the basic flow of services a piece of capital must provide: it must pay for itself over its lifetime. The reweighted net capital stock is computed as in the simulation. Each component of the net capital stock is assigned a weight equal to the inverse of its mean service life on the assumption that the relative productivity of different pieces of capital should be roughly inversely related to their service life. The BLS service flow measure is designed to capture systematically all the effects that alter the aggregate capital input. These effects include shifts in the mix of capital between capital types with different productivities, and changes in the optimal productivity of installed capital resulting from changes in the cost of finance and in the structure of taxes and subsidies to

capital.[14] The alternative measure of real gross investment, derived from chain-weighted price changes, may be preferable to conventionally measured real gross investment because it reflects the lowered marginal productivity of capital goods, notably computers, whose relative prices have dropped sharply over time.[15] Also, changes in implicit price deflators — and hence, growth of real spending — can be distorted by shifts in the composition of real spending. Price indexes derived from changes in chain-weighted deflators avoid this problem.

The standard measures for the nonfarm business capital input — gross capital, net capital, and capital services — suggest that growth has been slower in this expansion than over the 1961-73 period (Table 4, columns 1, 2, and 5). Somewhat surprisingly, growth rates of all three measures throughout the 1980s have been below those of the 1970s.

The measures linking capital services most closely to service lives, the reweighted net capital stock and constant dollar depreciation, tell a moderately different story. They suggest neither a major improvement nor a deterioration in growth during the 1980s relative to the 1970s, but find some acceleration with respect to the 1960s (Table 4, columns 3 and 4).

Of the seven measures of capital input growth, only conventionally measured gross investment shows a definite break with past trends, beginning in the mid-1980s (Table 4, column 6). (Chain-weighted gross investment also shows a sharp improvement in the mid-1980s, but its current growth rate is comparable to that in the 1960s and 1970s.) The two gross investment measures differ from all the other measures of capital services in being completely independent of capital scrappage or depreciation.

[14] See U.S. Bureau of Labor Statistics, "Trends in Multifactor Productivity, 1948-81," Bulletin 2178, Washington, D.C., 1983, for detail on the construction of this series.

[15] de Leeuw, "Interpreting Investment," argues strongly for these chain-weighted measures.

Table 4

Measures of Capital Input Growth: All Nonfarm Business

(Percent Change at an Annual Rate)

	1 Constant Dollar Gross Capital Stock	2 Constant Dollar Net Capital Stock	3 Reweighted Net Capital Stock	4 Constant Dollar Depreciation	5 Private Nonfarm Business Capital Services	6 Constant Dollar Gross Investment	7 Chain-Weighted Investment
1984-88†	3.53	3.20	4.93	4.84	3.64	7.04	6.03
1979-88†	3.56	3.17	4.47	4.76	3.80	3.90	3.57
1973-79	3.79	3.53	4.90	4.78	3.95	5.31	5.77
1961-73	3.74	4.26	4.20	4.32	4.09	5.59	6.09

Sources: Bureau of Economic Analysis, columns 1, 2, 4, and 6; Bureau of Labor Statistics, column 5; Federal Reserve Bank of New York calculations based on Bureau of Economic Analysis data, columns 3 and 7.

†1987 for capital services.

Table 5

Measures of Capital Input Growth: Manufacturing Industries Only

(Percent Change at an Annual Rate)

	1 Constant Dollar Gross Capital Stock	2 Constant Dollar Net Capital Stock	3 Reweighted Net Capital Stock	4 Constant Dollar Depreciation	5 Manufacturing Capital Services	6 Constant Dollar Gross Investment	7 Chain-Weighted Investment
1984-88†	1.80	0.85	1.48	2.43	1.38	5.90	5.49
1979-88†	2.47	1.63	2.24	3.23	2.32	0.92	1.04
1973-79	3.87	3.44	4.51	4.10	3.92	6.30	7.09
1961-73	3.98	4.31	4.69	4.05	4.12	5.09	5.32

Sources: Bureau of Economic Analysis, columns 1, 2, 4, and 6; Bureau of Labor Statistics, column 5; Federal Reserve Bank of New York calculations based on Bureau of Economic Analysis data, columns 3 and 7.

†1987 for capital services.

To make the argument that the gross investment measures are better indicators of capital services than the others, one might maintain either that the measures of depreciation and scrappage are greatly overstated or that the greater productivity of new investment relative to investment being depreciated or scrapped is significantly understated by the data. Although these are theoretical possibilities, there is little evidence showing that service lives are overstated or understated, and little presumption in the literature that these factors are causing large distortions in the data. Moreover, the argument for gross investment as an indicator is much more commonly based on other claims—namely, the robustness of gross investment to shifts in the composition of investment. Nevertheless, as we have seen, indicators that are better at reflecting mix shifts do not show a major break with past trends.

The movement in the manufacturing measures has been more dramatic than in all nonfarm business. The 1980s as a whole have witnessed much slower growth in measures of the capital input, and the weakness has been concentrated in recent years. The net manufacturing capital stock has shown virtually no growth in this expansion (Table 5, column 2). Overall, the first five measures show drops ranging from one and seven-tenths percentage points to three percentage points in the growth of capital input in the late 1980s relative to the 1970s. Again, only conventional gross investment appears moderately robust, declining only four-tenths of a percentage point from its growth rate in the 1970s. (Chain-weighted investment slowed by one and six-tenths percentage points but is still strong relative to its performance in the 1960s.) Even for these investment measures, however, growth since 1979 has been very weak.

In manufacturing, as in nonfarm business, the first five measures tell a consistent story: capital formation is proceeding at historically low levels. The measures differ in the exact level of growth, but they point to a qualitatively similar slowing. Labor input has actually been falling through the 1980s, so that capital-to-labor ratios have been rising, presumably aiding productivity growth. But it is hard to argue that the capital input data show either capital or labor making a rising contribution to sectoral growth.[16] Technology and efficiency may be improving at a more rapid clip, but little evidence supports a similar finding for capital formation.

Some of the minor differences between the measures of capital input growth for nonfarm business and manufacturing can be readily explained. For example, growth in the gross capital stock in both the total nonfarm business and manufacturing sectors has slowed less than growth in the net capital stock, while the growth rate of depreciation has exceeded those of net and gross capital in every subperiod since 1973. This divergence reflects the shift of the capital stock to short-lived assets (most notably computers), a development which has tended to increase the depreciation rate on the overall capital stock. During the transition period, a switch to short-lived capital will increase the growth of depreciation and reduce the growth of the net capital stock relative to the gross capital stock.

The gross investment data differ from all other capital input measures in the impression they present, both for all nonfarm business and for manufacturing. Conventionally measured gross investment has been growing at very rapid rates in this expansion. The comparison is not quite as favorable for the chain-weighted series; still, this measure of investment has been growing about as rapidly as in the 1960s. As noted above, the virtue of gross investment as a measure of capital input is that it is relatively robust to mix changes in investment. Nevertheless, three of the first five capital input measures in Tables 4 and 5—reweighted net capital stock, constant dollar depreciation, and capital services—reflect these mix shifts directly, in a manner more consistent with economic theory. They show flat or declining trends in capital service growth despite the mix shift. Hence the use of a gross investment measure as an indicator of capital input cannot be justified by its robustness to shifts in investment composition.

Which indicator of capital services works best?

Theoretical considerations, simulations, and descriptive statistics can only go so far. It may be helpful to consider whether, in a more practical context, the net and gross capital stocks are unreliable indexes of the aggregate U.S. capital input. Regression analysis of U.S. economic growth can give us a partial answer. If the net and gross capital stocks are poor measures of the capital input, then they should yield explanations of overall U.S. growth that are significantly poorer than those provided by theoretically superior alternatives. Conversely, if gross investment captures factors omitted in the standard capital input measures, it may be more correlated with output movements in practice.

The table in the Box summarizes regressions explaining the annual growth of real nonfarm business output, using hours worked as the measure of the labor input and various alternative measures of the capital input. The alternative capital input measures are the net capital stock, the gross capital stock, the BLS index of capital services, real depreciation, the reweighted

[16] We do not focus on output growth rates in manufacturing because critics have argued that they are implausibly rapid, and publication of substantially revised data is expected soon. See Frank de Leeuw, "Gross National Product by Industry: Comments on Recent Criticism," *Survey of Current Business*, vol. 68 (July 1988), pp. 132-33.

Box: Testing the Capital Stocks in Production Relationships

Several different approaches to measuring capital and capital services are discussed in the text. Each measure requires that some strong assumptions be made about the path of capital service flows. The rental cost measure, preferred theoretically, is the most demanding in terms of parameter requirements. Thus, there appears to be a substantial trade-off between simplicity and elegance. We apply a simple criterion to identify the particular capital stock measure that outperforms the others in practice: a capital measure performs better if its implied capital service flows are more closely related to output or productivity than those of the other capital measures.

Output growth can be decomposed into components representing labor input growth, capital input growth, and a residual that is often termed total factor productivity growth. The residual tends to be very procyclical and can be broken down into a relatively stable component, viewed as the productivity trend, and a strongly cyclical component. Other assumptions, such as constant returns to scale, can also help identify the relationship. Our approach is to estimate a variety of such production relationships and to select the capital input measure that contributes to the best explanation of growth.

We assume a constant returns to scale Cobb-Douglas production function, which can be written in logarithmic terms as

$$\ln Y = a + \alpha \ln L + (1-\alpha) \ln K + \lambda t,$$

Performance of Capital Service Measures in Production Relationships

	Coefficients						Equation Residual Standard Errors					
	Net Capital	Gross Capital	Chain-Weighted Investment	Depreciation	Capital Services	Reweighted Net Capital Stock	Net Capital	Gross Capital	Chain-Weighted Investment	Depreciation	Capital Services	Reweighted Net Capital Stock
Equation												
1	0.37	0.53	0.00	0.32	0.33	−0.18	0.008	0.009	0.010	0.010	0.009	0.010
2	0.58	0.91	0.00	0.75	0.56	−0.17	0.98	0.76	1.09	0.82	0.99	1.04
3	0.35†	0.35†	0.35†	0.35†	0.35†	0.35†	0.98	0.88	3.13	0.89	0.99	1.45
4	0.35†	0.35†	0.35†	0.35†	0.35†	0.35†	1.05	0.97	4.05	1.00	1.08	1.54
5	0.24	0.21	−0.02	−0.02	0.12	0.03	0.009	0.010	0.010	0.010	0.010	0.010

1 $\ln(\text{lprod}) = a_0 + a_1 \ln(\text{caphrs}) + a_2\, \text{cycl} + \sum_{j=3}^{7} aj\, T_i$

2 $\text{dlprod} = a_0 + a_1\, \text{dcaphrs} + a_2\, \text{dcycl} + \sum_{j=3}^{6} aj\, D_i$

3 $\text{dlprod} = a_0 + .35\, \text{caphrs} + a_2\, \text{dcycl} + \sum_{j=3}^{6} aj\, D_i$

4 $\text{dlprod} = a_0 + .35\, \text{caphrs} + .4\, \text{dcycl} + \sum_{j=3}^{6} aj\, D_i$

5 $\ln(\text{out}) = a_0 + .65 \ln(\text{hrs}) + a_1 \ln \text{cap} + a_2\, \text{cycl} + \sum_{j=3}^{7} aj\, T_i$

where

- lprod = nonfarm business sector labor productivity
- dlprod = the percent change in labor productivity
- caphrs = the ratio of capital input to hours worked
- dcaphrs = the percent change in the capital input-to-labor ratio
- cycl = a measure of capacity utilization (the ratio of actual to potential real GNP, as calculated by the Federal Reserve Board staff)
- dcycl = the change in capacity utilization
- T_j = a set of time trends (allowing for breaks in 1952-61, 1962-68, 1969-73, 1974-79, 1980-88)
- D_j = a set of (0,1) dummy variables (allowing for breaks in 1952-61, 1962-68, 1969-73, 1974-79, 1980-88)
- out = output in the nonfarm business sector
- hrs = manhours worked in the nonfarm business sector
- cap = the capital input.

†Imposed.

Box: Testing the Capital Stocks in Production Relationships *(continued)*

where Y, L, K, and λ are respectively output, labor input, capital input, and the rate of total factor productivity growth, and α and $(1-\alpha)$ are elasticities of output with respect to labor and capital. (The last two parameters can be shown under constant returns to scale to equal their income shares.)
This expression can be rewritten as

$$(A) \quad \ln (Y/L) = a + (1-\alpha) \ln(K/L) + \lambda t,$$

or in first difference form,

$$(B) \quad \Delta(Y/L) = (1-\alpha) \Delta\ln(K/L) + \lambda.$$

The estimated equations differ in the extent to which the coefficients are freely estimated and whether the relationship is estimated in levels or first differences. In the accompanying table, equations 1 and 2 assume constant returns to scale, freely estimate the cyclical correction, and estimate implicitly the elasticity of output with respect to the capital input. In theory this elasticity should equal capital's share of output, which is about 0.35. Equation 1 is estimated in levels, equation 2 in first differences.

Equation 3 imposes this theoretical response of output to the capital input, while equation 4 also imposes a cyclical response of productivity to capacity utilization of 0.4. (Both of these equations are estimated in first differences.) The residual standard errors in 3 and 4 as compared with 2 indicate how much explanatory power is lost by imposing the theoretical output response elasticities on the alternative capital input measures. Equation 5, estimated in levels, drops constant returns to scale, assumes that the output elasticity with respect to labor is 0.65, and estimates the elasticity with respect to capital.

Looking at the regression results, we see that in equation 1 — the specification that uses the log of labor productivity as the dependent variable — the net capital stock has the closest fit, followed by the gross capital stock and the capital services index. We expected that the coefficient on the capital input would be in the neighborhood of 0.35 (capital's share of output); this prediction roughly holds for four of the measures. In equation 2 — the equation 1 specification in first difference form — only the net capital stock and capital services have coefficients anywhere near 0.35, but the gross capital stock and depreciation have the greatest explanatory power.

In equation 3 we constrain capital's marginal contribution to output to be constant at 0.35. In this formulation, gross capital and depreciation have the closest fit. The same is true in equation 4, which imposes the additional constraint on the capacity utilization response.

Finally, equation 5 constrains labor's marginal contribution to output to be 0.65. The net capital stock has the best fit, and its coefficient is closest to the hypothesized 0.35. The gross capital stock and capital services follow, while investment, depreciation, and the reweighted capital stock perform poorly.

net capital stock, and chain-weighted real gross investment.

The list of capital input proxies allows for testing a wide range of assumptions about the correct way to aggregate the inputs of capital. If either gross or net capital provides the best explanation for economic growth, then the problems of the changing mix of capital have not been severe (or at least have not been better addressed by the alternatives). The comparison of gross and net capital amounts to testing whether the U.S. capital stock has a service flow pattern more like that of lightbulbs or automobiles. In other words, does depreciation occur at the end of an item's service life or continually as the item ages?

Depreciation and the reweighted net capital stock are alternative measures intended to capture any effects of the changing service life of the aggregate capital stock. (The comparison of the two measures is analogous to the comparison of gross and net capital.) If the BLS capital services measure provides the best fit, then there have been substantive changes in the aggregate productivity of the capital stock which must be accounted for in a rigorous fashion. Finally, if the gross investment measure proves superior, it would imply that measurement problems are so severe that the best compromise between theory and reality is to assume that contemporaneous capital demand should be related to the capital input.

Because regressions relating aggregate output to aggregate inputs lack a solid theoretical foundation and often give aberrant results (such as negative contributions to output from capital), we used five different specifications. In the first, we assumed that the logarithm of the ratio of output to hours (that is, the log of labor productivity) was related to the logarithm of the ratio of the capital input to hours, time trends, and the cyclical state of the economy. In the second, we assumed that this relationship held for the changes in

the logarithms of labor productivity (that is, the relationship held for growth rates). The third specification related the growth of labor productivity less 0.35 times the growth in the capital-to-labor ratio to a cyclical variable and dummy variables for subperiods; the justification for this specification was that capital's share of output is roughly constant at 0.35, and this relationship simply imposes that constraint. The fourth specification was the same as the third but limited the coefficient of the cyclical variable to 0.4. The fifth specification related the log of output less 0.65 times the log of hours to the log of the capital input. (The motivation for the tests is presented in the Box.)

On the whole, the results suggest that no one measure is clearly superior to the others, but some patterns emerge. First, out of the five production relationships estimated, the gross capital stock performed best in three and the net capital stock in two. Depreciation and capital services followed. The reweighted capital stock performed poorly, and the indicator based on gross investment showed the least explanatory power. Knowledge of gross investment levels or growth rates, without any knowledge of the capital stock, provided virtually no useful information about output.[17]

While the gross capital stock showed greater explanatory power in three of five regressions, the estimated coefficients for the net capital stock were closer to the expected 0.35 value. In both specifications in which this elasticity was imposed, however, the gross capital stock produced the equation with the least residual error in output growth.

The theoretically preferred measure of capital services that was based on estimated capital rental rates performed somewhat worse than net and gross capital, but generally its performance was not far below that of net and gross capital. In coefficient size and residual error, it was a little closer to the net capital than to the gross capital stock.

While different capital input measures "fit" best in different specifications, in no case did gross *investment* outperform these other measures.[18] To the extent that methods based on production functions are valid, there was no evidence that gross investment flows provided an adequate approximation to the flow of capital services.

Such exercises are suggestive but hardly conclusive. The validity of the test is highly dependent on a correctly specified production relationship. Substantial quality shifts in labor input, the absence of constant returns to scale, the existence of a more complicated production relationship than is assumed in our regression equation (for example, translog as opposed to Cobb-Douglas), or the unstable evolution of total factor productivity could undermine the usefulness of the test. Despite these concerns, the test does determine how well the various capital measures fit into a commonly used production framework. Moreover, it provides some guidance in determining which capital input measure provides the most information about trend output growth and whether or not the mix shift has had a discernible effect on productivity and output growth.

Nevertheless, it is fairly astonishing to find that gross and net capital do so well in the regressions relative to measures designed to reflect the changing mix of the capital stock. Although the change in the mix has been less rapid than in the simulation, short-lived capital has

[17]Conventionally measured, as opposed to chain-weighted, gross investment also performed poorly when tested in similar regressions.

[18]Beginning the regressions in 1973 did not alter the relative performance of investment and the alternative capital input variables.

Table 6

Growth of Gross Capital Stock Types: All Nonfarm Business

(Percent per Year)

	Short-Lived Capital (Service Life of Eleven Years or Less)		Medium-Lived Capital (Service Life of Twelve to Twenty-Four Years)		Long-Lived Capital (Service Life of Twenty-Five Years or More)	
	Change in Real Stock	Price Change	Change in Real Stock	Price Change	Change in Real Stock	Price Change
1984-88	8.47	−5.27	2.90	3.54	2.27	3.05
1979-88	6.74	0.02	3.88	5.54	2.40	5.41
1973-79	7.19	7.56	4.32	8.95	2.75	9.05
1961-73	5.74	1.85	4.00	3.48	3.26	3.69

Source: Federal Reserve Bank of New York calculations based on Bureau of Economic Analysis data.

Note: Price changes based on implicit deflators.

grown substantially as a share of the total capital stock over the last generation, and the difference in growth rates has increased (Table 6). Why is it so hard to detect the influence of the changing mix?

The most plausible answer is that the shift of the capital stock did not necessarily imply a shift to assets with greater immediate productivity. One reason, mentioned above, is the possible role of taxes in spurring the shift; a change in asset mixes due solely to tax considerations does not necessarily imply that either mix is more productive (as opposed to profitable).

More important perhaps, the shift in the relative prices of capital goods has also had implications for relative productivities. Primarily because of the sharp decline in the price of computers, the cost of short-lived capital has plunged, both in absolute terms and relative to long-lived capital (Table 6). The effect of prices on user costs is very similar to the effect of tax incentives: low-priced capital goods are purchased to the point that the last, or marginal, unit is placed in a low-productivity setting. Thus, changes in the relative price of capital goods affect the marginal productivity of capital types.

The sharp drop in the relative price of short-lived capital goods makes it plausible to argue that the recent switch to short-lived capital has not markedly changed the overall productivity of the existing capital stock. Thus, the net and gross capital stocks can be plausible approximations to the capital input. (The Appendix presents a more technical discussion of the approximation error involved in using simple sum aggregates of the capital stock.)

Conclusion

A wide variety of capital input measures for the nonfarm economy — including the Commerce Department's estimates of the gross and net capital stocks and alternative measures designed to capture the output effects of a changing capital mix — suggest that in recent years there has been a continuation of 1970s growth rates at best, or an outright decline in growth. In sharp contrast, the growth of gross investment has accelerated during this expansion. It has been argued that in periods of rapid shifts in the capital mix, gross investment may give some clues to the growth of the capital input — better clues, at least, than those provided by the gross and net capital stock measures. Thus, a conflict emerges: if we follow the capital stock data, we would conclude that growth in the capital input has not improved in recent years; if we follow the gross investment data, we would conclude that the capital input may be growing more rapidly than in the past.

The recent divergence in growth between the capital stock measures and other indicators designed to capture the effects of a changing mix has not been as marked as the divergence between the capital stock measures and gross investment. In empirical relationships linking nonfarm business inputs to output, the simple net and gross capital stock measures did as well as, or better than, the alternative capital input measures, and gross investment did worse than any of the other measures.

The evidence for the entire nonfarm business sector suggests that the growth in the aggregate capital input has not accelerated in this expansion. Applying these results to manufacturing gives a stronger verdict: the growth of all the alternative measures of the capital input, except for gross investment, has been decidedly weak. A reversal of this trend would strengthen the growth of U.S. industrial capacity and aid the U.S. external adjustment process by augmenting the potential output available to meet the growth of foreign and domestic demand.[19]

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[19]The relationship between industrial capacity growth and the adjustment process is described in Akhtar, "Adjustment of U.S. External Balances"; and in R. Spence Hilton, "Capacity Constraints and the Prospects for External Adjustment and Economic Growth: 1989-90," Federal Reserve Bank of New York *Quarterly Review*, vol. 13, no. 4/vol. 14, no.1 (Winter-Spring 1989), pp. 52-68.

Appendix: Approximating the Error from Simple Sum Aggregates of the Capital Stock

Assume that three types of capital are in service. Type 1 capital is short-lived, type 2 has a medium life, and type 3 is long-lived. They emit services at the rates μ_1, μ_2, and μ_3, respectively. The total input of capital services, KS, is then

(1) $KS = \mu_1 K_1 + \mu_2 K_2 + \mu_3 K_3$.

Suppose we want to approximate the growth of KS by the growth of the simple sum of the physical capital stocks, $KG = K_1 + K_2 + K_3$. The approximation error, AE, will be determined by

$$(2)\ AE = (K_1 K_2(\mu_1 - \mu_2)(\dot{K}_1 - \dot{K}_2) + K_1 K_3(\mu_1 - \mu_3)(\dot{K}_1 - \dot{K}_3) + K_2 K_3(\mu_2 - \mu_3)(\dot{K}_2 - \dot{K}_3) + \dot{\mu}_1 K_1 + \dot{\mu}_2 K_2 + \dot{\mu}_3 K_3)/(KG^{*}KS),$$

where the dot over the variable indicates a growth rate.

Note that if the rate of service emission is unchanged over time, and either the emission rates are equal across types or the growth rates of the capital types are equal, there will be no error.

In reality, we observe the growth rates of capital stocks, not the services they emit. But with some simplifying assumptions we can estimate the approximation errors that result from treating the growth of the U.S. gross capital stock as the growth of the capital input.

To simplify, we divide the capital stock into short-lived (service life, zero to eleven years), medium-lived (twelve to twenty-four years) and long-lived (twenty-five or more years) goods. The average service life is calculated for each of these goods. In general this composite average service life will vary from year to year as the mix of capital types within each category changes. For simplicity we ignore tax effects and assume that the real interest rate is constant at 4 percent. The "one-hoss-shay" assumption is made, so each capital good is assumed capable of producing the same physical product from installation to the end of its service life.

Apart from differing service lives, the major factor affecting the relative productivity of the different types of capital is their cost and the rate of change in relative prices. Consider an investor buying a computer at time t versus time t+1. Because the real price of the same computer will fall between t and t+1, the computer's contribution to output has to be high enough in period t to offset the gain that would be realized by the investor who waited another period before purchasing a cheaper computer. Each period, however, the same machine gets cheaper and cheaper, implying that the value of its marginal product is falling. For example, if the real price of computers falls by 50 percent over five years, a computer bought today has to be only half as productive on the margin as an identical computer purchased five years earlier. That is, computers will be used less and less productively.

This last consideration is very important. If investors are purchasing many short-lived capital goods because they have become relatively cheap, the diminished value of their marginal product may substantially offset the effect of shorter service lives on the growth of capital services.

The exact formula used to estimate the value of the marginal products of capital types with varying service lives is

$$\mu_j = P_j(1 - V_j)/(V_j^{(SL_j + 1)}),$$

where

- μ_j = the value of the marginal product of the j'th capital type
- P_j = the price of the j'th capital type relative to overall capital goods prices,
- V_j = $(P^t_j/P^{t-5}_j)/1.04$, the rate of relative price appreciation (averaged over five years) divided by the assumed real interest rate, and
- SL_j = the average service life of the j'th capital type.

The time superscript is suppressed in all cases except in the calculation of V_j.†

The table shows the approximation errors that arise when the gross capital stock is used to calculate the capital input. We see that in the 1960s the gross capital stock grew at virtually the same rate as the hypothetical capital input. In the 1970s the capital input grew more rapidly, but in the current expansion the gross capital stock has grown more rapidly than the approximate capital input.

Average Approximation Error
(Growth of Hypothetical Capital Input Less Growth of Gross Capital Stock, Percent per Year)

1984-88	−0.33
1979-88	−0.11
1973-79	0.57
1961-73	0.17

In general these approximation errors are small, less than 15 percent of the average capital stock growth rate. Moreover, when converted to a contribution to labor productivity or overall growth (multiplying by an average capital share of 0.35), the error is extremely small and unlikely to be significant in any policy debate.

†The price changes are calculated over five-year periods to smooth out short-term price fluctuations, which probably do not greatly affect decision makers.

Inflation Expectations Surveys as Predictors of Inflation and Behavior in Financial and Labor Markets

Inflation expectations underlie many important decisions made in product, labor, and financial markets. They contribute to the determination of nominal compensation gains and interest rates, and they even influence the future course of inflation itself. Among the surveys that report inflation expectations are the University of Michigan Institute for Social Research Survey (MICH), the Decision Makers Poll (DMP), and the Blue Chip Consensus (BCC). The surveys differ in their orientation: MICH focuses on the expectations held by households, DMP attempts to capture the expectations of individuals active in financial markets, and BCC canvasses professional economists and industry-based forecasters as well as financial market participants. This article examines whether these differing groups hold the same expectations and whether their inflation expectations, as reported in the surveys, are more closely related to future trends in inflation than is the recent behavior of actual inflation.

We conclude that over the last decade inflation surveys have on the whole conveyed useful information about subsequent inflation developments. Specifically, during this time period the inflation surveys possess a statistically significant forward-looking element and are more reliable than past inflation in predicting future inflation trends. We also find, however, that although the surveys have performed well for the decade as a whole, their record since 1982 has been quite poor. All three surveys overpredict consumer price inflation substantially, and this bias remains present, although to a smaller degree, even when the effects of fluctuations in food and energy prices are removed.

The similarity in the forecasting performances of the inflation surveys in recent years reflects the strong correlations of the surveys with each other and with past inflation rates. Despite these correlations, however, the forecasts produced by the different surveys are by no means identical. At various times in recent years the surveys have given different indications of the level and the direction of inflation.

Such differences might be interpreted as random variations without any economic significance, except that households and financial market participants appear to act on their different expectations. More specifically, household inflation expectations, as revealed in MICH, appear to feed into future compensation growth, while financial market inflation forecasts, revealed in DMP, appear to feed into interest rate developments. The household inflation forecasts contain little information useful for interest rate determination; the financial market forecasts contribute relatively little to the explanation of nominal compensation growth.

These results have several important implications. First, inflation expectations can be consistently wrong for several years. Partial explanations can be found for the errors, but ex post real interest rates can differ significantly and persistently from their ex ante expectations. Given the continuing pattern of errors in recent years, high nominal interest rates caused by pessimistic financial market inflation expectations are likely to have produced unexpectedly higher real rates on an ex post basis. To the extent that households viewed inflation prospects more optimistically, they would have viewed the higher nominal rates as higher real interest rates on an ex ante basis, and hence the higher rates would have been contractionary.

Erroneous inflation forecasts also may affect the efficiency of capital accumulation and savings. If financial markets and households have different inflation expectations, they may perceive different real returns to savings and costs of funds, with consequent effects on savings and investment decisions.

Although not common, divergent inflation expectations appear to have contributed to movements in nominal interest rates on several occasions in recent years. The first and most important instance began in mid-1983 and extended through the first eight months of 1984. The financial market expectation of inflation exceeded that of households by a percentage point or more through much of this period and was considerably higher than realized inflation as well. In another notable instance, during the first three quarters of 1987, financial market inflation expectations and interest rates rose sharply in anticipation of inflationary pressures which did not emerge, while household inflation expectations moved less pessimistically. In recent months, inflation expectations have declined sharply in a number of published surveys. Both future economic performance and the appropriate stance of monetary policy depend on whether interest rate movements in response to such changing expectations are best interpreted as real interest rate movements or neutral nominal rate changes that on average correctly reflect future inflation rate trends.

Our findings also possess some academic interest. First, they represent yet another in a long line of empirical rejections of the rational expectations hypothesis.[1] More important, they suggest that inflation expectations in specific markets can affect the relative prices determined within these markets. Such heterogenous expectations may have a significant impact on economic activity because there is no immediate mechanism by which such expectations differences can be arbitraged away.

The survey data

Three surveys of expected inflation over a one-year time horizon are examined. The surveys evaluate the expectations of individuals who may interpret economic conditions and data differently. DMP focuses on financial market expectations; the vast majority of respondents are equity or bond portfolio managers, chief investment officers, and financial officers. MICH, by contrast, canvasses the inflation expectations of randomly selected households. Although BCC overlaps to some extent in its coverage with the DMP, it is much more heavily weighted to economists, economic consultants, forecasters, and nonfinancial corporations, and probably reflects the views of professional forecasters to a greater degree than DMP. These groups are clearly unlike in their perspectives and knowledge of economics. Their differences may cause them to react to information and events differently and to hold diverse beliefs.

Since February 1982, Richard Hoey, Chief Economist at Drexel Burnham Lambert, has published DMP on a regular basis. The response group comprises anywhere from 190 to 400 institutional investment portfolio managers, economists, and executives in financial and investment institutions. Respondents are not asked to forecast any specific inflation rate, but the pollers regard the consensus forecast as the sample's expectation of the one-year change in the consumer price index (CPI). Publication is rapid, so an expectation published in January 1983 is the expected change in the inflation rate from January 1983 to January 1984. DMP is issued every two or three months. In order to have as many data points as possible for our statistical analysis, we linearly interpolate the missing values, using the data points on either side of the missing value.[2]

MICH is a monthly survey of over 1,000 randomly chosen households. The households are asked their prediction of the change in the prices of the goods that they buy.[3] The survey has changed over the years; prior to 1966, respondents were asked for only a quali-

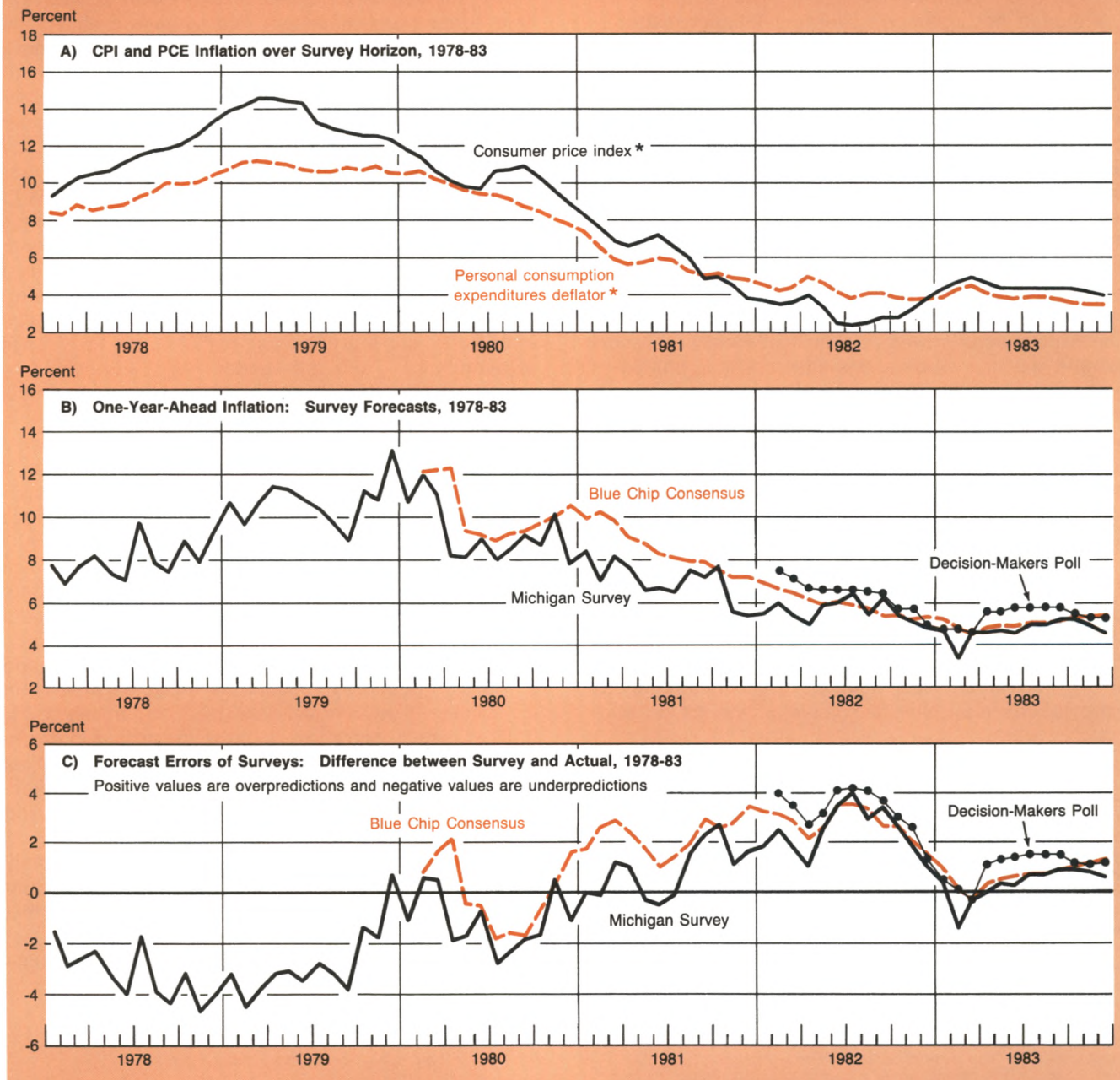
[1]Considerable effort has been devoted to determining whether survey expectations are rational. The working paper version of this paper, A. Steven Englander and Gary Stone, "Inflation Expectations Surveys as Predictors of Inflation and Behavior in Financial and Labor Markets," Federal Reserve Bank of New York, Research Paper no. 8918, December 1989, cites many of the relevant sources. A recent article treating the question is Adrian Throop, "An Evaluation of Alternative Measures of Expected Inflation," Federal Reserve Bank of San Francisco *Economic Review*, no. 3 (Summer 1988), pp. 27-43. Throop also analyzes the performance of surveys in relationships where inflation expectations are thought to be important. His results differ from ours in that he finds in general that autoregressive or augmented autoregressive expectations outperform surveys in regression equations estimating such relationships. Our approach differs in that we use only data that would have been available at the time of the forecast and we consider surveys that are relevant in specific markets. For these reasons, Throop's procedure may be biased towards finding that surveys contain little information beyond what is available in autoregressions. By contrast, a recent paper by Michael P. Keane and David E. Runkle, "Testing the Rationality of Price Forecasts: New Evidence from Panel Data," Federal Reserve Bank of Minneapolis, Mimeo, November 1988, examines the performance of individual professional forecasters in the ASA-NBER survey and concludes that their forecasts are indeed rational.

[2]Lagging the DMP to eliminate any possible effect from the interpolation procedure does not produce substantially different results, nor does removing the interpolated months.

[3]For a more detailed discussion of the Michigan survey and a comparison with a survey of professional economists (Livingston Survey), see Edward M. Gramlich, "Models of Inflation Expectations Formulation, A Comparison of Household and Economist Forecasts," *The Journal of Money, Credit and Banking*, vol. 15, no. 2 (May 1983), pp. 155-73.

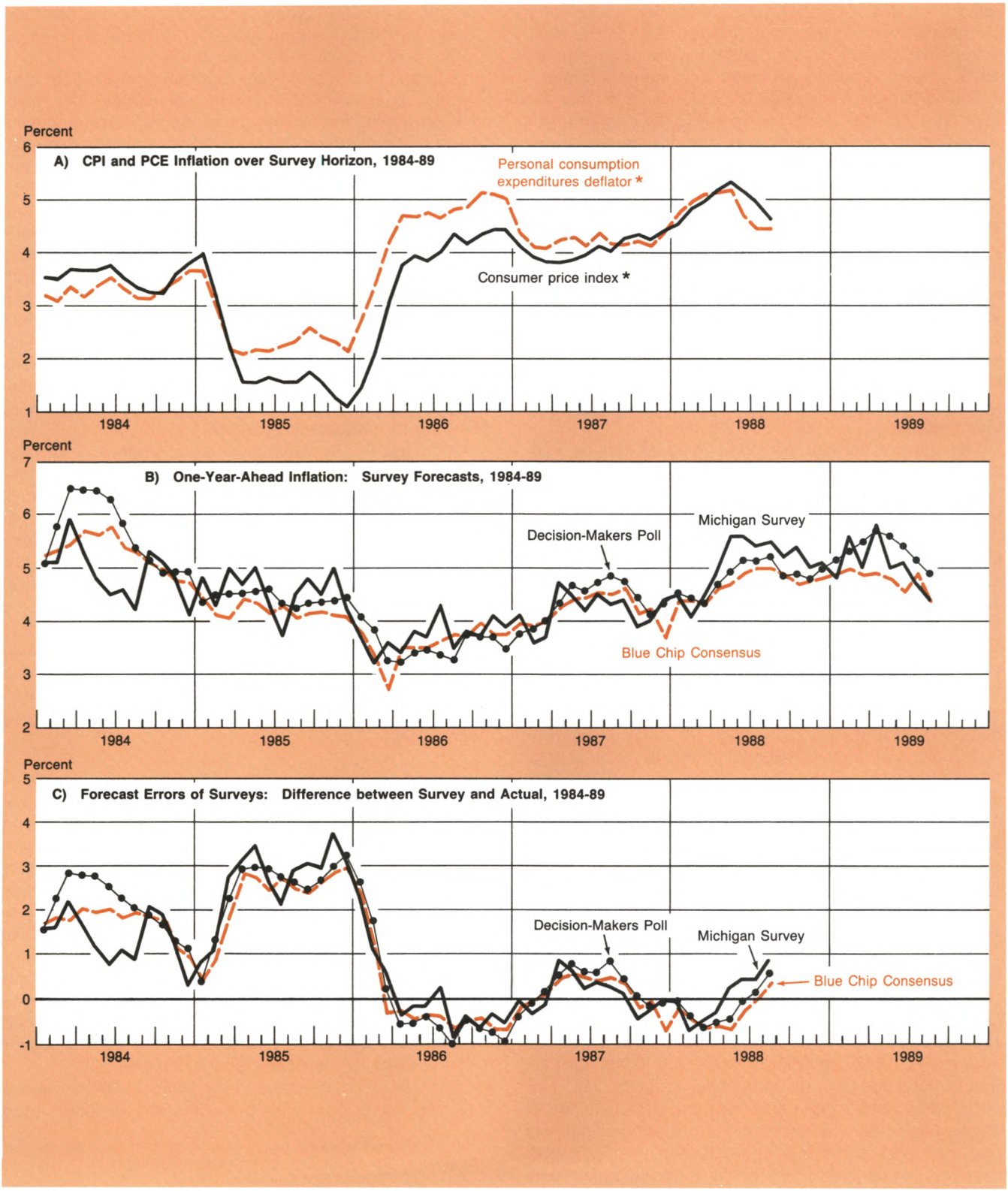
Chart 1

Comparisons of Inflation and Inflation Expectations



Sources: Eggert Economic Enterprises, Blue Chip Economics Indicators; Drexel Burnham Lambert, Decision-Makers Poll; and Institute for Social Research, University of Michigan, Survey of Consumers.

* The consumer price index (CPI) and the personal consumption expenditures (PCE) deflator are the actual inflation rates over the survey horizon.



tative measure, but after 1966 they were asked for a quantitative measure on a quarterly basis. In the analysis below, we use data on MICH beginning in January 1978, when the survey switched to a monthly format.

The publication schedule of MICH is such that the reported number is actually the previous month's expectation of inflation over the following twelve months. We align the expectations so that they correspond to the month in which they were taken, not the month of publication. Thus, the expectation reported in February 1978 is the expectation of the change in inflation from January 1978 to January 1979, and we treat it accordingly.

In March 1980, Robert J. Eggert introduced the BCC, a survey reporting the forecasts of CPI growth made by banks, econometric forecasting companies, financial markets firms, and large nonfinancial companies. The forecasts are made at the beginning of the month in which the survey is published or at the end of the previous month.

The one-year-ahead expected inflation rate is constructed by taking the average of four consecutive annualized quarterly forecasts, beginning with the forecast following the current quarter. Although respondents are not asked to forecast inflation over a twelve-month horizon, as they are in the other surveys, the time profile of the quarterly forecasts is extremely flat, suggesting that respondents are providing their general sense of future inflation rather than period-dependent forecasts. Because only the BCC makes a specific reference to the CPI, the forecasting performance of all three surveys is compared to growth in both the CPI and the personal consumption expenditures (PCE) deflator. CPI and PCE deflator growth rates are similar in trends, although substantial differences appear in the magnitude of the changes in the inflation rate (Chart 1, panel A). The PCE neither increases nor falls as rapidly as the CPI. This reflects differences between a fixed-weighted index (CPI) and an implicit deflator (PCE), as well as the compositional differences in the two consumer price indicators.

Comparison of the survey forecasts

The broad movements in the survey forecasts are similar, but during some periods their predictions differ markedly. For example, the BCC forecast exceeded the MICH forecast from the beginning of 1980 until early 1982 (Chart 1, panel B). Subsequently, for extended portions of 1982, 1983, and 1984, the DMP forecast was substantially higher than those of either BCC or MICH. At intermittent periods since 1984, the MICH inflation forecast was above those of the other surveys (parts of 1985 and much of 1988), and the DMP forecast was higher than those of the other surveys (parts of 1987 and 1989). Since 1982, BCC generally has forecast lower inflation than the other surveys or taken an intermediate position between them.

A more formal statistical analysis reveals both similarities and differences among the surveys. As might be expected, the surveys are highly correlated with each other, although the association is greater between DMP and BCC than between MICH and the other two surveys. The adjusted R^2 from a regression of the DMP forecast on the BCC forecast is 0.88, as against about 0.61 for the regression of MICH on either BCC or DMP.

To some extent the correlations among the surveys reflect the correlation that each of the surveys has with past inflation. A distributed lag on past inflation can account for somewhat more than half of the variation in the surveys, ranging from 0.53 for BCC to 0.59 for MICH to 0.61 for DMP.[4] These are higher correlations than exist in fact between future and past inflation, suggesting that survey respondents may be backward looking to a substantial degree.

Although the surveys show a fair degree of correlation with one another and with past inflation, some dissimilarities emerge when one looks a little deeper. If only those components of the surveys *not* related to past inflation are considered, the correlation between MICH and the other two surveys weakens considerably. Only about a quarter of the variation in MICH that is independent of past inflation can be explained by the other two surveys. By contrast, even after the effects of past inflation are removed, BCC and DMP can explain more than 80 percent of the residual variation in each other. This suggests that BCC and DMP are correlated well beyond their common backward-looking components.

Inflation-forecasting performance

The forecast performance of MICH is quite respectable over the 1978-88 period. It is virtually unbiased with respect to the CPI, has a moderate upward bias with respect to the PCE, and its root mean-squared errors (RMSEs, which measure the typical size of error irrespective of sign) are only about half the standard deviation of CPI and PCE inflation (Table 1, column 12). The performance is also strong relative to the naive forecast that just projects next year's inflation as equaling that of the past year. The RMSEs of MICH are quite a bit lower than those of the naive forecasts, although the upward prediction bias of MICH is slightly higher with respect to the PCE (Table 1, column 13).

The RMSE falls substantially when MICH is viewed as forecasting consumer price inflation excluding food

[4]The adjusted R^2 from such regressions changes with the sample period. The standard errors remain relatively stable in the 0.45 to 0.65 range throughout the available sample.

and energy. Households appear to forecast the core component of consumer price growth better than they forecast food and energy price fluctuations.

The performance since February 1980 (when BCC becomes available) is similar. MICH remains better than the naive forecast, and its RMSEs are a good deal lower than the standard deviations of actual inflation (Table 1, columns 9 and 10). The performance of BCC in forecasting inflation as measured by growth in the overall CPI and the CPI excluding food and energy is much better than that of the naive forecast and slightly worse than that of MICH. (Recall that BCC respondents are asked specifically to forecast CPI inflation.)

When we evaluate the performance of all three surveys beginning in 1982, the year DMP became available on a regular basis, we find that the forecasting performance falls apart. None of the surveys provides very good unconditional forecasts of one-year-ahead inflation over the period from February 1982 to August 1988 (Table 1, columns 1-3). The average overprediction ranges from one and three-tenths percentage points for DMP with respect to the CPI to eight-tenths of a percentage point for MICH with respect to the PCE deflator. The errors have also been persistent, with only a few small instances of underprediction (Chart 1, panel C).

A comparison of forecast RMSEs with the standard deviation of actual inflation also illustrates the limited predictive success of the surveys in the mid and late 1980s. The standard deviations of inflation since 1982 are less than half their post-1980 levels (Table 1, memo item). By contrast, the forecast RMSEs are virtually the same for MICH and only slightly lower for BCC across the two periods, despite the stability of inflation.

Much of the bias in the forecasts can be explained by variations in food and energy prices. For example, the average overpredictions of MICH and BCC fall from about one percentage point to about three-tenths of a percentage point if the surveys are viewed as projecting growth in the CPI excluding food and energy. The bias in DMP falls as well, but remains high compared to the bias in the other two surveys.

Table 1

Performance of Surveys in Forecasting Inflation

Inflation expectations measured by:	February 1982-August 1988				January 1984-August 1988				February 1980-August 1988			January 1978-August 1988	
	(1) DMP	(2) MICH	(3) BCC	(4) Naive	(5) DMP	(6) MICH	(7) BCC	(8) Naive	(9) MICH	(10) BCC	(11) Naive	(12) MICH	(13) Naive
Performance in predicting twelve-month growth in:													
Consumer price index													
Bias†	1.31	1.04	1.05	0.16	0.99	0.90	0.82	−0.08	0.79	1.10	1.00	0.06	0.27
RMSE	1.91†	1.65	1.63	1.86	1.66	1.52	1.45	1.59	1.61	1.72	2.50	2.01	2.67
Personal consumption expenditures													
Bias†	1.12	0.84	0.85	0.16	0.78	0.69	0.61	−0.12	0.81	1.12	0.75	0.53	0.27
RMSE	1.77	1.43	1.46	1.34	1.65	1.44	1.42	1.43	1.42	1.70	1.83	1.38	1.84
CPI excluding food, energy													
Bias†	0.56	0.28	0.29	0.37	0.23	0.15	0.06	0.11	0.04	0.35	0.91	−0.29	0.25
RMSE	1.21	0.92	0.92	1.59	0.76	0.59	0.58	0.48	1.13	1.11	2.07	1.31	2.19
PCE excluding food, energy													
Bias†	0.68	0.41	0.42	0.36	0.39	0.30	0.22	−0.01	−0.25	0.70	0.63	0.52	0.25
RMSE	1.34	1.02	1.05	0.99	1.28	1.08	1.08	0.81	1.23	1.28	1.24	1.12	1.30
Memo: standard deviation of twelve-month growth in:													
CPI	1.04				1.13				2.37			3.80	
PCE	0.83				0.95				1.88			2.78	
CPI excluding food, energy	0.48				0.26				2.14			3.05	
PCE excluding food, energy	0.58				0.53				1.64			2.04	

Note: Naive forecast assumes that inflation over the following twelve months will be the same as inflation over the previous twelve months.
†Bias defined as average value of actual inflation less forecasted inflation. A minus sign indicates that the survey underpredicted on average; a negative sign, that it overpredicted.

The performance of the surveys improves over the period from January 1984 to August 1988, after the initial stages of the deceleration in inflation had ended. This was a period of very stable inflation, however, and all three surveys are outperformed on the whole by the naive forecast, with RMSEs substantially higher than the standard deviation of actual inflation (Table 1, columns 5-8). Among the surveys, the DMP performs unambiguously the worst both in terms of bias and RMSE.

Regression analysis generally supports the conclusions reached above. For the 1982-88 period, when inflation rates were very stable except for food and energy price fluctuations, no meaningful information about future inflation is contained in any of the surveys or in past inflation itself (Table 2, columns 1-4). When the sample is extended back to 1980, the picture reverses. Both MICH and BCC contain significant information about future inflation and more information than a distributed lag on past inflation. That is, on average, changes in MICH or BCC are better guides to future inflation trends than the past patterns of actual price inflation (Table 2, columns 5-7).[5] The significance of the surveys in explaining future inflation remains even when they are entered simultaneously with lagged values on past inflation (Table 2, columns 8 and 9). If we go back to 1978, when only MICH is available, the margin by which that survey outperforms a distributed lag on past inflation increases substantially.

[5]As might be expected with forecast horizons of twelve months, the errors possess a strong moving average component. Although the moving average errors do not affect the consistency of the estimates, they do affect the consistency of the standard errors estimated by ordinary least squares regressions. For discussions of this problem and proposed corrections see Halbert White, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and Direct Test for Heteroskedasticity," *Econometrica*, vol. 48 (1980), pp. 817-38; and Lars P. Hansen and Kenneth J. Singleton, "Generalized Instrumental Variables Estimation of Non-Linear Rational Expectations Models," *Econometrica*, vol. 50 (1982), pp. 1269-86. The method proposed by Whitney K. Newey and Kenneth D. West, "A Simple Positive Semi-Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, vol. 55 (1987), pp. 703-8, was used to correct the estimated standard errors of the coefficients for eleventh-order moving average errors and heteroskedasticity.

Table 2

The Inflation Surveys as Forecasts of Future Inflation: Regression Results†

Dependent Variable: Growth rate in consumer price index over the next twelve months.

	February 1982-August 1988				February 1980-August 1988					January 1978-August 1988		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)‡
Inflation expectations measured by:	DMP	MICH	BCC	Lagged Inflation	MICH	BCC	Lagged Inflation	MICH	BCC	MICH	Lagged Inflation	MICH
Coefficients:												
Intercept	3.61**	3.92**	3.14***	4.22*	−1.43	−0.55	1.76*	−0.52	−0.64	−2.86*	1.94*	−0.89
Inflation survey	−0.00	−0.07	0.10		1.12*	0.90*		0.75*	0.95*	1.45*		1.06*
Distributed lag on inflation				−0.19			0.56*	0.20***	−0.03		0.81	
Significance level of rationality test [a=0, b(+c)=1]	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.09	0.58	0.00	0.00	0.19
DW	0.99	0.10	0.10	0.10	0.39	0.16	0.12	0.25	0.17	0.55	0.13	0.56
SEE	1.05	1.04	1.04	1.03	1.40	1.32	1.49	1.39	1.34	1.72	2.37	1.27
ADJ. R**2	−0.01	−0.01	−0.01	0.01	0.65	0.69	0.60	0.66	0.68	0.79	0.61	0.79

Notes: Standard errors are corrected for eleventh-order moving average errors and heteroskedasticity. See Newey and West, "A Simple Positive Semi-Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix."

†Equation: CPI12F = a+b · inflation expectation (+c · lagged inflation), where CPI12F is the growth rate in the consumer price index over the next twelve months, and the lagged inflation term is an eighteen-month polynomial distributed lag on one-month annualized growth in the consumer price index with degree two and an endpoint constraint.

‡Dependent variable is the growth rate in the personal consumption expenditures deflator over the next twelve months.

*Significant at 1 percent.

**Significant at 5 percent.

***Significant at 10 percent.

It is difficult to determine whether BCC or MICH contains the more significant information. Regression analysis indicates that BCC is marginally superior to MICH in general. When the two surveys are entered simultaneously, they both contribute significantly to explaining one-year-ahead inflation, although the coefficient size and statistical significance are greater for BCC. The existence of significant information on future inflation in both surveys indicates that the differences between the surveys are not random noise. Their forecasts are different but informative.

We can partially reconcile the poor performance of the surveys during 1982-88 with the much stronger performance when the sample period is extended backwards even a few years if we examine the sources of inflation fluctuations in the two periods. The surveys do poorly in periods when the primary sources of variation in inflation are food and energy prices, factors which are volatile and difficult to anticipate. By contrast, the surveys do better when the variation in inflation is largely due to fundamental labor market and business cycle pressures. The inflationary cycles caused by such forces extend over longer periods, and survey respondents may be able to assimilate them to a greater degree than the shorter lasting fluctuations caused by food and energy prices. Extending the sample backwards to 1980 introduces additional cyclical fluctuation and may account for the superior forecasting performance of the survey in the longer samples. Since 1982, the standard deviation of the CPI excluding food and energy has been less than half that of the overall CPI; for the post-1980 period as a whole, this share jumps to more than 90 percent (Table 1, memo item).

Although the longer term forecasting performance of the surveys is good, the survey forecasts are not clearly "rational" in the economists' sense of efficiently incorporating all available information. The standard form of this rationality test is provided at the bottom of Table 2. Over the shorter period the data strongly reject rationality, a result which is not surprising since all the surveys were strongly biased with respect to actual inflation. Over the longer periods the tests are close to accepting the hypothesis of rationality; indeed, over the 1978-88 period the tests on the coefficients easily accept the hypothesis that MICH rationally predicts PCE inflation. However, the persistence of over- and underpredictions for lengthy periods suggests that the surveys do not incorporate all available information (Chart 1, panel C).[6] Thus, the surveys are somewhat forward looking and may be useful in forecasting inflation, but the pattern of prediction errors suggests that the surveys do not correspond to economists' conception of rationality.[7]

Inflation expectations and compensation growth

The poor record of surveys in predicting inflation in recent years does not necessarily mean that they contain no information about future economic developments. Inflation expectations enter importantly into many economic decisions. The key question is whether individuals act on their expressed beliefs when they make these decisions.

To explore this question, we consider the relationship between inflation expectations and nominal compensation growth. In theory, nominal compensation growth ought to be strongly influenced by expectations of future inflation, with workers factoring an inflation markup into their real wage bargains. In practice, most econometric models assume that the expectations process can be modeled reasonably well by a distributed lag on past inflation rates, or alternatively, that this distributed lag reflects workers' willingness to "catch up" with past inflationary movements rather than base their wages on a forecast of future inflation. This section examines whether the putative inflation expectations component of nominal compensation growth is entirely related to past inflation, or whether the survey inflation forecasts contain a discernible forward-looking component.

The underlying model which we use is very simple. Workers contract for the year ahead on the basis of current labor market conditions and their expectations of future inflation. For each time period, the surveys are entered first individually, then in pairs, and finally in combination with distributed lags on past CPI and PCE inflation as candidate representations of inflation expectations.[8] Each inflation expectations proxy is

[6] More formally, because the surveys are forecasting twelve months ahead, the autocorrelations of the errors should disappear after a lag of eleven months. In fact, they persist at a level of around 0.2,

Footnote 6 continued
indicating that not all available information is used in the surveys since a better forecast could be made using the forecast error of twelve months earlier. The persistence of the autocorrelation alone warrants rejection of the rationality hypothesis.

[7] Prior researchers have reached varied conclusions on the rationality of the Michigan survey. For example, James S. Fackler and Brian Stanhouse in "Rationality of the Michigan Price Expectations Data," *Journal of Money, Credit and Banking*, vol. 9 (November 1977), pp. 662-66, argue on the basis of their coefficient estimates that MICH is rational, but they do not discuss autocorrelation in errors. Edward M. Gramlich in "Models of Inflation Expectations" rejects the rationality hypothesis.

[8] For example, in the 1982-89 period, thirteen proxies for inflation expectations are entered: (1) DMP, (2) MICH, (3) BCC, (4) CPI, (5) PCE, (6) MICH, CPI, (7) MICH, PCE, (8) BCC, CPI, (9) BCC, PCE, (10) MICH, DMP, (11) BCC, DMP, (12) DMP, CPI, (13) DMP, PCE. In the above listing PCE and CPI represent an eight-quarter second-order polynomial distributed lag on past PCE or CPI inflation with an endpoint constraint.

evaluated according to its ability to contribute to the prediction of compensation growth over a one- and four-period-ahead horizon. We use two models of nominal compensation determination — a basic model relating compensation growth to the prime age male unemployment rate and to inflation expectations, and a more elaborate model (E-L) that has been found to fit well and have stable parameters over long periods of time.[9]

Because there are three time periods, two forecast horizons, and two compensation models, twelve "horse races" are being run. In all, we estimate 108 regression equations to determine which combination of surveys and distributed lags on past inflation best explains future compensation growth.

The results point in a common direction. Equations with MICH or a combination of MICH and a distributed lag on either PCE or CPI inflation have the highest explanatory power (as measured by adjusted R^2) in ten of the twelve "horse races" (Table 3). In the other two instances, a distributed lag on past CPI inflation proves superior, although the margin is small over MICH.

In all instances MICH contributes to explaining compensation growth over a four-period horizon, but it is outperformed by a distributed lag on CPI inflation in two instances of forecasting compensation growth over a one-quarter horizon. This finding is of interest because our regressions suggest that the four-quarter horizon provides more reliable results. The standard errors for the four-quarter-ahead equations are much less than one-half the size of the standard errors of the one-quarter-ahead equations, indicating that some of the one-quarter-ahead error is offset within a year. (Where compensation growth rates are annualized, errors that are random on a quarter-by-quarter basis should produce standard errors in the four-quarter-ahead compensation equation that are one-half the size of those for the one-quarter-ahead equation.) Thus, the survey in all cases contributes to explaining more stable medium-term trends, even though it misses some near-term fluctuations.

In the period since 1982, MICH has done particularly well relative to both the other surveys. In no case did including DMP or BCC improve the fit of an equation

[9]The model and its properties are discussed in A. Steven Englander and Cornelis A. Los, "The Stability of the Phillips Curve and Its Implications for the 1980s," Federal Reserve Bank of New York, Research Paper no. 8303, February 1983. The model includes as explanatory variables not only inflation expectations and the prime-age male unemployment rate, but also the growth in the civilian labor force, the share of unemployment benefits paid under extended benefits programs, and the positive change in the prime age male unemployment rate.

Table 3

Inflation Expectations Proxies Showing the Best Fit over Alternative Time Periods, Specifications, and Forecast Horizons

Time Period	Specification	Forecast Horizon	Coefficients of Best Fitting Inflation Expectations Proxy	Equation Adjusted R^2	Equation Standard Error
1982-II to 1988-III	E-L	Four quarters	i) MICH = 0.50** ii) CPI = 0.33*†	0.59	0.48
1982-II to 1988-III	Basic	Four quarters	i) MICH = 0.45*	0.54	0.51
1982-II to 1989-II	E-L	One quarter	i) MICH = 0.73*	0.14	1.41
1982-II to 1989-II	Basic	One quarter	i) CPI = 0.57*†	0.19	1.37
1980-II to 1988-III	E-L	Four quarters	i) MICH = 0.55* ii) PCE = 0.23**†	0.90	0.56
1980-II to 1988-III	Basic	Four quarters	i) MICH = 0.56* ii) PCE = 0.21*†	0.90	0.54
1980-II to 1989-II	E-L	One quarter	i) MICH = 1.16*	0.66	1.39
1980-II to 1989-II	Basic	One quarter	i) CPI = 0.52*†	0.65	1.41
1978-I to 1988-III	E-L	Four quarters	i) MICH = 0.52* ii) PCE = 0.23*†	0.95	0.59
1978-I to 1988-III	Basic	Four quarters	i) MICH = 0.58* ii) PCE = 0.23*†	0.94	0.61
1978-I to 1989-II	E-L	One quarter	i) MICH = 0.34*** ii) CPI = 0.36*†	0.78	1.34
1978-I to 1989-II	Basic	One quarter	i) MICH = 0.35*** ii) CPI = 0.40*†	0.76	1.39

Note: The basic specification includes the prime age male unemployment and inflation expectations as explanatory variables for compensation growth. The E-L specification is discussed in Englander and Los, "The Stability of the Phillips Curve and Its Implications for the 1980s." The significance levels of the inflation expectations coefficients in equations with a four-quarter horizon are based on Chi-squared tests after the standard errors are corrected for a fourth-order moving average process and heteroskedasticity. See Newey and West, "A Simple Positive Semi-Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix."

†Sum of coefficients in an eight-month polynomial distributed lag on one-month growth in either the consumer price index or the personal consumption expenditures deflator with degree two and an endpoint constraint.

*Significant at 1 percent.

**Significant at 5 percent.

***Significant at 10 percent.

containing MICH. Indeed, in all cases the adjusted R^2s fell and the standard errors rose. At least since 1982, MICH has been the survey most useful for forecasting compensation growth.

When the sample is extended back to 1978, the results again suggest that MICH embodies a substantial portion of inflation expectations. The estimated effect of MICH is always of the same magnitude as, or greater than, the estimated effects of past inflation, although the significance level is sometimes relatively low. Taken as a whole, the data suggest that the inflation expectations process relevant to compensation growth can be well represented by MICH alone or by a combination of MICH and a distributed lag on past inflation. None of the other surveys, whether by itself or in combination with past inflation or another survey, provides any additional information beyond what is embedded in MICH and past inflation.

Finally, it is informative to make a comparison between the compensation-forecasting and inflation-forecasting equations, although the four-quarter horizon of the former differs slightly from the twelve-month horizon of the latter. The standard errors of the four-quarter-ahead compensation equation range from about five-tenths to six-tenths of a percentage point. By contrast, the standard errors of the inflation-forecasting equations in Table 2 varied from about one percentage point to two and four-tenths percentage points depending on the time period and dependent variable. The much greater precision of the one-year-ahead compensation projection relative to that of inflation indicates that shocks to prices over the forecast horizon are not likely to be complemented by shocks to compensation growth.[10] Otherwise the magnitude of the forecast errors would be similar, given that inflation expectations affect compensation growth on close to a one-to-one basis. The large difference in precision suggests that surprise inflation or disinflation mainly affects real compensation as opposed to nominal compensation. That is, nominal compensation growth does not seem to change fast enough in response to inflation shocks to maintain real wage growth at expected levels.

In sum, the significance of MICH in compensation determination and the tight fit of the relationship are reasons to take the household survey seriously, at least as a partial indicator of underlying inflation expectations. Even when the survey provides a relatively poor guide to future inflation, as in the mid-1980s, it appears to represent the beliefs on which households act.

[10]To test these conjectures formally, we would have to convert the twelve-month-ahead inflation forecasting equations of Table 2 into four-quarter-ahead forecasting equations and correlate the residuals across equations. For the reasons mentioned in the text and the fact that the residuals in the inflation-forecasting equations are much more autocorrelated than in the compensation equations (Durbin-Watson statistics of about 0.1 to 0.5 as against 1.2 for the compensation equations), unexpected inflation does not appear to have similar effects on inflation and compensation within a given year.

Inflation surveys and interest rates

This section analyzes the relationship of the inflation surveys and interest rates to determine which survey, if any, represents the inflation expectation underlying interest rate movements. The approach parallels that of the previous section in that the surveys alone and in combination with distributed lags on past inflation are entered into nominal interest rate equations. The inflation proxy that best explains contemporaneous interest rate movements — as before, in terms of highest adjusted R^2 and minimum standard errors — is judged the best representation of the underlying inflation expectation. (The question whether causation runs from the inflation expectations surveys to interest rates or the reverse is addressed in the next section.)

The result also parallels that of the previous section in that one inflation survey is found to be better related than the others to the variable in question. In this case, the best fitting survey is the DMP, by a moderate but consistent margin. Movements in the DMP inflation forecast are more closely aligned with movements in interest rates than are those of either BCC or MICH. More important in light of the results on compensation growth, MICH is poorly related to interest rates, with a coefficient that is often small and insignificant.

Our model of interest rate determination relates nominal interest rates to expected inflation and to past data on inflation and interest rates.[11] It can be written as

$$R_t = a + b\,\Pi_t^e + c\,R_{t-1} + d\,\Pi_{t-1}^e,$$

where R is the nominal one-year Treasury bill rate, Π^e is the expectation of inflation, and t and t-1 are time subscripts. With specific restrictions on the coefficients, the equation can be made consistent with a variety of interest rate models: a simple Fisher equation, $b=1$, $c=d=0$; a rational expectations cum Fisher equation, $b=c=-d$, $a=0$; a modified Fisher equation in which real rates deviating from the equilibrium level gradually adjust back to that level, $b=1$, $c=d<1$, $a=(1-c)\cdot r$, where r is the equilibrium real rate of interest; real interest rates that follow a random walk, $b=1$, $a=0$,

[11]The model is a variant of a model estimated by James D. Hamilton in "Uncovering Financial Market Expectations of Inflation," *Journal of Political Economy*, vol. 93, no. 6 (1985), pp. 1224-41, and others. We do not make the assumptions on the error structure that Hamilton uses to identify his model.

c=d=1; partial adjustment of nominal rates to inflation expectations, d=0, b+c=1 or b+c+d=1; or more general sets of coefficient estimates. To explore the possibility that survey inflation expectations do not adequately reflect the expectations contributing to interest rate determination, lagged values of past inflation are included in some of the estimated equations. Such a loose specification has the advantage of being based only on observable nominal inflation and interest rates rather than conjectured real interest rates, while allowing for patterns of coefficient estimates consistent with a wide variety of models.

The regression results support three conclusions. First, the equations in which DMP is entered have lower standard error and higher adjusted R^2 than do similar equations with MICH and BCC (Table 4, column 1 as compared with columns 2 and 3, column 5 as compared with columns 6 and 7). The DMP coefficient is generally larger and more significant than the coefficients of MICH or BCC. Second, even when the sample is extended back to 1978, the significance level of the coefficient on MICH remains low as compared to the levels observed for the other surveys over a shorter time period (Table 4, columns 9-12). Third, including a variety of lagged inflation terms does not greatly alter the significance or size of the DMP coefficient (Table 4, column 1 as compared with column 4, column 5 as compared with column 8). Nor does introducing the other surveys simultaneously with DMP significantly improve the fit of the equation or reduce the level and significance of the DMP coefficient.[12] Finally, introducing a second lag of the dependent variable or correcting for autocorrelation to eliminate the moderate but

[12]All of the results discussed in this paragraph and the next are presented in greater detail in the working paper version of this article.

Table 4

Inflation Expectations and Interest Rates†

Dependent Variable: Yield on actively traded one-year Treasury issues adjusted to constant maturities.

	March 1982-August 1989								February 1978-August 1989			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Inflation expectations measured by:	DMP	MICH	BCC	DMP	DMP	MICH	BCC	DMP	MICH	MICH	MICH	MICH
Coefficients:												
Intercept(a)	−0.31	0.08	−0.45	−0.43	−0.13	0.27	−0.47	−0.41	−0.15	0.12	0.18	0.21
	(−1.29)	(0.23)	(−1.41)	(−1.84)	(−0.54)	(0.77)	(−1.47)	(−1.71)	(−0.43)	(0.35)	(0.69)	(0.60)
Inflation survey(b)	0.46	0.15	0.43	0.53	0.58	0.19	0.18	0.56	0.11	0.16	0.21	0.21
	(5.13)	(1.66)	(3.77)	(5.67)	(3.55)	(1.84)	(0.91)	(3.52)	(1.82)	(2.60)	(2.62)	(2.63)
Lagged interest rate(c)	0.82	0.92	0.84	0.83	0.83	0.92	0.80	0.83	0.92	0.90	0.93	0.90
	(22.41)	(27.32)	(21.35)	(20.07)	(19.98)	(30.45)	(19.69)	(19.05)	(27.85)	(25.90)	(34.66)	(25.91)
Lagged inflation(d)	−0.11	−0.04	−0.05	0.21					−0.06	0.05	−0.12	
	(−2.21)	(−0.65)	(−1.08)	(1.99)					(−0.14)	(0.33)	(−1.50)	
Lagged survey(d')					−0.25	−0.11	0.29	−0.46				−0.09
					(−1.41)	(−1.01)	(1.35)	(−0.25)				(−0.99)
Distributed lag on past inflation(e)‡				−0.40				−0.19		0.08		0.00
				(−3.40)				(−3.21)		(0.42)		(0.02)
DW	1.39	1.29	1.47	1.60	1.34	1.30	1.29	1.52	1.30	1.32	1.35	0.93
SEE	0.39	0.44	0.42	0.37	0.40	0.44	0.41	0.38	0.76	0.75	0.76	0.75
ADJ. R**2	0.96	0.95	0.96	0.97	0.96	0.95	0.96	0.95	0.92	0.92	0.92	0.92

Note: T-statistics in parentheses.

†Equations: $R_t = a + b \cdot \text{survey} + c \cdot R_{t-1} + d \cdot \text{CPI12}_{t-1} + e \cdot \text{lagged inflation}$, and $R_t = a + b \cdot \text{survey} + c \cdot R_{t-1} + d' \cdot \text{survey}_{t-1} + e \cdot \text{lagged inflation}$, where CPI12 is the twelve-month growth in the consumer price index and the lagged inflation term is the eighteen-month polynomial distributed lag on one-month annualized growth in the consumer price index with degree two and an endpoint constraint.

persistent autocorrelation indicated by the low Durbin-Watson statistics barely alters the results. Taken together, these results support the view that the DMP and, possibly to a lesser extent, BCC inflation forecasts contribute to the inflation expectations underlying interest rates.

Variations on the basic regression equations produce essentially the same results. In estimating the same relationships for interest rates with maturities of three and six months, one finds that both the size of the coefficients and their significance increase as the maturities lengthen. The fact that the surveys uniformly contain more information for one-year Treasury bill rates than for shorter maturities suggests that respondents are correctly identifying their inflation rate expectation over that time and not just responding to short-term fluctuations. Also, if one estimates equations for the change in interest rates (by constraining the coefficient of the lagged interest rate variable to equal one), the qualitative results do not change.

The form of rational expectations embodied in the Fisher equation would demand that the effects of higher inflation be passed through to interest rates on a one-for-one basis. This hypothesis is examined either directly or indirectly in most tests of rationality relating interest rates to inflation expectations. The regression results show plausible estimates of the various coefficients but reject the coefficient of one on inflation expectations. Such tests implicitly assume that tax-induced distortions in the cost of borrowing or return to lending are insignificant or exactly offset each other, or that marginal borrowers and lenders are nontaxable. As neither theoretical nor empirical analysis seems to support these hypotheses, it is not appropriate to make the hypothesis of rationality depend critically on a coefficient of uncertain theoretical magnitude.[13]

Do financial market participants base their forecasts on interest rates?

Thus far we have assumed that financial market respondents hold independent views of inflation, which they then translate into interest rates. An alternative assumption is that financial market participants, when questioned about inflation, take their cues from current interest rates. When they observe a rise in rates, they may be inclined to attribute it to a rise in inflation expectations, whether or not expectations have in fact risen. In this case, the interpretation of the empirical results would have to be substantially revised, because the causality would be reversed. The reported inflation expectations would not determine interest rates. Rather, survey respondents would be formulating their stated expectations largely in response to current interest rates. If this interpretation were correct, it would not be possible to base any inferences on the estimated relationships that use the inflation surveys. While such a possibility seems very unlikely in the case of the household survey, it is more plausible in the case of DMP and, to a lesser extent, BCC. The composition of the response groups suggests that all of the participants in DMP and many in BCC would pay careful attention to interest rates.[14]

Several factors, however, support the interpretation that the surveys reflect actual inflation expectations. First, the survey forecasts are highly correlated with past inflation, and the financial market forecasts are more highly correlated with past inflation than is the household forecast. It may not be a good forecasting methodology for financial market participants to base their inflation forecasts on past inflation to this degree, but it is a plausible one.

Second, the correlation of the inflation expectations survey and inflation is actually higher between the current survey and future (two-months-ahead) interest rates than between the current survey and current interest rates. This relationship is true of BCC as well.[15] More formally, DMP appears to Granger cause one-year Treasury bill rates (significance level 0.02), while Treasury bill rates do not Granger cause DMP (significance level 0.35).[16] If anything, interest rates appear to react to inflation expectations with a short lag.

Finally, the characteristics of the survey forecasts match those of inflation much more closely than those of interest rates. The variances of the inflation forecasts are quite close to the variance of inflation over the forecast horizon and much lower than the variance of interest rates. If survey inflation expectations were derived by subtracting a relatively stable expected real interest rate from observed nominal interest rates, the variances of survey inflation expectations would more closely match the variance of interest rates. Hence, our findings support the view that the inflation expectations

[13]See, for example, Lawrence H. Summers, "The Nonadjustment of Nominal Interest Rates: A Study of the Fisher Effect," in James Tobin, ed., *Macroeconomics, Prices and Quantities* (Washington, D.C.: Brookings Institution, 1983).

[14]In the earlier sections, the issue of causality was not central because the surveys were being used to predict *future* compensation growth and inflation.

[15]Over the sample available for all of the surveys, the correlation of the current one-year Treasury bill rate with DMP is 0.87; with BCC, 0.86; and with the Michigan survey, 0.66. For DMP and BCC the interest rate correlation is maximized with a two-month lead on interest rates, at 0.90 and 0.89, respectively. The correlation between the Michigan survey and future interest rates is scarcely changed.

[16]Four lags of each variable are included. Even with DMP lagged two months, it still Granger causes one-year Treasury bill rates.

surveys contain information independent of contemporaneously observed interest rates.

Assessing the differences in inflation expectations

The regression results indicate strongly that MICH is the inflation expectation relevant to future compensation growth, while DMP is the inflation expectation most relevant to interest rates. In theory, such differences of opinion should not exist — households and financial market participants have access to much the same economic data from which to form a view of future inflation trends. Nevertheless, it is inherently plausible that the survey of households would be most correlated with labor market developments and the survey of financial market participants most correlated with interest rates movements. By small but persistent margins, expectations in labor and financial markets are shown to be most relevant to the determination of relative prices in these markets.

To be sure, recognition of the existence and significance of such differences in expectations should not lead to an overstatement of their ongoing importance. The mean difference between the MICH and DMP surveys since 1982 is about three-tenths of a percentage point and the root mean squared difference about seven-tenths of one percentage point. Since the early 1980s, the range of forecasts has narrowed in line with the stabilization of actual inflation rates, as Chart 1 demonstrated. Consequently, in recent years differences in household and financial market inflations expectations have led to different perceptions of real interest rates and real compensation growth only for limited periods. The gaps are likely to return to economically significant levels consistently only if the inflation outlook becomes more uncertain.

Conclusions

Surveys of inflation expectations contain useful information about future inflation on average, but they have proved to be unreliable in recent years. Even if the respondents' expectations are not realized, however, the surveys contain important information. Correct or incorrect, the survey expectations appear to reflect the respondents' underlying beliefs about inflation, beliefs which contribute to nominal compensation growth and interest rate determination. In other words, individuals appear to act on their stated beliefs, even when those beliefs are wrong.

One of our major findings is that different groups act on different inflation expectations. The household survey contains significantly more information on future compensation developments than does the survey of financial market participants. The financial markets survey, by contrast, reveals much more about interest rates than does the household survey.

The differences in inflation expectations at particular times suggest that financial markets and households may have divergent views of the tightness of monetary policy and the real costs and returns to borrowing and saving. Differing perceptions of inflation premia may affect the behavior of both savers and investors. To the extent that incorrect forecasts of accelerating or decelerating inflation affect interest rates and compensation growth, these forecasts may contribute unforeseen contractionary or expansionary impulses to the economy. Somewhat paradoxically, the inflation surveys ought to be regarded as reliable indicators of the underlying beliefs of respondents but should be used cautiously as a guide to future inflationary trends.

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Japanese Trade Balance Adjustment to Yen Appreciation

Beween 1985 and 1988 the Japanese yen appreciated 47 percent on a nominal trade-weighted basis. During this same period the Japanese trade surplus increased by $39 billion. This trade performance contrasts sharply with the U.S. experience from 1980 to 1985, when nominal dollar appreciation of about the same magnitude resulted in a U.S. trade balance deterioration of $95 billion. Although in real, or volume, terms the difference in the trade performance of the two countries is somewhat smaller, it is also striking. This article investigates why the Japanese trade performance remained so strong in the face of Japan's large nominal exchange rate appreciation.

The article finds that three factors were important in explaining Japan's trade strength measured in both nominal and real terms. These factors also acounted for most of the difference in Japanese and U.S. trade performance. The first factor was simply a starting base effect. Because Japanese exports were substantially larger than Japanese imports in 1985, Japanese imports would have had to grow significantly faster than exports just to keep Japan's trade surplus from rising. Japan's trade performance was also aided by its commodity composition. Raw materials accounted for over half of Japanese imports in 1985 but represented a negligible proportion of Japanese exports. This trade composition made Japan's trade balance less responsive to the relative price and demand conditions that were working to push it down. The third factor supporting Japan's trade balance was the much smaller real appreciation of the yen, especially when measured in terms of relative export prices, compared with its nominal rise. Falling Japanese prices in yen terms enabled Japan to maintain a much better price competitiveness position than the nominal rise in the yen alone would have suggested. These falling yen prices reflected a sharp drop in imported raw material input prices as well as significant profit cutting by Japanese export industries. Japan's nominal trade balance was further bolstered by the sharply falling world price of oil. Finally, the conversion of Japan's nominal trade balance from yen into depreciated dollars entailed a significant currency translation effect, raising the dollar value of Japan's nominal trade balance.

These conclusions about the sources of Japan's trade strength are important for what they exclude as well as for what they include. The analysis suggests that some factors often mentioned as lying behind Japan's robust trade performance — superior Japanese business ability, a world investment boom, and the expansion of Japanese export trade to a growing number of Japanese foreign subsidiaries — appear to have played a minor or no role in that performance to date. Falling Japanese profit rates, moreover, were important in explaining Japan's real trade balance strength but they were considerably less important in explaining developments in Japan's nominal trade balance.

The primary focus of this article is Japan's real trade balance. The article begins with an accounting of the starting base, demand growth, and relative price factors that helped shape Japan's real trade balance evolution. Subsequent sections treat the influence of both Japan's distinctive commodity composition and domestic and foreign demand growth on Japan's trade performance. Also examined in some detail is the change

in Japan's relative price position, broken down into its components — nominal appreciation, unit labor cost, profit margins, and raw material input prices. Throughout the discussion, the Japanese experience in responding to yen appreciation is compared with the U.S. experience under dollar appreciation in order to identify those developments offering unique support to Japan's trade balance adjustment. The analysis of Japan's real trade balance culminates in conclusions about what did and did not contribute to Japan's strong performance. Following a brief accounting of developments in Japan's nominal trade balance, the country's trade behavior in 1989 is discussed. A final section examines the implications of the analysis for Japan's future trade balance evolution.

Major factors underlying Japan's real trade balance performance

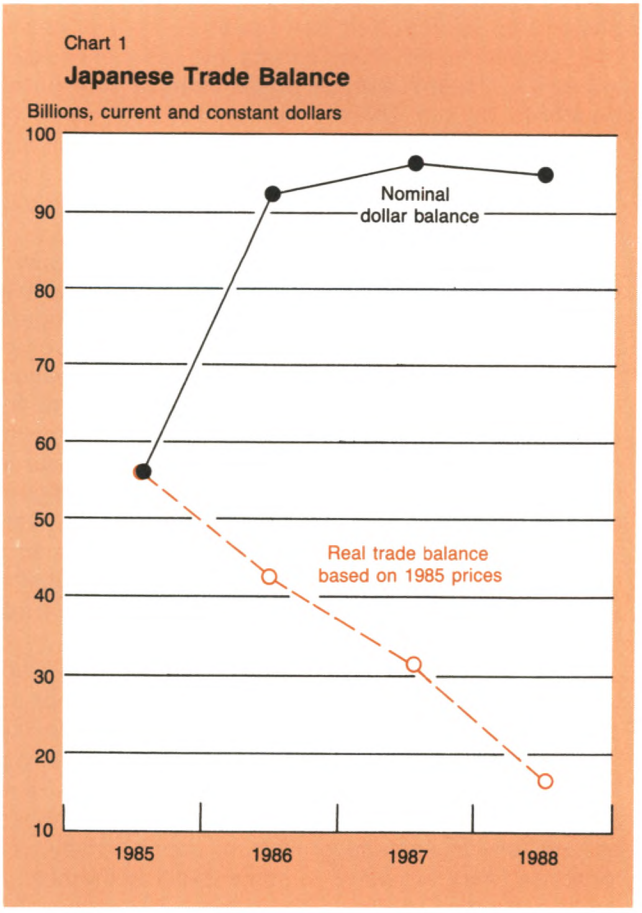
In real terms, based on 1985 prices, the Japanese trade surplus fell from $56 billion in 1985 to $16 billion in 1988 (Chart 1). This fall was the consequence of a 4 percent rise in the volume of Japanese exports and a 41 percent rise in the volume of Japanese imports. Corresponding figures for the United States provide a benchmark for comparison: the real U.S. trade balance, based on 1980 prices, fell from a deficit of $26 billion in 1980 to a deficit of $171 billion in 1985. During these two periods the yen and dollar appreciated 47 percent and 46 percent, respectively, on a nominal trade-weighted basis (Chart 2).[1]

Japan's stronger trade balance performance reflected both significantly faster export volume growth and slightly more moderate import volume growth than that achieved by the United States. However, it is important to consider Japan's trade volume growth rates in combination with the starting bases to which these growth rates were applied.[2] The volume of Japanese exports in 1985 was about one and a half times as large as the volume of Japanese imports. This export-to-import ratio meant that imports had to grow roughly 50 percent faster than exports just to keep Japan's trade surplus from rising.

The quantitative significance of Japan's starting trade surplus in keeping Japan's ending surplus relatively high can be gauged by applying actual Japanese export and import volume growth rates to a hypothetical Japanese starting position of balanced trade. If Japanese imports and exports in 1985 were set equal to a level halfway between their actual levels and then

Chart 1

Japanese Trade Balance



[1]Effective exchange rate movements and export and import volume changes are provided by the International Monetary Fund, *International Financial Statistics*, various issues. Exchange rate changes are calculated relative to the exchange rates of seventeen industrial countries. Real trade balance changes are computed based on export and import volume growth rates applied to nominal base year trade levels for Japan and the United States. The volume growth rates are calculated based on unit value price indexes; consequently, they are little affected by changes in base years. However, applying these volume growth rates to nominal base year exports and imports during each country's appreciation period means that the real trade balance change reported for Japan is based on 1985 prices whereas the real trade balance change reported for the United States is based on 1980 prices. To the extent prices changed between 1980 and 1985, the calculated real trade balance changes for the two countries are not strictly comparable. However, deviations from purchasing power parity exchange rates and differences in commodity composition make any cross-country comparison of real trade balance changes measured in constant dollar terms problematic. Since the quantitatively estimated effects of the factors lying behind Japanese and U.S. real trade balance adjustment presented in the text are also based on volume growth applied to 1985 nominal export and import levels for Japan and 1980 nominal export and import levels for the United States, they accurately account for the difference in the two countries' real trade balance adjustment measured from these respective base year starting points.

[2]The starting trade balance measured in real terms depends upon the choice of base year prices used to convert nominal exports and imports into volume levels. Since Japan currently reports its trade volume growth from a 1985 basis, 1985 base year prices are used in the above analysis.

both grew at their actual rates through 1988, the Japanese real trade balance would have fallen $15 billion more than it actually did between 1985 and 1988.

Several developments contributed to the growth rates observed for Japanese exports and imports. Japan's 4 percent export volume growth was promoted by a cumulative 11 percent growth in demand in other industrial countries during the 1985-88 period.[3] This foreign demand growth more than offset the negative impact on export volume from the rise in Japanese export prices relative to foreign prices attributable to yen appreciation. Foreign demand growth had a greater impact partly because the actual increase in Japanese export prices relative to foreign prices was only 9 percent despite the 47 percent nominal appreciation of the yen.[4]

This surprisingly small Japanese relative export price rise was primarily due to a 23 percent fall in the yen price of Japanese exports.[5] Some rise in foreign wholesale prices during the period also helped support Japan's price competitiveness. The 23 percent fall in Japanese yen export prices reflected two major factors. The first was a sharp drop in Japanese domestic wholesale prices; these prices fell 8 percent between 1985 and 1988.[6] The second factor was substantial price reductions through dramatic cutting of profit margins in Japan's export sector. In fact, Japanese export prices fell fifteen percentage points more than Japanese domestic wholesale prices in almost every industry during this period (Table 1).

The quantitative impact that world demand growth and relative price changes had on Japanese export volume can be roughly gauged by applying econometrically estimated export volume elasticities to these changes. The Japanese export volume elasticity with respect to foreign demand is about 1.8; the Japanese export volume elasticity with respect to relative price changes is about −1.1.[7] On the basis of these export

[3]Demand growth is defined as growth in GNP plus imports minus exports. It measures growth in a country's demand for all domestic and imported goods and services. Throughout this article, industrial country demand and price changes are used as a proxy for unavailable world data. This substitution may skew some of the results. However, applying the trade elasticities discussed in the text to industrial country data appears to explain Japanese export and import growth reasonably well.

[4]*International Financial Statistics.*

[5]Japan's 23 percent yen price decline offset all but thirteen percentage points of the yen's forty-seven percentage point nominal appreciation. Mathematically, the yen change in export prices times yen appreciation equals (1−0.23) × 1.47 = 1.13.

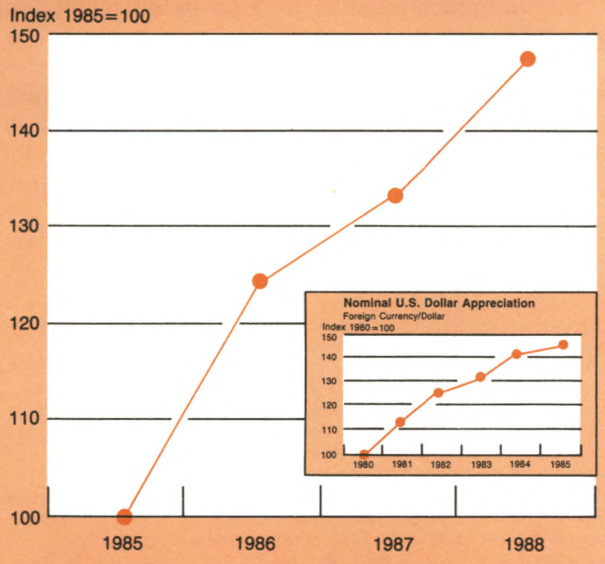
[6]Domestic wholesale prices and domestic wholesale prices for manufactured goods only both fell 8 percent during this period.

[7]Export and import volume elasticities measure the percentage changes in exports and imports that result from a 1 percent change in foreign and domestic demand growth or a 1 percent change in relative prices. Volume elasticity estimates vary significantly. The above export elasticities are the average of elasticities estimated by Robert Corker, "External Adjustment and the Strong Yen: Recent

Chart 2

Nominal Yen Appreciation

Foreign Currency/Yen, Year Average Levels*



Source: International Monetary Fund, International Financial Statistics.

* Nominal effective exchange rate weighted by manufactured goods trade with seventeen industrial countries.

Table 1

Japanese Export Prices Compared with Japanese Domestic Prices

(Cumulative Percent Change, 1985-88)

	Export Prices	Domestic Manufactured Goods Prices
All commodities	−21.2	−8.1
Textiles	−19.0	−7.6
Chemicals	−32.5	−10.1
General machinery	−15.7	−2.7
Electrical machinery	−29.2	−15.1
Transport equipment	−15.1	−3.3
Precision instruments	−12.3	−1.0

elasticities, the 11 percent rise in foreign demand supplied about a 20 percent boost to Japanese export volume. The small 9 percent rise in Japanese prices relative to foreign prices cut Japanese export volume by only about 10 percent. These two factors combined explain fairly well the continued strength of Japanese export volume between 1985 and 1988.

The 41 percent increase in Japanese import volume also reflected the effects of demand growth—in this case Japanese demand—and relative price changes. These two developments both promoted growth in Japanese import volume. Relative price changes were more important for imports than for exports because they were much larger. The price of Japanese imports fell 45 percent in yen terms between 1985 and 1988, with about two-thirds of this fall due to the rise in the nominal effective value of the yen.[8] An approximately 40 percent fall in the *dollar* price of Japanese petroleum imports also contributed significantly to the decline in Japanese import prices. Moderate foreign inflation did put some mild upward pressure on these prices.

Relative to Japanese domestic prices, Japanese import prices fell roughly 40 percent. This decline reflects the 8 percent drop in Japanese wholesale prices in 1985-88 that was noted earlier.[9] On the import side, foreign prices fell much more relative to Japanese prices than was the case for the Japanese export sector primarily because of the oil price factor and the absence of significant Japanese profit cutting for import-competing products.[10]

Elasticity analysis can again be used to evaluate the importance of demand growth and relative price changes in promoting imports. The Japanese import volume elasticity with respect to Japanese demand growth is about 1.3; the Japanese import volume elasticity with respect to relative price changes is about −0.4.[11] Japanese demand grew a cumulative 18 percent between 1985 and 1988. The elasticity analysis suggests that this demand growth raised Japanese import volume by about 25 percent. It also suggests that the 40 percent relative fall in Japanese import prices boosted Japanese import volume by about 15 percent.

These calculations imply that foreign demand growth was the major force accounting for change in Japanese export volume because the sharply falling yen price of Japanese exports meant there was not much movement in relative prices despite substantial yen appreciation during this period. Japanese demand growth and relative price changes both provided support to import volume growth because, on the import side, foreign prices did fall significantly relative to Japanese prices. The next sections look at Japanese trade composition, relative rates of demand growth, and the factors underlying relative price changes to clarify why this picture emerges. They also compare developments in the determinants of U.S. and Japanese real trade balance adjustment during appreciation to identify the factors that enabled Japan to cope exceptionally well with the yen's rise.

Japanese trade composition and trade elasticities

Japanese trade composition is distinctly different from that of most other industrialized countries, including the United States. Japanese exports are almost entirely

Footnote 7 continued
Japanese Experience," *IMF Staff Papers*, June 1989, and William Helkie, cited in *Realignment of the Yen—Dollar Exchange Rate: Aspects of the Adjustment Process in Japan*, by Bonnie E. Loopesko and Robert A. Johnson, International Finance Discussion Paper no. 311, Board of Governors, Federal Reserve System, August 1987. The elasticities from these two sources were chosen because they were relatively up-to-date. Average Japanese export volume elasticities estimated during the 1960s and 1970s were 2.6 with respect to foreign demand and −1.4 with respect to relative price, according to Morris Goldstein and Mohsin Khan, "Income and Price Effects in Foreign Trade," *Handbook on International Economics*, vol. 2 (Amsterdam: North Holland, 1985). Using these earlier elasticities suggests that the combined impact of foreign demand growth and relative price changes would have led to about a 15 percent growth in Japanese export volume over the 1985-88 period. This figure is somewhat larger than the 10 percent export volume growth suggested by the elasticities used in the text and significantly larger than the 5 percent actual Japanese export volume growth.

[8]A 47 percent increase in the value of the yen translates into about a 30 percent fall in yen import prices. Mathematically the yen value of import prices now equals 1/1.47 = 0.68 of its previous value.

[9]That is, (1−0.45)/(1−0.08) = 0.60. Japanese import prices are compared with Japanese wholesale prices in the text despite a substantial difference in commodity composition. This comparison is made because the elasticity estimates used in the text are based on this relative price ratio. Japanese manufactured goods import prices fell roughly 20 percent relative to Japanese domestic manufactured goods prices.

[10]The absence of domestic profit cutting may have helped to provide financial support to Japanese producers who were cutting profits on export sales.

[11]These elasticities are calculated by weighting the subcomponent elasticities for food, fuel, other raw materials, and manufactured goods estimated by Corker and Helkie by their 1985 trade shares. As presented in Goldstein and Khan, elasticities estimated during the 1960s and 1970s averaged 1.2 with respect to Japanese demand growth and −1.0 with respect to relative price changes. The earlier price elasticity estimates were higher than the more recent ones in part because the import subcomponent of fuel, which has a low price elasticity, was a much smaller share of Japanese imports in the 1960s and 1970s. See, for example, M.A. Akhtar ("Manufacturing Import Functions for Canada, Japan and the United States," *Hitotsubashi Journal of Economics*, vol. 22, no. 1 [June 1981]). The average import elasticities provided by Goldstein and Khan would suggest that Japanese import volume increased almost 60 percent because of changes in demand and relative prices. This result is very similar to the outcome of the calculations in the next section of this article that compute how much faster Japanese import volume would have grown if Japan had had a less fuel-intensive import composition.

manufactured goods while only about three-quarters of industrialized country exports on average are manufactured products. In contrast, Japanese imports are much more concentrated in raw materials than are the imports of other industrialized countries. Of Japanese imports in 1985, 44 percent were fuel, 14 percent food, 15 percent other raw materials, and only 27 percent manufactured goods. The United States may be used as a benchmark for comparison. U.S. imports in 1985 were about 15 percent fuel, 7 percent food, 5 percent other raw materials, and 73 percent manufactured goods.[12]

Japan's unusual trade composition had a significant impact on aggregate Japanese import prices. Because the world price of petroleum dropped sharply in the mid-1980s, the fall in Japan's petroleum import price measured in yen terms was significantly greater than the yen price fall for other Japanese import subcomponents (Table 2). The unusually large share of petroleum in Japanese imports meant that this petroleum price fall had an inordinately large impact on overall Japanese import prices. In fact, if the yen price declines in Japan's import subcomponents were reweighted to reflect the shares of these subcomponents in the import composition of the United States, Japan's import prices would have declined only about 30 percent during 1985-88. This result contrasts significantly with the actual 45 percent decline in Japanese import prices.[13]

Although Japan's trade composition helped push down import prices and thereby promoted a deterioration in Japan's real trade balance, its impact on Japan's trade elasticities more than offset this negative trade balance factor. Raw material sales, particularly fuel sales, are generally less responsive to exchange rate changes than are manufactured goods sales.[14] Consequently, Japanese import volume, heavily skewed to raw materials, had a significantly lower elasticity response with respect to exchange rate movements than did the import volumes of other industrial countries. Japan's export volume, in contrast, had a slightly higher than average elasticity response to exchange rate movements. Raw material sales are also somewhat less responsive to demand growth than are manufactured goods sales. Therefore, Japanese imports again had a somewhat lower elasticity response to Japanese demand growth than might be expected on the basis of other countries' experiences while Japanese exports had a slightly higher than average elasticity response.

Japanese import elasticities are significantly different from U.S. import elasticities (Table 3).[15] This difference is explained in large part by the difference in trade composition. The composition effect can be seen by taking Japanese trade elasticities that have been estimated for the subcomponents of imports — fuel, food, other raw materials, and manufactured goods — and weighting them according to the hypothetical import share they would have had if Japanese imports had had the same composition pattern as U.S. imports. The resulting hypothetical Japanese import elasticities of 2.0 with respect to Japanese demand and −0.7 with respect to relative price changes are significantly closer to the U.S. import elasticities of 2.0 and −1.1, respectively, than are the actual Japanese elasticities of 1.3 and −0.4.

On the export side, a similar exercise is more difficult because the almost total concentration of Japanese exports in manufactured goods means that Japanese subcomponent elasticity estimates are not available. The export composition of the two countries, however, is much more alike than their import composition. Consequently, although the composition effect on Japan's export elasticities helped keep Japanese exports stronger than they otherwise would have been (because of a stronger response to foreign growth), the effect was smaller than that estimated for Japanese imports.

By contrast, the composition effect on Japanese

[12] *International Financial Statistics, Supplement on Trade Statistics*, 1988. The average import composition of industrial countries in 1985 was 18 percent fuel, 10 percent food, 7 percent other raw materials, and 65 percent manufactured goods.

[13] Reweighting the price subcomponents to reflect a more normal trade composition on Japan's export side is difficult because Japanese export price data for nonmanufactured goods do not exist. However, reweighting on the export side is less important because Japan's difference in export trade composition from the industrial country average is not that great.

Table 2

Yen Import Price Change

(Cumulative Percent Change, 1985-88)

All imports	−45
Energy products	−63
Food	−33
Other raw materials	−25
Manufactured goods	−25

[14] Manufactured goods are more sensitive to exchange rate changes because the country in question can generally increase its own manufactured goods supply more easily.

[15] The U.S. import-volume elasticities in this table are obtained from a regression that includes U.S. supply factors. Omitting supply factors may raise the U.S. import volume elasticity with respect to demand. Nevertheless, a reweighting of the Japanese elasticities to reflect a more average import composition would still move them closer to the U.S. elasticities.

import prices and import elasticities had a substantial impact on Japanese trade. Applying the hypothetical import elasticities estimated for Japan on the basis of the U.S. import composition to Japan's rate of demand growth and to the hypothetical Japanese relative import price change, again based on U.S. import composition, implies that Japanese import volume would have grown about fifteen percentage points faster if Japan had not had such an unusual import composition. This hypothetical Japanese import volume growth rate suggests that Japan's import volume (measured in 1985 prices) would have been about $20 billion greater than the level actually recorded in 1988. Clearly, Japan's unusual import composition was an important factor affecting how Japan adjusted to currency appreciation, particularly in comparison with the U.S. experience.

Demand growth

As noted above, demand growth was relatively brisk in Japan and other industrial countries during the 1985-88 period. Japanese demand growth averaged over 5½ percent annually during this period while foreign demand growth averaged 3½ percent. The strong growth in Japanese demand boosted Japanese imports by about 25 percent while foreign demand growth raised Japanese exports by around 20 percent. This growth differential favoring imports arose even though Japanese exports were more sensitive to foreign demand growth, measured in elasticity terms, than Japanese imports were to Japanese demand growth.

Demand growth conditions for Japanese trade during 1985-88 may be compared to demand growth conditions for U.S. trade during 1980-85 to see if growth conditions unique to Japan helped support its trade surplus. This comparison is important because a country whose currency is appreciating will frequently raise its rate of domestic demand to maintain employment levels.[16] Therefore, rapid Japanese demand growth does not necessarily mean that demand growth factors were unimportant in explaining Japan's muted trade balance response to appreciation.

Japan did face a relatively vibrant world trade environment in the mid-1980s that helped to keep its exports growing. Real foreign demand growth was on average much stronger in the mid-1980s than in the early 1980s. However, Japanese demand growth in the mid-1980s was also on average considerably stronger than early 1980s demand growth in the United States. Cumulative demand growth rates both at home and abroad over the entire respective appreciation periods for Japan and the United States were remarkably similar. (The yearly pattern of growth rates was different, but the United States achieved the same cumulative growth as Japan because U.S. demand grew rapidly late in the 1980-85 period following a steep early recession.) Cumulative growth in Japanese demand in the mid-1980s equaled 18 percent, while cumulative growth in U.S. demand in the early 1980s equaled 19 percent. As to foreign demand, Japan faced cumulative foreign growth of 11 percent during 1985-88; the United States faced cumulative foreign growth of 9 percent during 1980-85. These comparisons suggest that demand conditions did not leave Japan in a special position to adjust to currency appreciation.

Table 3

Import Elasticity Comparison

	Elasticity with Respect to Demand Growth	Elasticity with Respect to Relative Price Changes
Actual Japanese elasticities	1.3	−0.4
Japanese subcomponent elasticities:		
Fuel	1.0	−0.1
Food	0.5	−0.6
Other raw materials	1.1	−0.4
Manufactured goods	2.4	−0.9
U.S. elasticities	2.0†	−1.1
Hypothetical Japanese elasticities based on U.S. trade composition	2.0	−0.7

Sources: Japanese import elasticities are averages of estimates in Corker, "External Adjustment," and Helkie, cited in Loopesko and Johnson, *Realignment*. U.S. elasticities are the weighted combination of oil and non-oil import elasticities given in William L. Helkie and Peter Hooper, "An Empirical Analysis of the External Deficit, 1980-86," in Ralph C. Bryant, Gerald Holtham, and Peter Hooper, eds., *External Deficits and the Dollar* (Washington, D.C.: Brookings Institution, 1988), pp. 10-56.

†Elasticity with respect to U.S. income growth.

Relative price changes

Price changes have four basic components — nominal exchange rate movements, changes in unit labor costs, adjustments to profit margins, and changes in raw

[16] A country with an appreciating currency may use expansionary fiscal policy to maintain economic growth. An expansionary fiscal policy is at times an important element in realigning a country's savings/investment gap. Because a country's trade balance equals its savings/investment gap, this realignment is necessary for the trade balance to adjust. Expansionary fiscal policy, through its impact on demand growth, played an important role in bringing down Japan's nominal and real yen trade balance.

material input prices.[17] The 47 percent rise in the nominal effective value of the yen would have had a very significant impact on Japan's real trade balance had the other three price factors remained unchanged. Specifically, given the Japanese trade elasticities, the yen's nominal appreciation could have been expected to lower Japanese export volume by over 50 percent while increasing Japanese import volume by over 10 percent.

Changes in the other three price factors measured in yen terms, however, significantly improved Japan's price competitiveness position, notably on the export side. In fact, because of these three price factors, the yen rose only 9 percent on a real trade-weighted basis calculated from changes in the export prices of Japanese and other industrial country manufactured goods. A comparison of Japanese import prices with Japanese domestic prices suggests that, as noted earlier, relative prices on the import side changed much more sharply.

The most significant factor holding down Japanese export prices was substantial profit cutting on Japanese export sales. Sales of Japanese import-competing goods were not subject to significant profit cutting; for manufacturing sales in general, Japanese profit margins in the mid-1980s stayed near their pre-appreciation levels (Chart 3).[18] Export prices, however, differed sharply from domestic sales prices. Japanese export prices fell on average fifteen percentage points more than Japanese domestic wholesale prices for manufactured goods from 1985-88. This large difference, which was observable in almost every industry, may be attributed to massive cuts in export profit margins. Indeed, since profits account for only a portion of overall export price, profit margins must have been slashed deeply to bring overall export prices down fifteen percentage points relative to domestic prices.

In addition to export profit cutting, a decline in the price of raw material inputs helped to lower the price of Japanese exports and import-competing goods substantially. Japan imports a high proportion of its raw material inputs. When the yen appreciated, the price of these inputs fell in yen terms. A 40 percent fall in the world price of petroleum during 1985-88 brought Japanese raw material input prices down significantly further. In sum, between 1985 and 1988 Japanese raw material prices fell 40 percent, contributing substantially to an 8 percent fall in Japanese domestic wholesale prices.

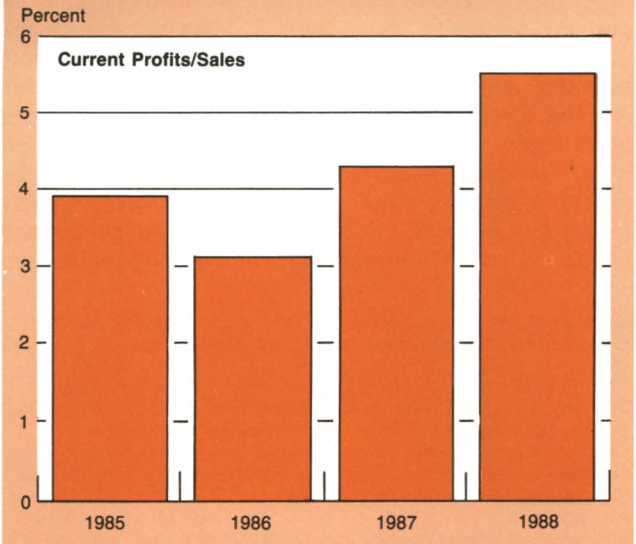
Changes in unit labor costs also helped to reduce Japanese prices. Japanese unit labor costs in manufacturing declined 4 percent between 1985 and 1988. This fall was due to strong Japanese productivity growth, which continued at the average annual 5½ percent rate that it had achieved in the early 1980s. Japanese labor compensation actually grew at a relatively robust rate from 1985 to 1988, averaging 4.2 percent annually during this period. This rate was just modestly lower than the 4.6 annual rate Japan experienced in the 1980-85 period. Japan's relatively strong growth in labor compensation was important because it helped support the rapid growth in Japanese demand discussed in the previous section.

To evaluate Japan's price competitiveness during the years 1980-85, changes in Japanese prices must be considered in relation to changes in foreign prices. Unfortunately, studies comparing changes in Japanese profit rates, the single most important factor holding Japanese export prices down, with changes in the profit rates of Japan's trade partners are not available. However, an assessment of the change in Japan's value-added deflator in manufacturing relative to changes in foreign value-added deflators is available.[19]

[17] Because exchange rate changes are treated separately, changes in unit labor costs, profit margins, and raw material input prices refer to changes measured in yen terms.

Chart 3

Japanese Manufacturing Profit Margins



Source: Bank of Japan, Tankan, May 1989.

Note: Data are for Japanese fiscal years, which begin in April.

[18] Bank of Japan, *Tankan: Short-term Economic Survey of Enterprises in Japan*, May 1989.

[19] Comparisons of relative changes in unit labor costs, value-added deflators, wholesale prices, and export prices in manufacturing may be derived from the real effective exchange rate series provided in *International Financial Statistics*, various issues.

Value-added deflators combine labor costs and profit rates. A comparison of changes in unit labor costs alone is also available. Consequently, the importance of changes in relative profit rates may be inferred from the data after the impact of changes in relative unit labor costs is assessed. Similarly, it is difficult to find a comprehensive comparison of changes in Japanese raw material prices, the second most important factor holding Japanese overall prices down, with changes in the raw material prices of Japan's trade partners. But a comparison of changes in Japanese and foreign wholesale prices in manufacturing is available.[20] Wholesale prices are a combination of labor costs, profit rates, and raw material prices. Consequently, after the relative changes in labor costs and profit rates are analyzed, the relative changes in raw material costs may be inferred from the wholesale price data. The wholesale price data analysis also indicates how important changes in raw material costs are to overall manufactured goods price changes.

As noted, Japanese unit labor costs in manufacturing fell 4 percent between 1985 and 1988. During this period, manufacturing unit labor costs in other industrial countries, measured on a Japanese trade-weighted basis, rose 2 percent.[21] As a result, Japan gained 6 percent in relative labor cost competitiveness.

Now, to assess the impact of relative profit changes, consider the change in the value-added deflators. Japan's value-added deflator fell 9 percent relative to the trade-weighted value-added deflators of its major competitors. Since Japan's unit labor costs fell 6 percent relative to foreign unit labor costs, a fall in Japanese profit rates relative to those abroad may be taken as responsible for the additional three percentage point fall in Japan's value-added deflator relative to foreign deflators.

This value-added deflator comparison implies that Japanese profit rates fell significantly more than 9 percent relative to foreign profit rates. That is, since Japan's labor costs fell only 6 percent relative to foreign labor costs, Japan's profit rates must have fallen substantially more than 9 percent relative to rates abroad in order for the combined impact of changes in relative labor costs and profit rates to equal 9 percent. Moreover, since Japanese profit rates fell only for exports, not for domestic sales, and exports only accounted for about 10 percent of Japanese manufacturing output,[22] the comparison on the export side is even more dramatic. Profit cutting pulled down Japanese export prices about fifteen percentage points more than falling unit labor costs alone did, as the 15 percent difference between the change in Japan's export prices and the change in Japan's wholesale prices attests. In other words, export profit rates had to have fallen much more than 15 percent to explain the difference between Japanese export and domestic price levels.

Evaluating changes in relative raw material prices is complicated by the lack of raw material price indexes for all of Japan's major trade partners. Nevertheless, a Japanese trade-weighted average of the indexes for those countries that do report raw material prices fell 10 percent between 1985 and 1988.[23] In contrast, Japanese raw material prices fell 40 percent during this period, in large part because yen appreciation reduced the price of raw material imports. Japan clearly gained substantial price competitiveness from these relative movements in raw material prices.

A more comprehensive comparison of raw material price changes in Japan and other industrial countries may be inferred from a comparison of changes in overall manufacturing wholesale price indexes. Japanese domestic wholesale prices fell 8 percent between 1985 and 1988, while the trade-weighted average of wholesale prices for Japan's trade partners rose 6 percent.[24] The resulting fourteen percentage point difference in wholesale price movements suggests that Japanese raw material prices had to have fallen more than 14 percent relative to prices abroad. That is, because the combined relative change in Japan's labor costs, profit margins, and raw material prices equaled 14 percent and the combined impact of relative changes in Japan's labor costs and profit rates alone equaled only 9 percent, the fall in relative raw material prices had to be greater than 14 percent. Alternatively viewed, sharply falling raw material prices contributed five percentage points to Japan's fourteen percentage point fall in rela-

[20] Wholesale price indexes for manufactured goods are apt to differ less in composition across countries than are wholesale price indexes for raw materials.

[21] Bureau of Labor Statistics, *International Comparisons of Manufacturing Productivity and Labor Cost Trends, 1988*, News Release. Other industrial countries include Canada, Denmark, France, Germany, Italy, the Netherlands, Sweden, the United Kingdom, and the United States.

[22] Statistics Bureau, Management and Coordination Agency, *Monthly Statistics of Japan*, Japanese input/output price table.

[23] Countries reporting raw material wholesale prices include Belgium, Germany, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States. Other countries included in the more comprehensive industrial country data used in this article are Austria, Australia, Canada, Denmark, Finland, France, Iceland, Ireland, Italy, New Zealand, Norway, Spain, and Sweden.

[24] Differences in wholesale price movements across countries may reflect differences in the composition of wholesale price indexes. However, petroleum products, which showed the largest price movement in this period, had a weight in the Japanese price index that was about equal (under 10 percent) to its weight in the U.S. price index. The United States is Japan's major trade partner.

tive wholesale prices.

Combined, the domestic price factors of profit cutting, declining raw material input prices, and falling unit labor costs were important in keeping Japan price-competitive in the face of the large nominal appreciation of the yen. On the export side, these factors explain why Japanese prices rose only 9 percent relative to foreign prices despite the 47 percent nominal rise in the yen. Given Japan's export elasticity of −1.1 with respect to price, the thirty-eight percentage point difference in these two measures boosted Japanese export volume more than 40 percent, or $70 billion (based on 1985 prices), beyond what it otherwise would have been. On the import side, falling raw material input prices and unit labor costs boosted the price competitiveness of Japanese import-competing manufactured goods by about 9 percent, offsetting some of the increase in import volume resulting from the sharp fall in import prices. Given Japan's import volume elasticity of −0.4 with respect to price, these two factors cut Japanese import volume more than 5 percent, or about $10 billion, from what it otherwise would have been.

Since all countries try to hold domestic costs down as their currencies appreciate, it is instructive to compare the price developments in Japan and the United States during yen and dollar appreciation, respectively. Such an analysis helps identify which price factors gave Japan an exceptional ability to maintain a strong trade performance. Although profit cutting, falling raw material prices, and declining unit labor costs were all important in explaining the evolution of Japan's real trade balance during the period of yen appreciation, a comparison with the earlier U.S. appreciation experience suggests that Japan's falling raw material prices were the most important determinant of the difference in the two countries' trade performances. In fact, Japan and the United States experienced remarkably similar changes in relative unit labor costs and profit cutting during their respective episodes of currency appreciation while raw material price developments were very different.

Consider profit developments first. U.S. export prices fell about ten percentage points relative to U.S. wholesale prices during the 1980-85 period (Table 4). This price fall was not spread as evenly across sectors as the Japanese export price fall relative to domestic prices of fifteen percentage points. In particular, in the automobile sector, where U.S. exports are primarily intra-firm trade across the Canadian border, export prices actually rose relative to domestic prices. Nevertheless, on average, profit cutting in the U.S. export sector appears to have been significant.

Moreover, for U.S. manufacturing in general, profit rates were significantly lower in 1985 than they had been in 1980 (Chart 4). The recession in the early 1980s initially brought U.S. profit rates down, but even when the U.S. economy was growing at a brisk pace in 1984 and 1985, trade pressure arising from dollar appreciation held profit rates to a relatively low level. Indeed, since the United States started its appreciation period with imports larger than exports, the fact that U.S. profit rates were down in both export and domestic import-competing industries meant that profit cutting may have had an even bigger impact on the U.S. trade balance than it did on the Japanese trade balance. The

Table 4

U.S. Export Prices Compared with U.S. Domestic Prices

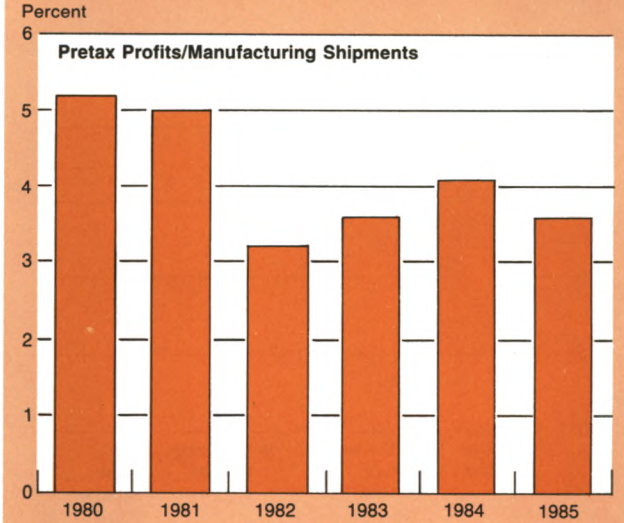
(Cumulative Percent Change, 1980-85)

	Export Prices†	Domestic Producers' Prices
All commodities	5	15
Food, feed, beverages	−12	−9
Industrial supplies	−4	14
Capital goods	14	25
Automobiles and parts	34	28
Consumer goods	5	19

†Fixed-weight export price indexes from the U.S. National Income and Product Accounts.

Chart 4

U.S. Manufacturing Profit Margins



greater fall in the U.S. relative value-added deflator for manufacturing relative to the fall in the Japanese value-added deflator shows the importance of across-the-board profit cutting for the U.S. trade balance.

Before drawing profit implications from the change in the U.S. value-added deflator, however, it is necessary to examine changes in unit labor costs. U.S. unit labor costs fell 6 percent relative to the U.S. trade-weighted average of foreign unit labor costs during 1980-85.[25] This fall is actually identical to the fall in Japanese relative unit labor costs during 1985-88. Consequently, differences in relative unit labor cost developments do not explain why the Japanese and U.S. real trade balances moved so differently in response to appreciation nor why the Japanese and U.S. relative value-added deflators fell to a different extent.

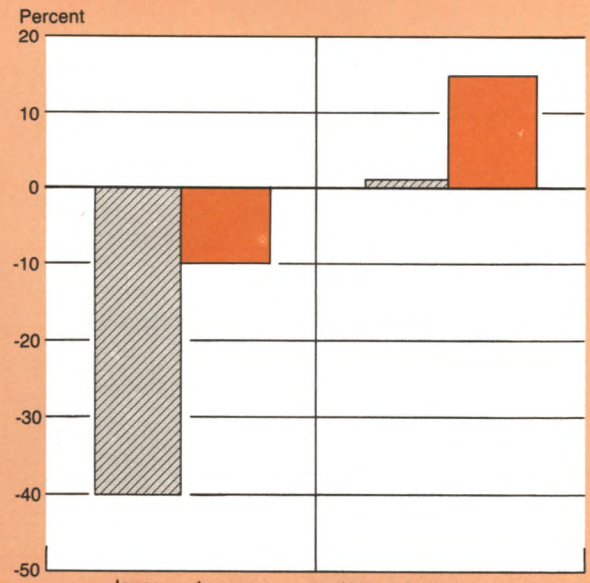
The U.S. value-added deflator in manufacturing fell 11 percent relative to the deflators of U.S. trade partners during 1980-85. This fall was greater than the 9 percent relative fall in the Japanese value-added deflator. Since Japanese and U.S. unit labor costs moved similarly, the greater fall in the U.S. relative value-added deflator implies more extensive U.S. profit cutting during dollar appreciation than Japanese profit cutting during yen appreciation. Consequently, profit cutting does not appear to explain the large difference in Japanese and U.S. trade balance changes.

In contrast, relative changes in raw material prices do emerge as an important determinant of the difference in trade balance adjustment. A comparison of Japanese and U.S. relative raw material price movements reveals a significant difference in price changes in the two countries. Evidence from countries that report raw material wholesale prices suggests that while Japanese raw material prices were down 30 percent relative to those of Japan's trade partners during yen appreciation, U.S. raw material prices were only down about 15 percent relative to those of U.S. trade partners during dollar appreciation (Chart 5).[26] This substantial discrepancy may be traced to the fact that the United States is a large raw materials producer while Japan is not. Since U.S. raw material prices reflect to a large degree U.S. domestic prices, they did not change very much in dollar terms during the period of dollar appreciation. Because Japan imports a large proportion of its raw materials, its raw material prices primarily reflect import prices. Therefore, when the yen rose, Japanese raw material prices fell sharply in yen terms.

The impact of differences in relative raw material price changes can be seen by comparing changes in Japanese and U.S. relative wholesale prices. As noted, Japanese wholesale prices fell 14 percent relative to the wholesale prices of Japan's trade partners during yen appreciation. U.S. wholesale prices fell only 7 percent relative to the wholesale prices of U.S. trade partners during dollar depreciation. Since unit labor cost developments were the same for both countries and U.S. profit rates actually fell more than Japanese profit rates, the greater fall in Japanese wholesale prices is directly attributable to the much sharper fall in Japanese raw material input prices. Movements in raw material input prices thus gave Japan a unique advantage in adjusting to currency appreciation.

Chart 5

Cumulative Change in Raw Material Input Prices



Other potential factors affecting Japanese real trade balance adjustment

Three other possible factors have received considerable attention as sources of Japan's strong trade performance. Some observers have attributed this strong performance to an exceptionally competitive Japanese business ability. Others have pointed to a world invest-

[25]Bureau of Labor Statistics.

[26]Canada is a major U.S. trade partner that does not report raw material wholesale prices. Since Canadian prices move relatively closely with U.S. prices, however, the measured fall in U.S. raw material prices relative to those abroad would have been smaller if Canadian prices were included in the comparison.

ment boom that has supported Japanese capital goods exports, and still others to an upsurge in demand for Japanese exports to service rapidly growing Japanese overseas direct investment. The analysis in this article suggests that none of these factors was of major significance in keeping Japan's trade surplus high.

The foregoing analysis of factors underlying differences in Japanese and U.S. trade balance adjustment implies that business ability distinctions do not explain the variation in the Japanese and U.S. experiences. Abstracting from the starting balance effect, the prime economic factors behind the very large disparity between Japanese and U.S. adjustment to currency appreciation appear to be differences in the two countries' import elasticities and the trade balance boost Japan received from falling imported raw material prices. The import elasticity differences also reflect the distinctive role raw materials played in Japanese trade. Adding the effect of different starting trade balances to the estimated quantitative impact of these raw material factors more than accounts for the difference in the response of the Japanese and U.S. trade balances to currency appreciation, as Table 5 reveals.

For this table, the impact of different starting trade balances is calculated by measuring how the disparity between the real Japanese and the real U.S. trade balance adjustments differs from the disparity that would have arisen if the countries' respective export and import volumes had grown at actual rates but from a balanced trade position. In this balanced position, exports and imports are set equal to the numeric average of actual 1985 Japanese exports and imports.[27] The elasticity effect listed in the table shows the change that would have occurred in Japanese trade if Japanese import volume had responded in the manner suggested by a combination of Japan's import subcomponent elasticities, weighted to reflect the composition of U.S. trade. This calculation also involves the reweighting of Japanese import prices to reflect how they would have moved in aggregate if Japan's import composition equaled that of the United States. The raw material price effect in the table is derived by computing how the actual growth in Japanese export and import volumes differs from the growth that would have taken place (based on Japan's export and import volume elasticities) had falling Japanese raw material input prices had the same limited impact on Japanese relative wholesale prices as more moderately falling U.S. raw material input prices had on U.S. relative wholesale prices. These hypothetical Japanese export and import changes are netted together. The importance of these calculations attributing the difference in Japanese and U.S. trade balance adjustment solely to the effects of different starting balances and raw materials trade lies in what they exclude. Specifically, the calculations suggest that the trade balance adjustment disparity between Japan and the United States had relatively little to do with different business strategies or abilities to compete.[28]

As for the arguments concerning a world investment boom and Japanese overseas direct investment, the earlier analysis explains Japanese export growth reasonably well as the outcome of other factors already discussed, namely, foreign demand growth and relative price changes. In fact, actual Japanese export growth was slightly slower than a combination of the last-named factors suggested. Consequently, there does not appear to be strong evidence that a major world investment boom led to a temporary surge in Japan's

[27]By starting the exercise with identical export and import levels, this analysis also adjusts for the difference in the two countries' overall trade size.

[28]This conclusion does not mean that Japanese and U.S. producers followed identical business practices. Nevertheless, Japanese practices generally cited as having a positive effect on Japanese competitiveness (such as strict attention to quality control) appear to have offset practices generally viewed as having a negative effect on Japanese competitiveness (such as relatively inflexible supply relationships) to the same extent positive practices offset negative practices in the United States.

Table 5

Comparison of Japanese and U.S. Real Trade Balance Adjustment to Currency Appreciation

(Billions of Dollars)

Japanese real trade balance change, 1985-88	−40
U.S. real trade balance change, 1980-85	−145
Difference between Japanese and U.S. real trade balance changes	+105
Difference due to:	
Starting base effect	+70
Trade composition effect on import prices and elasticities	+20
Net raw material price effect on exports and imports	+25
Residual	−10

Note: These numbers are based on calculations described in the text. The numbers have been rounded to the nearest $5 billion since it is impossible to estimate them exactly. In particular, the last four numbers listed depend on estimated Japanese trade elasticities. Changes in these elasticities could significantly affect the results. Moreover, the last four numbers depend on a comparison of price indexes across countries. Differences in index composition or method of calculation could affect the results. Japan's real trade balance change is computed by applying export and import volume growth rates to Japan's nominal 1985 trade levels. The U.S. change is computed by applying volume growth rates to nominal 1980 trade levels. Footnote 1 of the text considers the implications of this methodology.

capital goods exports. Nor does it appear that Japan's exports were substantially increased by sales to Japanese subsidiaries abroad.

This reasoning is not meant to imply that world and overseas Japanese investment were unimportant for Japanese exports. Rather, it suggests that these two factors did not play exceptional roles that could explain Japan's strong trade performance. Foreign investment does not appear to have offered Japan a unique export environment in the mid-1980s. Cumulative gross fixed nonresidential investment in industrial countries other than Japan grew about the same between 1985 and 1988 as did cumulative gross fixed nonresidential investment in industrial countries other than the United States between 1980 and 1985. Like Japan, the United States was a major capital goods exporter that benefited from this earlier foreign investment growth. That overseas investment does not emerge as a unique element in Japanese export growth between 1985 and 1988 may be due to the fact that this investment became really large only at the end of this period (Table 6). Consequently, the impact of this investment on Japanese exports is likely to be more fully felt in 1989 and beyond.

Adjustment of the Japanese nominal trade balance

Between 1985 and 1988, the nominal Japanese trade balance rose $39 billion, from a surplus of $56 billion to a surplus of $95 billion. This rise reflects a dollar translation effect, a starting base effect, and price movements applied to the export and import volume growth rates already discussed.

The dollar translation effect is the dollar rise that results when Japan's nominal trade balance measured in yen is converted into depreciated dollars.[29] When measured in yen, the Japanese trade surplus did not grow between 1985 and 1988; it actually shrank by ¥974 billion (or $8 billion converted at the 1988 dollar/yen exchange rate). But because the dollar value of the yen increased by 86 percent, the measured dollar level of Japan's surplus rose despite this fall in yen terms.

The starting base effect for Japan's nominal trade balance is analogous to the starting base effect already examined for Japan's real trade balance. The nominal starting base effect can be measured jointly with the dollar translation effect just discussed. This calculation compares the actual dollar change in Japan's trade surplus with the change that would have occurred if Japan had started with balanced trade and if the nominal *dollar* levels of exports and imports had grown at their actual nominal *yen* growth rates. The hypothetical starting base used for this procedure is again derived by setting Japanese exports and imports equal to the average of their 1985 actual levels. This exercise suggests that Japan's large trade surplus at the start of its appreciation period, combined with the effect of translating the Japanese surplus into depreciated dollars, raised Japan's nominal 1988 trade balance by $33 billion above what it otherwise would have been.

These dollar translation and starting base effects are thus clearly very important in explaining Japan's nominal trade strength. Even after these effects are taken into account, however, Japan's nominal trade balance would still have remained very high during the 1985-88 period despite the 47 percent nominal effective appreciation of the yen. To determine what lay behind this underlying nominal trade strength, it is instructive to consider each of the factors already discussed in the real trade balance analysis.

The first factor is trade composition and its impact on import price and import elasticities. Japan's unusual trade composition has been estimated to have reduced Japanese import volume by about 15 percent. To this volume effect must now be added the composition effect on import price in order to calculate the overall effect of import composition on Japan's nominal trade balance. As already estimated, the composition effect lowered Japanese import prices by about fifteen percentage points from what they would have been if Japan had had a more normal import composition. The combined 30 percent price and volume reduction in imports attributable to Japan's unusual import composition cut Japanese nominal import payments (or raised the Japanese nominal trade balance) by about $35

Table 6

Japanese Foreign Direct Investment in Manufacturing

(Billions of Dollars)

1985	2
1986	4
1987	8
1988 estimate	15

Source: Bank of Japan, *Balance of Payments Adjustment in Japan: Recent Developments and Prospects*, Special Paper no. 178, May 1989. The estimate for 1988 is based on the number for the first half of 1988 listed in the source. Data are for Japanese fiscal years, which begin in April.

[29] It is important to distinguish how Japan's nominal trade balance moved in yen terms from how it moved in dollar terms. The yen change reflects a more fundamental adjustment for Japan because Japanese labor must be paid in yen and Japanese profits are gauged domestically in yen terms. Moreover, Japanese savings and investment, and the gap between savings and investment that constitutes Japan's current account deficit, are economically determined in Japan's yen-based economy.

billion.[30]

Profit cutting also had a major impact on Japan's real trade balance, specifically on the export side. Its impact on Japan's nominal trade balance, however, appears to have been significantly smaller. Profit cutting reduced the yen payment received on each export sale. This payment reduction per sales unit offset a significant proportion of the export volume gain attributable to profit cutting. Indeed, the export volume elasticity with respect to relative price changes of −1.1 discussed earlier implies that almost all of the volume gain was offset by the yen price fall attributable to profit cutting, leaving only a small positive impact on Japan's nominal export level.[31]

Unit labor cost developments also boosted Japan's real trade balance. Again, however, the impact on Japan's nominal trade balance was relatively small. On the export side, Japan translated its falling unit labor costs into a reduction in the yen price of its products. While the volume of exports rose because of this price reduction, the yen payment per unit exported fell. This fall in per unit payment offset most of the volume gain, just as it did in the case of profit cutting. The nominal level of Japanese exports increased only modestly. On the import side, in contrast, Japanese unit labor cost developments had no direct impact on Japanese import prices. Therefore, the reduction in import volume resulting from falling Japanese unit labor costs relative to those abroad was not offset by any import price changes. However, the reduction in import volume from falling relative unit labor costs was actually only on the order of $5 billion. The decrease was small because Japanese import demand is quite unresponsive to relative price changes. (It has only an estimated −0.4 import volume elasticity with respect to these changes.) Consequently, falling Japanese unit labor costs do not appear to explain a substantial part of Japan's strong nominal trade performance.

Falling raw material input prices were the third price factor providing support to Japan's real trade balance performance. The impact of this factor on Japan's nominal trade balance was also substantial. Its significance is in distinct contrast to the small nominal impact of Japanese profit cutting and declining Japanese unit labor costs. Falling raw material prices did lower Japanese export prices, as did profit cutting and declining labor costs. But falling raw material prices also reflected falling Japanese import prices whereas the other two factors did not. In fact, because the appreciation-induced fall in the yen price of *imported* raw materials accounted for the overall fall in Japanese raw material costs relative to those of foreign competitors, the negative effect of falling export prices on Japan's nominal trade balance was just about matched by the positive effect of falling import prices. Consequently, with a positive export volume effect and offsetting export and import price effects, Japan's nominal trade balance clearly benefited from falling raw material prices.[32] On the basis of the magnitude of the raw material price fall and Japan's trade elasticities, this benefit equaled about $20 billion in 1988 prices.

Falling raw material prices had one other important effect on Japan's nominal import level aside from the gain in the price competitiveness of Japan's manufactured goods. The sharply falling price of petroleum imports lowered the cost of Japanese home heating oil and gasoline as well as the cost of petroleum used as a manufacturing input. Japanese petroleum import prices declined about forty percentage points more than other Japanese import prices because of the falling world price of petroleum during 1985-88. Japanese petroleum imports not going into manufacturing production were roughly $35 billion in 1985.[33] A 40 percent savings on this import level would equal about $15 billion. This import savings from the world petroleum price fall was separate from, but simultaneous with, the adjustment that occurred in Japan's nominal trade balance in response to yen appreciation. Japan's large petroleum savings, therefore, contributed significantly to the strong performance of Japan's nominal trade balance.

Demand growth, a world investment boom, and Japanese overseas direct investment did not have an unusual effect on Japan's real trade balance. This conclusion holds for Japan's nominal trade balance as well, and the reasons are the same as those cited in the real balance analysis. To determine if Japanese business acumen played a role, the factors underlying Japanese nominal trade adjustment can be compared with those underlying U.S. nominal trade adjustment, just as the factors determining the real trade performances of the two countries were compared. The results

[30]This calculation and those that follow in this section abstract from the dollar translation impact to avoid double counting. In other words, the $35 billion estimate measures the magnitude of the trade composition impact in the absence of any dollar translation effect.

[31]Japanese export volume elasticities with respect to relative price estimated in the 1960s and 1970s averaged −1.4. These elasticities would suggest that the negative price effect of profit cutting offset about 70 percent of the positive volume effect of profit cutting.

[32]This argument is a more general version of the case in which an entrepot economy imports products solely for the purpose of re-exporting them. The entrepot economy's trade balance is relatively immune to changes in its exchange rate.

[33]Bank of Japan, *Economics Statistical Annual 1988*, Japanese input/output table. Because Japanese petroleum import volume is very unresponsive to changes in price, the $15 billion savings calculated above did not show up in the earlier real trade balance analysis.

of the nominal comparison are shown in Table 7. For this table, the dollar translation and starting base effect are calculated by computing how the nominal Japanese and U.S. trade balances would have adjusted if they had both started with identical balanced export and import levels and each country had followed its actual domestic currency nominal export and import growth rates. The difference between the actual trade balance results and these hypothetical results accounts for $75 billion of the difference in Japanese and U.S. nominal trade balance adjustment. The trade composition effect is calculated as described above. The raw material price effect is based on the difference that would have occurred in Japan's nominal trade balance if Japanese relative raw material prices had moved the same as U.S. relative raw material prices. The heating oil and gasoline price effect equals $10 billion rather than the $15 billion Japanese savings calculated above because U.S. petroleum import prices also fell somewhat during 1980-85.[34] The negative residual in this table suggests that the factors listed more than account for the difference in Japanese and U.S. nominal trade balance adjustment to currency appreciation. Consequently, as the analysis of the real trade balance suggested earlier, differences in business ability or business strategies do not explain Japan's nominal trade balance strength.

[34] There is some double accounting of the oil price effect with the trade composition effect. The trade composition effect includes the impact of oil's large import share. If the oil share were not so large, the falling oil price effect would be less.

Table 7

Comparison of Japanese and U.S. Nominal Trade Balance Adjustment to Currency Appreciation

(Billions of Dollars)

Japanese nominal trade balance change, 1985-88	+39
U.S. nominal trade balance change, 1980-85	−96
Difference between Japanese and U.S. nominal trade balance changes	+135
Difference due to:	
Dollar translation and starting base effects	+75
Trade composition effect on import prices and elasticities	+35
Net raw material price effect on exports and imports	+20
Decline in price of heating oil and gasoline	+10
Residual	− 5

Note: These numbers are based on calculations described in the text. The numbers have been rounded to the nearest $5 billion since it is impossible to estimate them exactly. In particular, several of the numbers listed depend on estimated Japanese trade elasticities. Changes in these elasticities could significantly affect the results. Similarly, some numbers depend on a comparison of price indexes across countries. Differences in index composition or method of calculation could affect the results.

Recent Japanese trade behavior

Japan's trade surplus fell significantly in the middle of 1989 after rising sharply early in the year. Japan's second-quarter and third-quarter 1989 annualized surpluses, averaging $72 billion, were substantially lower than its 1988 trade surplus of $95 billion. Exchange rate changes, raw materials prices, and relative demand growth explain these recent developments in Japan's trade balance fairly well.

There were some notable exchange rate and oil price changes in the spring of 1989. The yen depreciated 3 percent in the second quarter from its 1988 average level and 5 percent from its first-quarter 1989 level. It fell another 3 percent in the third quarter. Although the gain in price competitiveness from depreciation should raise Japan's trade surplus over time, the initial impact of the 1989 depreciation was to lower the dollar value of Japan's trade surplus through the dollar translation effect (which in this case worked in reverse). Dollar petroleum prices also rose about 15 percent in the spring of 1989 from their average 1988 and first-quarter 1989 levels, further lowering Japan's 1989 trade surplus.

Another important factor behind the recent turndown in Japan's trade surplus was Japan's relatively rapid demand growth during 1989. Japanese demand grew at an average annual rate of over 5 percent in the first half of 1989 (growth was concentrated in the first quarter but demand growth had some lagged effect on imports) while demand in other industrial countries grew at only about half that rate. Japan's export and import trade volume elasticities with respect to demand growth suggest that this divergent demand growth performance by itself led to Japanese import growth about 50 percent faster than Japanese export growth. Since Japanese imports were 64 percent of Japanese exports in 1988, a 50 percent growth differential was necessary to keep the Japanese trade surplus from rising. Demand growth that was much more rapid in Japan than in other countries achieved this result and thereby allowed the 1989 price changes to actually push the Japanese trade balance down.

Conclusion

This analysis of Japan's trade balance adjustment to yen appreciation suggests that the rise in Japan's trade surplus from 1985 to 1988, measured in either real or nominal dollar terms, can be explained in a relatively straightforward manner. A substantial starting base trade surplus in 1985 accounts for a significant part of the rise in Japan's trade balance. In addition, the com-

modity structure of Japan's trade, with imports dominated by raw materials and exports consisting almost exclusively of manufactured goods, had a substantial favorable effect on Japan's trade balance. Japan's real trade balance was further supported by the profit cutting measures of Japan's export industries, although profit cutting had a much smaller effect on Japan's nominal trade balance. The statistical effect from translating a yen balance into depreciated dollars, combined with substantial import savings from the falling world price of petroleum during 1985-88, boosted Japan's nominal trade balance but had little effect on Japan's real trade balance. Apart from these factors, Japanese exports and imports appear to have responded fairly conventionally to changes in relative price and demand growth at home and abroad.

A corollary of these findings is that the impressive strength of Japan's trade surplus in the mid-1980s does not appear to stem from any unique Japanese business strategy or ability to compete. Nor does it appear to be directly related to temporary factors such as a world investment boom or Japanese sales to overseas subsidiaries. Consequently, measures taken to address these other factors, although they may influence Japan's trade balance, are not likely to affect the macroeconomic conditions behind Japan's trade strength.

Looking to the future, although longer term factors such as shifting international supply conditions, changes in trade policies, and shifts in demand preferences may affect Japan's trade position, they probably will not by themselves be enough to offset the trade gains Japan realized from declining imported raw material prices over the past few years. Consequently, if its trade surplus is to decline substantially, Japan will likely have to continue to grow much more rapidly than its trade partners, or relative prices may have to change further to reduce the competitiveness of Japanese goods.

One encouraging development is that Japan's trade balance will probably respond more strongly now to both Japanese demand growth and changes in the value of the yen than was the case in 1985. After the sharp profit cutting of the last two years, Japanese manufacturers currently have considerably less room to cut profit margins on export sales. Even more important perhaps, Japanese imports are a higher percentage of exports in 1989 than they were on average between 1985 and 1988. Therefore, every percentage point increase in the growth rate of imports relative to exports will have a larger effect on Japan's trade balance now than it did over the past few years. Moreover, manufactured goods imports are a higher percentage of total imports than was the case in the past. Consequently, import growth should now be more responsive to changes in demand and relative prices.

Susan Hickok

The Effectiveness of Tax Amnesty Programs in Selected Countries

Tax evasion presents a serious problem for a variety of countries. Every year, governments lose large amounts of potential revenue because many citizens, in some manner, avoid paying taxes. in Italy, for example, some estimates place tax evasion as high as 20 percent of gross domestic product each year.[1] Estimates of the amount of unpaid taxes in the United States range as high as $100 billion yearly.[2] The problem of tax evasion is especially serious in less developed countries (LDCs), where large percentages of the population fail to pay taxes fully.

To address the problem of tax evasion, many countries have implemented tax amnesty programs over the years. In this decade alone, Argentina, Australia, Belgium, Colombia, Ecuador, France, Honduras, India, Ireland, Italy, Panama, the Philippines, and the United States have all implemented some form of tax amnesty.[3] In addition, Denmark, Mexico, the Netherlands, Norway, Peru, Sweden, and West Germany have, or have had at one time in the 1980s, standing tax amnesty programs reducing or abolishing penalties for delinquent taxpayers who voluntarily disclose past errors or omissions. The specific provisions of the programs have differed greatly; the length of time the amnesties are effective, the types of taxes eligible for the amnesty, and the types of penalties absolved vary across countries. Nevertheless, most amnesty programs share a common feature — a grace period during which delinquent taxpayers can correct prior infractions of the tax law without incurring penalties normally associated with tax delinquency.

Governments implement tax amnesties to raise revenues from three main sources. The first source is the large amount of revenue in the domestic economy that goes unreported because it is circulating in the underground economy. Tax amnesties are designed not only to increase current tax revenue but also to reduce permanently the amount of economic activity occurring in the underground economy, thereby increasing future tax revenues as well. The second source of potential revenue is flight capital. Governments use amnesties as an inducement for citizens to repatriate sums of money, often very large, that have been illegally transported abroad. A substantial amount of potential tax revenue is lost yearly, especially in LDCs, because of flight capital. According to one set of estimates, for example, the compounded value of flight capital assets held abroad from 1977 to 1987 amounted to $84 billion for Mexico, $58 billion for Venezuela, $46 billion for Argentina, and $31 billion for Brazil.[4] The third and final source of potential revenue is the payment of back

[1] John Wyles, "The Taxing Problem Italy Faces," *Financial Times*, August 7, 1989, p. 15.

[2] Herman Leonard and Richard Zeckhauser, "Amnesty, Enforcement and Tax Policy," National Bureau of Economic Research, Working Paper Series, no. 2096, 1986, p. 2.

[3] The United States has never had a federal tax amnesty program, but the following states have implemented tax amnesties: Alabama, Arizona, California, Colorado, Idaho, Illinois, Kansas, Louisiana, Massachusetts, Minnesota, Missouri, New Mexico, New York, North Dakota, Oklahoma, South Carolina, Texas, and Wisconsin. See U.S. Department of the Treasury, Internal Revenue Service, "Study of Tax Amnesty Programs," August 1987.

[4] "LDC Debt Reduction: A Critical Appraisal," *World Financial Markets*, Morgan Guaranty Trust Company, December 30, 1988, p. 9.

taxes by those who inadvertently underpaid taxes but never reported this mistake because of the penalties associated with tax evasion. Tax amnesties encourage full repayment by eliminating or lessening such penalties.

This article examines the benefits and costs of tax amnesty programs. It analyzes programs enacted in six countries in the 1980s, giving particular consideration to those features that appear to have contributed most to program success. The analysis suggests that tax amnesties are successful only if they are perceived as onetime opportunities to redress tax violations. In addition, the evidence gathered here shows that the effectiveness of the programs is enhanced if they are accompanied by stricter tax enforcement or changes in tax rates.

Benefits

A number of benefits may be derived from tax amnesty programs. The most evident potential benefit is a windfall revenue gain that accrues to the government from the collection of past debts. Some governments have collected substantial sums of back taxes that have helped reduce the treasury's borrowing requirements. Programs have also proved successful in collecting money from both the underground domestic economy and capital held abroad.

A further benefit is that amnesty programs can increase the tax base and thereby improve future tax collections. Governments implement the programs hoping both to enlarge the base of registered taxpayers and to increase the amount of reported economic activity. A well-regulated tax amnesty program can ensure that those individuals who utilize the amnesty are not only added to the list of taxpayers but also carefully audited in the future. Amnesties can therefore decrease the need to raise taxes in the future because of the expanded tax base. Consequently, regular taxpayers can also benefit from tax amnesties as nonpayers are brought into the fold.

An additional advantage of these programs is that they can ease the transition to a new tax enforcement regime. A government that desires to strengthen its tax collection mechanism can couple this enhanced enforcement with a tax amnesty. This coupling allows those taxpayers who were unwilling to acknowledge past underpayments to come forward without fear of penalties before the new collection regime is introduced.

Costs

The benefits of tax amnesty programs must be weighed against a number of potential costs. First, the programs can have undesirable incentive effects if they are implemented frequently. Citizens may come to expect their governments to offer periodic tax amnesties. These expectations can decrease the incentive to pay taxes routinely and lead eventually to an increase in the number of tax evaders. Moreover, if amnesties make evasion seem forgivable, they may reduce voluntary compliance over the long run, causing serious financial consequences for the governments.

Amnesties may also have the effect of penalizing regular taxpayers. Some of the amnesties have offered better returns on assets to those who have evaded taxes than to those who have routinely paid. Most amnesties, however, seem simply to have rewarded errant taxpayers by absolving them of penalties on unpaid taxes.

A further cost of a tax amnesty is that it can be interpreted as a sign of the government's inability to enforce its tax laws. Consequently, an amnesty carries the potential of reducing the credibility of the government instituting the amnesty.

By providing a windfall gain in revenue, tax amnesties may also enable governments to ignore structural problems in the economy. For example, a government receiving such a windfall may be less inclined to reexamine burdensome regulations and poor economic policies that often are the root causes of the tax evasion. Were governments to concentrate on correcting these structural inefficiencies, they would encourage more activity to take place in the legal economy, thereby increasing the overall tax base.

Requirements for a successful program

The performance of the programs examined in this study strongly suggests that a tax amnesty can be successful only if it is perceived as a unique event. Many countries offering tax amnesties on a repeated basis have met with little or no success after the initial program. The reason is fairly simple. If the citizens of a country expect there to be more than one amnesty, they have little or no incentive to report or redress an offense immediately. In fact, because they expect a future amnesty, they have an incentive not to pay current taxes. Only if individuals see the amnesty as their single opportunity to redress past offenses is the program likely to be effective. Thus, in deciding whether to participate in the amnesty, these individuals are likely to be guided by the government's announcements about future policy. Repeated tax amnesties not only remove the incentive for reporting overdue taxes, but also in many cases increase the frequency of tax evasion.

Evidence to date also suggests that amnesties, to be successful, require adjustments in other areas of the tax system. Most notably, the effectiveness of an amnesty program is likely to improve markedly if the existing enforcement mechanisms are strengthened.

An amnesty alone may not be sufficient to induce delinquent taxpayers to declare heretofore unreported income. They may come forward, however, if the amnesty is accompanied by the increased likelihood of detection. The public must therefore be convinced that tax evasion successfully practiced before the amnesty will no longer be possible once the amnesty is in place. The enhanced enforcement mechanisms may not only increase participation in the amnesty but also reassure regular taxpayers of the government's resolve to apprehend future tax offenders.[5]

Because tax evasion is often the result of high tax rates and poor economic policies, amnesties have also proved more successful when they have been part of an overall package of tax changes. For example, Colombia reduced its tax rates at the same time as it announced a tax amnesty, while the Philippines increased allowable exemptions. In the long run, however, the success of tax amnesties depends importantly upon the government's willingness to undertake structural changes. The experience of countries that have implemented tax amnesties to date indicates that an amnesty can lead to revenue gains, but the country must address the more fundamental economic problems of the economy that may have encouraged tax evasion in the first place.

Finally, the effectiveness of a tax amnesty program may be influenced by the type of government in power or likely to take power. Tax amnesties often fail not on the merits of the program but as a result of political factors. For example, citizens may refrain from participating in an amnesty program if they believe that the current government or one likely to be elected will not abide by the amnesty or will adopt economic measures greatly reducing the value of the newly reported income. In fact, some amnesty programs have become highly politicized. For example, the socialist parties in France in 1986 and Belgium in 1985 repudiated recently passed tax amnesties in their election platforms because they were convinced that the amnesties would almost solely benefit the wealthy.

The following sections examine tax amnesty programs enacted by six countries in the 1980s. The discussion underscores the variation in program design and explores the reasons for the programs' differing success rates.

Ireland

By most accounts, the Irish government has carried out the most successful tax amnesty program to date. In the January 1988 budget, the Irish government introduced a comprehensive proposal that gave delinquent taxpayers ten months to pay overdue taxes without incurring any interest or penalty charges. The government also promised not to prosecute any of these delinquent taxpayers.

In addition to granting the amnesty, the government simultaneously implemented a series of supporting measures. It increased the number of "tax sheriffs" responsible for enforcing tax collection. It began publishing in the national newspapers lists of the names of people who were delinquent in their tax payments. At the end of the ten-month amnesty, it introduced a new tax system. Further, the government increased interest and penalty payments on delinquent taxes and gave added power to the revenue commissioners. The additional powers included the right to seize stock and other assets and to freeze bank accounts belonging to convicted tax evaders.

According to the Central Bank of Ireland, the tax amnesty raised approximately $750 million. This windfall gain helped reduce the treasury's total borrowing requirement to approximately 3.4 percent of GDP in 1988, compared with 10 percent in 1987.[6] The amount of revenue raised from the amnesty far exceeded expectations when the amnesty was first proposed. The government had anticipated raising only about $50 million; the final amount of $750 million clearly represented a success. The one remaining question is whether Ireland's tax amnesty will lead to a larger permanent tax base or whether the gains will have been achieved on a onetime basis only.

Although the experience of most programs to date suggests that tax amnesties are not likely to widen the tax base, Ireland may prove to be the exception because of its emphasis on greater tax enforcement. Still, much of the success of the Irish program appears to be due to the laxity in collecting taxes before the amnesty. Substantial sums were available for the amnesty because a large percentage of Irish wage earners had successfully underpaid for many years.

More important, Ireland's program probably benefited from the fact that the government had never previously attempted a tax amnesty. In implementing the 1988 program, the government emphasized that this amnesty was the first and last opportunity for delinquent taxpayers to be forgiven. A large percentage of the $750 million was raised in the last few months of the program because Irish citizens seemed to realize that this was a onetime opportunity.

One factor that may undercut the success of Ireland's amnesty in increasing future tax revenues is that the government did not reduce its tax rates or increase exemptions as part of the package. The widespread

[5]Peter Stella, "An Economic Analysis of Tax Amnesties," IMF Working Paper, WP/89/42, May 1989, p. 13.

[6]Central Bank of Ireland, *Quarterly Bulletin*, Winter 1988, p. 11.

evasion of taxes in Ireland was probably in large part a response to the country's tax rates, which are among the highest in Europe. Therefore, while the strengthened enforcement measures should help sustain the widened tax base, the maintenance of high tax rates may well increase the incentive for tax evasion.

India

In February 1981, the Indian government introduced a unique form of tax amnesty. For a period of about three months, the government sold special bearer bonds that were designed specifically to tap untaxed income. Anyone holding black market funds was allowed to use these funds to purchase the bonds with no questions asked about the source of the income. The bonds, which mature in 1991, carry only a nominal annual interest rate of 2 percent. But the money invested in the bonds was exempted from the wealth tax imposed on other bank deposits and from an income tax on principal and interest at the time of maturity. Some estimates suggest that a tax evader who bought the bonds with black market money would have up to 60 percent more money in ten years than would a citizen who bought the same amount of regularly issued bonds with money held in a savings account.[7] The Indian government was reportedly able to attract over $1 billion from the issuance of these bonds.[8]

Although the money collected was fairly substantial, the government did not raise as much money from the amnesty as it had anticipated, nor did it succeed in widening the overall tax base. The government had hoped to widen the tax base by adding taxpayers to the rolls and carefully auditing in the future those who participated in the program. Yet the issuance of the bonds was not accompanied by any strengthening of the tax laws or any structural changes in the tax system. Because the enforcement mechanisms remained the same, delinquent taxpayers had no reason to believe that penalties would be more likely in the future.

In addition, this amnesty, while different in form, was the fifth in a series of amnesty programs offered by the government over a period of twelve years. Many citizens may have assumed that the government would offer other, possibly more attractive, amnesties in the future. Consequently, they had little incentive to participate in the 1981 program.

The Indian program illustrates the way in which amnesties can penalize regular taxpayers. In this case, regular taxpayers were unable to purchase the more lucrative special bearer bonds.

[7]"India's Amnesty for Tax Evaders," *New York Times*, February 3, 1981.

[8]*Reserve Bank of India Bulletin*, vol. 35, no. 6 (June 1981), p. 462.

Argentina

Another type of amnesty program exempts from taxes all previously unreported income that is used for investment purposes. Argentina attempted this form of tax amnesty to stimulate the return of flight capital as part of its 1987 debt-to-equity program. The 1987 debt-to-equity program was open to both foreign and local investors. It stipulated that, for every dollar of debt converted, the investor had to contribute an additional dollar in fresh funds. Together with the matching funds, the converted debt had to be used to purchase new equipment, build new plants, or increase the physical capacity of existing facilities. Under the amnesty, the government permitted the return of the matching funds free of any taxes owed. It also promised not to investigate the origins of these funds or prosecute delinquent taxpayers.[9]

For a number of reasons, the program failed. Investors viewed the matching funds requirement as overly stringent. The one-to-one rule, even with the lifting of taxes, largely undercut the benefit from participating in the debt-to-equity program. In addition, the attraction of not paying taxes on the matching funds was in some ways inconsequential because tax evasion in Argentina is widespread in any case. Finally, the potential impact of the program was undermined by the frequency with which the Argentine government had offered tax amnesties. In 1988, the government adopted a new debt-to-equity program that partially removed the matching funds requirement and annulled the tax amnesty.

The case of Argentina supports the argument that a modest tax amnesty unsupported by structural adjustments is likely to fail. Argentina has for years lost large amounts of potential tax revenue to flight capital and the underground economy. Although tax amnesties have been introduced under various regimes, there has been little effort to address the sources of the tax evasion problem. The underground economy remains large, in part because of the highly regulated nature of the economy, while capital flight has recurred because of uncertainty concerning economic policies. Consequently, the tax amnesties in Argentina have failed to produce their intended results.

Belgium

In 1984, the Belgian government enacted a tax amnesty whose purpose was to attract flight capital and bring black market funds into the open economy.[10] The law exempted from taxes any capital invested by

[9]John Whitelaw, "Argentina Plans Debt Cut, Investment Spur," *The Christian Science Monitor*, September 5, 1986.

[10]U.S. Department of the Treasury, Internal Revenue Service, "Study of Tax Amnesty Programs."

Belgian residents in employment-creating activities before the end of the year. It also excused these residents from any obligation to report the origin of the funds. One-eleventh, or 9 percent, of the amount in question, however, had to be invested in five-year noninterest-bearing treasury certificates. Ultimately, the center-right coalition government, confronted with a number of political problems in 1985, annulled the legislation.

Colombia

The Colombian government implemented a successful amnesty program in 1987. The program stipulated that taxpayers who had previously failed to report assets or who had declared nonexistent liabilities would be able to rectify their reports without incurring sanctions or being subject to investigation or reappraisal. The law further stated that to be eligible for the amnesty the income declared could not be less than the income declared in the previous year. Finally, the amnesty was not made available to anyone already under investigation by the tax authorities.[11]

[11]Central Bank of Colombia, *Revista del Banco de la Republica*, vol. 59 (December 1986), p. 58.

Table 1

Effectiveness of Tax Amnesties

Country	Year Program Implemented	Estimated Amount Raised (In Millions of Dollars)	Amount as Percentage of GDP	Amount as Percentage of Central Government Deficit
Argentina	1987	—	—	—
Belgium	1984	—	—	—
Colombia	1987	93	0.3	54
France	1986	1610	0.22	8
India	1981	1000	0.54	10
Ireland	1988	750	2.55	158

At the same time the Colombian government instituted the amnesty, it unified the corporate income tax rate, lowered personal income tax rates, eliminated the double taxation of dividends, and raised income tax withholding rates. The government estimates that its tax amnesty yielded about $94 million, or the equivalent of 0.3 percent of GDP in 1987.[12]

In Colombia's case, it appears that the tax amnesty in conjunction with these other changes may have improved overall tax collection. The expansion of the revenue base that began with the 1987 amnesty continued in 1988. Nevertheless, revenue collections will have to be measured for a few more years to assess fully how these changes have affected the tax base.

France

France in 1986 enacted a tax amnesty geared solely toward recouping income illegally transferred abroad. Under the amnesty, the government reduced the tax rate on repatriated capital to 10 percent, a rate much lower than that normally imposed on income. The government also abolished the wealth tax and allowed the holdings of gold to be anonymous.

The government adopted these additional measures to make this amnesty more successful than one adopted in 1982. The 1982 law was also designed to encourage French citizens to repatriate capital illegally held abroad. That program failed in part because of the high wealth tax in existence in France at that time.

The exact amount of the revenue raised from the 1986 amnesty is unknown, but nonbank private capital inflows grew about 400 percent in 1986. Much of the increase, according to the central bank, was the result of this fiscal amnesty.[13] France's experience supports the view that a successful tax amnesty depends impor-

[12]Central Bank of Colombia, *Revista del Banco de la Republica*, vol. 60 (December 1987), p. xi.

[13]"La Balance des Paiements de la France," *Bank of France Annual Report*, 1986, p. 88.

Table 2

Characteristics of Tax Amnesties

Country	Accompanied by Enhanced Enforcement	Implemented for First Time	Designed to Attract Flight Capital	Geared to Domestic Capital	Accompanied by Tax Rate Adjustments
Argentina	No	No	Yes	No	No
Belgium	No	No	Yes	Yes	No
Colombia	Yes	Yes	No	Yes	Yes
France	No	No	Yes	No	Yes
India	No	No	Yes	Yes	No
Ireland	Yes	Yes	No	Yes	No

tantly upon the government's willingness to adopt simultaneously other structural changes. An amnesty alone was unable to attract the return of flight capital in 1982; the government had to address some of the causes of flight capital before it could achieve its purpose.

Conclusion

Tables 1 and 2 summarize the quantitative and qualitative characteristics of the programs examined in this article. As Table 1 indicates, tax amnesty programs have had varied success. Most of the programs have not led to a widening of the overall tax base, and many have failed to produce even very large onetime revenue gains. In the case of programs that combine tax amnesty with rate adjustments and more rigorous enforcement, it is difficult to distinguish revenue gains attributable to tax amnesty from the gains attributable to enhanced tax enforcement or changes in tax laws. On the one hand, if enhanced enforcement or other structural changes would have raised the same amount of revenue without the introduction of an amnesty, then the amnesty could have resulted in a loss of money to the state because of the forgone interest or penalty charges. On the other hand, if the amnesty accelerated the repayment of taxes, the state would have gained the advantage of collecting the money sooner, a benefit not available to governments making only structural changes.

Most programs seem to have failed because the countries implementing the amnesties did not possess the means or desire to enforce tax collection after the amnesty. As a result, the programs often led to onetime revenue gains but appear to have had no lasting effects.

For these reasons, it seems likely that developing countries in particular will gain little by implementing a tax amnesty until they improve their overall systems of tax collection. In addition, many developing countries have already enacted several tax amnesties, thereby diminishing their chances of implementing truly successful programs in the immediate future. Nevertheless, a well-designed tax amnesty program, accompanied by structural and tax reforms, has the potential to lead to beneficial results in both developed and developing countries.

Elliot Uchitelle

Treasury and Federal Reserve Foreign Exchange Operations

August-October 1989

During the first half of the August-October reporting period, the dollar came under renewed upward pressure in the face of strong investment inflows. In response, the U.S. monetary authorities intervened to sell dollars in keeping with Group of Seven (G-7) policy commitments to foster exchange rate stability. The dollar reached its highs of the period in mid-September. It then moved sharply lower after the G-7 statement of September 23 expressed concern over the dollar's rise and persistent coordinated intervention operations followed. Toward the end of the period, the dollar traded in a relatively narrow range. Demand for dollars moderated as a result of a narrowing of interest rate differentials favoring dollar assets and of concerns over volatility in U.S. equity markets. However, investment interest continued to provide some support at lower levels.

The dollar ended the August-October reporting period ½ percent higher on a trade-weighted basis in terms of other Group of Ten (G-10) currencies as measured by the staff of the Federal Reserve Board of Governors. Against individual currencies, however, the dollar's performance varied considerably. On balance, the dollar declined 1¼ percent against the German mark and ½ percent against the Canadian dollar while rising 4¼ percent against the Japanese yen and 5½ percent against the British pound.

During the three-month period, the U.S. monetary authorities sold a total of $5,871 million between August and early October, of which $3,289 million was against Japanese yen and $2,582 million was against German marks. These operations were conducted in coordination with foreign central banks.

A report presented by Sam Y. Cross, Executive Vice President in charge of the Foreign Group at the Federal Reserve Bank of New York and Manager of Foreign Operations for the System Open Market Account. George G. Bentley was primarily responsible for preparation of the report.

The dollar's rise from early August to mid-September

As the period opened, market participants were still apprehensive that the U.S. economy might be slipping into recession. In the final days of July, evidence was widespread that the Federal Reserve had responded to a slackening of economic growth and price pressures by easing monetary policy, and the dollar declined. On August 1, Chairman Greenspan confirmed in Senate testimony that the Federal Reserve had modestly eased its stance the previous week. On the same day, several leading banks cut their prime lending rates. The perception thereby strengthened in the market that U.S. interest rates were steadily declining and favorable dollar interest rate differentials would continue to narrow. The dollar then moved to its lows for the month of August of DM 1.8430 and ¥ 135.50 on August 2.

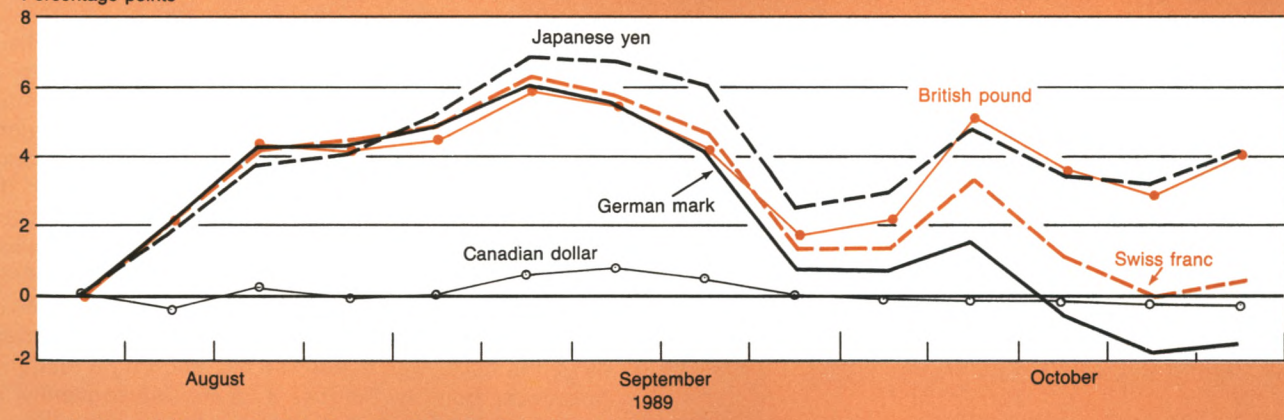
The dollar's softer tone was short-lived. Economic data released in early August alleviated the market's earlier concerns regarding the severity of an economic slowdown. The prospects of another imminent easing by the Federal Reserve appeared to fade after employment data released on August 4 showed a sharp upward revision in June nonfarm payrolls and continued employment growth for July. The release of figures on August 11 showing buoyant retail sales in July made the possibility of an easing appear even less likely. In addition, the monthly U.S. trade reports released in

both August and September suggested that the U.S. trade performance was continuing to improve.

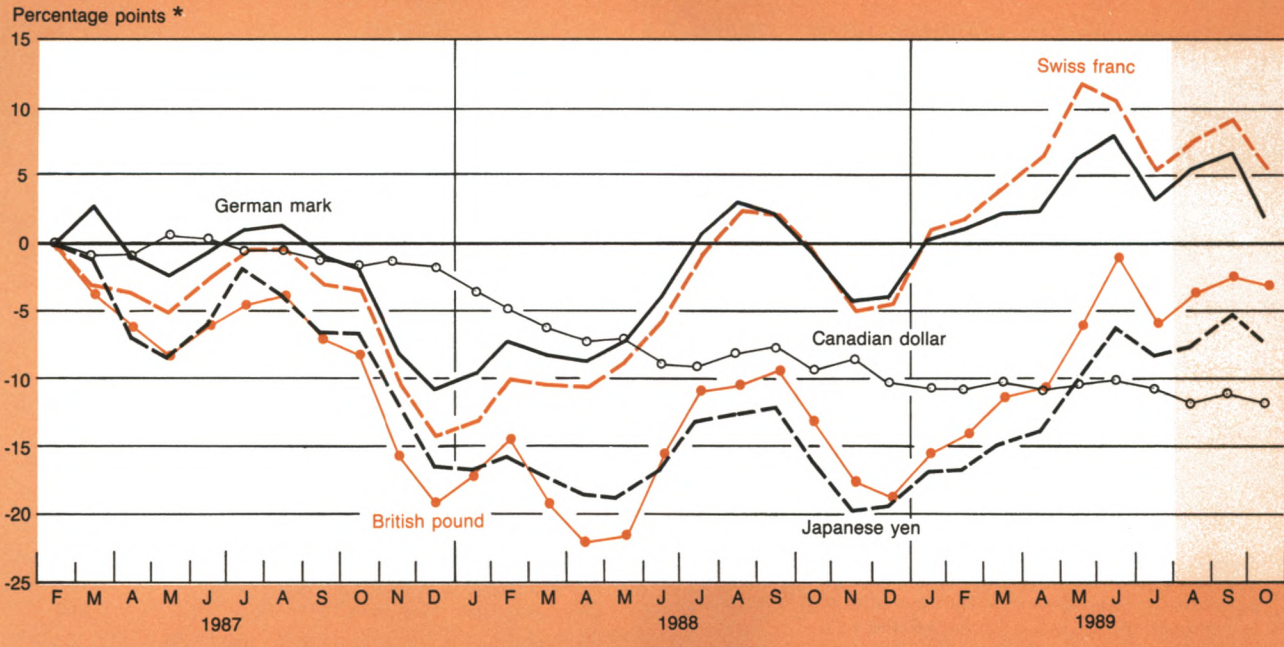
In this environment, commercial and investment demand for dollars revived, and the dollar was buoyant through mid-September. On September 15, following the announcement that the July U.S. trade deficit had narrowed unexpectedly to $7.58 billion, the dollar surged briefly to its highs of the three-month period of DM 2.0032 and ¥ 148.98, up roughly 7½ percent and 8¾ percent, respectively, from the closing rates of the previous reporting period. At these levels, the dollar was trading near the highs reached earlier in the year. Later that same day, when it appeared that the dollar would not move any higher, dealers began to take profits on long-dollar positions, triggering stop-loss orders, and a sudden decline in the dollar ensued.

Chart 1

After rising early in the reporting period, the dollar trended lower after mid-September . . .



and closed the period below its highs of earlier in the year.



* The top chart shows the percent change of weekly average rates for the dollar from August 4, 1989. The bottom chart shows the percent change of monthly average rates for the dollar from February 1987. All figures are calculated from New York noon quotations.

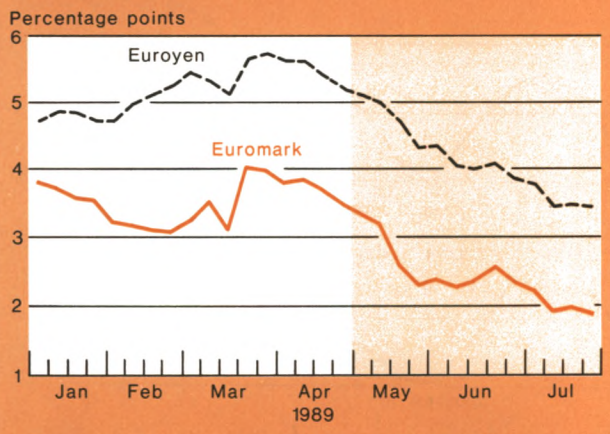
Although sentiment toward the dollar remained positive for quite a while afterwards, the episode revealed a vulnerability for the dollar at these higher levels.

During much of September, the U.S. monetary authorities again intervened in coordination with those of several other countries to resist upward pressure on the dollar. After mid-September, moreover, with the approaching G-7 meeting in Washington on September 23, the market became increasingly wary that more aggressive official action might be introduced to curb the dollar's strength, either through intervention or through monetary policy adjustments. The dollar then drifted down to close at DM 1.9520 and ¥ 146.00 on September 22, the Friday before the weekend G-7 meeting.

Accordingly, between August 1 and September 22, the U.S. monetary authorities sold a total of $1,452 million against marks and $1,699 million against yen. The operations became more frequent as upward pressure on the dollar intensified. During the first ten days of August, the U.S. authorities intervened only once, selling $70 million against yen. During the remainder of August, the U.S. monetary authorities sold dollars on six days for a total of $425 million against marks and $525 million against yen. The authorities entered the market more frequently after the beginning of September, intervening on eleven of the fifteen business days leading up to the G-7 meeting to sell a total of $1,027 million against marks and $1,104 million against yen.

Chart 2

Short-term interest rate differentials favoring the dollar continued to narrow as interest rates declined in the United States and increased abroad.



The chart shows weekly average interest rate differentials between three-month Eurodollar rates and three-month Euromarket deposit rates for marks and yen.

Dollar demand moderates after the late September G-7 meeting

After their meeting on Saturday, September 23, the G-7 finance ministers and governors issued a statement concluding, among other things, that the dollar's rise in recent months was inconsistent with longer run economic fundamentals and that a further rise of the dollar above then current levels or an excessive decline could adversely affect prospects for the world economy. The ministers and governors also expressed their intention to cooperate closely in exchange markets.

On the strength of the G-7 statement and official intervention to reinforce that statement, the dollar moved lower in Asian trading on Monday, September 25. The fact that the U.S. monetary authorities, along with others, were selling dollars in the Tokyo market sent a signal of the firmness of the G-7 resolve. In the days immediately following the statement, the G-7 monetary authorities persisted with their intervention. By October 2, the dollar had declined to DM 1.8650 and ¥ 138.60, about 5 percent lower than its closing levels on September 22. For the next eight business days, the dollar was again well bid, showing a tendency to recover from its October 2 levels. Subsequently, as

Table 1

Federal Reserve Reciprocal Currency Arrangements

In Millions of Dollars

Institution	Amount of Facility October 31, 1989
Austrian National Bank	250
National Bank of Belgium	1,000
Bank of Canada	2,000
National Bank of Denmark	250
Bank of England	3,000
Bank of France	2,000
Deutsche Bundesbank	6,000
Bank of Italy	3,000
Bank of Japan	5,000
Bank of Mexico	700
Netherlands Bank	500
Bank of Norway	250
Bank of Sweden	300
Swiss National Bank	4,000
Bank for International Settlements:	
Dollars against Swiss francs	600
Dollars against other authorized European currencies	1,250
Total	30,100

the authorities continued to intervene to resist the dollar's rise, market participants appeared more reconciled to the possibility that the dollar's uptrend might finally have been broken. In total, from September 25 through October 12, the U.S. monetary authorities sold $1,130 million against marks and $1,590 million against yen, operating on most days in that period.

The latter half of October

As mid-October approached, upward pressure on the dollar lessened. For the balance of the three-month period, the dollar remained below the mid-September highs.

One factor contributing to the easing of upward pressure was that interest rate differentials favoring the dollar narrowed further in October as a result of interest rate increases abroad. German market interest rates had begun edging higher in late September as dealers anticipated possible increases in the Bundesbank's official rates. On October 5, the Bundesbank announced a full one percentage point increase in both its discount and Lombard rates, surprising the market with the magnitude of the increase. The British, French, Swiss, Belgian, Dutch, Danish, Irish, and Austrian monetary authorities followed by raising their official rates. The following week, the Bank of Japan surprised the market by raising its discount rate by one-half percentage point on October 11, and short-term market interest rates in Japan increased by approximately 75 basis points within the span of a week.

Around this time, market participants also began to expect favorable interest rate differentials to diminish further because of an easing of monetary policy in the United States. Many observers viewed economic reports, particularly the September U.S. employment data released on October 6, as a sign that U.S. economic activity was sluggish enough to warrant a new move to lower U.S. interest rates. During the second week of October, the federal funds rate moved lower, and by mid-month, market participants concluded that the Federal Reserve had indeed eased.

Although interest rate differentials favoring the dollar had been narrowing throughout most of 1989 without any apparent negative effect on dollar exchange rates, the moves that occurred in October were sufficient to induce a moderation in capital inflows to the United States. By this time, interest rates in Germany had risen to levels that were almost as high as those in the United States. At the same time, as asset prices both in the United States and in foreign markets continued to adjust to the changing interest rate and economic assessments, questions arose about the continued

Table 2

Drawings and Repayments by Foreign Central Banks under Reciprocal Currency Arrangements with the Federal Reserve System

In Millions of Dollars; Drawings (+) or Repayments (−)

Central Bank Drawing on the Federal Reserve System	Amount of Facility	Outstanding as of July 31, 1989	August	September	October	Outstanding as of October 31, 1989
Bank of Mexico†	700.0	0	—	+700.0	—	+700.0

Data are on a value-date basis.

†Drawn as a part of the $2,000 million near-term credit facility established on September 21, 1989.

Table 3

Drawings and Repayments by Foreign Central Banks under Special Swap Arrangements with the Federal Reserve System

In Millions of Dollars; Drawings (+) or Repayments (−)

Central Bank Drawing on the U.S. Treasury	Amount of Facility	Outstanding as of July 31, 1989	August	September	October	Outstanding as of October 31, 1989
Bank of Mexico†	125.0	0	—	+84.1	—	+84.1

Data are on a value-date basis.

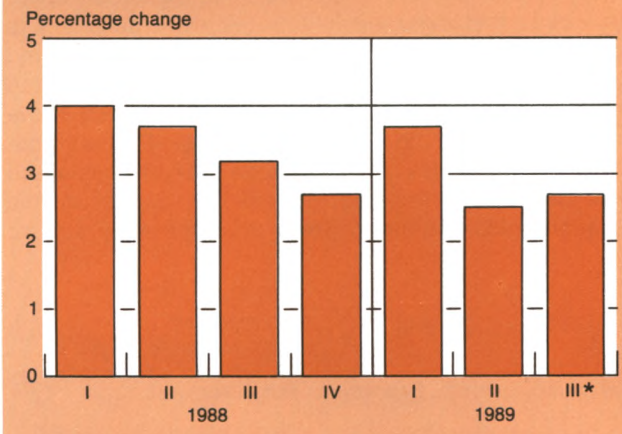
†Drawn as a part of the $2,000 million near-term credit facility established on September 21, 1989.

strength of certain capital markets—markets that had attracted investors either because of high yields or the prospect of sharp capital gains. Against this background, the sharp decline in U.S. equity prices on October 13 revived concerns that heavy foreign investment in the United States might be discouraged and that the Federal Reserve might ease even more quickly or aggressively than previously supposed.

The October 17 release of data showing a sharp deterioration in the U.S. trade position in August also served to reduce upward pressure on the dollar, as it highlighted the dangers of a further rise in the U.S. currency and reminded the market of the continuing need to correct the current account imbalances.

Chart 3

Real GNP growth figures for the third quarter of 1989 indicated a continued moderation in the pace of economic growth.



The chart shows the annualized change in U.S. real gross national product.

*The change in real gross national product for third-quarter 1989, originally reported at 2.5 percent on October 26, was later revised to 2.7 percent after the close of the reporting period.

Although the dollar's overall tone remained considerably softer late in the period, the dollar continued to receive some support from investment demand, particularly by Japanese entities, through the end of the three-month period. The dollar closed the quarterly period at DM 1.8415 against the mark and ¥ 142.85 against the yen.

With the dollar generally trading more narrowly in the latter part of the reporting period, markets tended to focus more on developments abroad, and the dollar's performance against individual currencies varied considerably. The dollar's decline against the mark was particularly pronounced, as the German currency benefited not only from the rise in German interest rates but more broadly from a growing sense of confidence in Germany's economic performance and prospects. Buoyant demand, high levels of capacity utilization, and reports of high wage demands from German labor unions seemed to indicate that interest rates would remain firm and economic growth strong. The process of reform just beginning to unfold in Eastern Europe and the inflow of East German immigrants were seen to promise longer term benefits for the West German economy, although there was considerable uncertainty about the short run.

Against the yen, conversely, the dollar showed a somewhat greater tendency to rise as actual and anticipated Japanese capital outflows kept the yen under downward pressure against most other major currencies. Japanese investor demand for dollars, which had helped support the dollar throughout 1989, reflected a high Japanese domestic savings rate, ample domestic liquidity, and a perception that domestic assets were relatively expensive. The United States was seen as having a good long-term investment environment and

Table 4

Drawings and Repayments by Foreign Central Banks under Special Swap Arrangements with the U.S. Treasury

In Millions of Dollars; Drawings (+) or Repayments (—)

Central Bank Drawing on the U.S. Treasury	Amount of Facility	Outstanding as of July 31, 1989	August	September	October	Outstanding as of October 31, 1989
Bank of Mexico†	425.0	0	—	+384.1	—	+384.1
Central Bank of Bolivia‡	100.0	100.0	—	—100.0	—	—
				+ 75.0	—	+ 75.0

Data are on a value-date basis.

†Represents the ESF portion of $2,000 million near-term credit facility.

‡The facility, which was established on July 11, 1989, was renewed on September 15, 1989.

as providing sufficient opportunities to absorb a large pool of Japanese savings.

Against sterling, the dollar traded relatively firmly throughout most of the three-month period as market participants became increasingly concerned about the outlook for the U.K. economy. Despite the fact that high British interest rates were raising worries about a recession, many analysts felt that the progress in curbing inflation and redressing external imbalances had been too slow. Market uncertainty regarding the future direction of U.K. economic policy was compounded by the perception that the U.K. authorities were divided on basic issues.

For the three months as a whole, the U.S. monetary authorities sold $5,871 million. The U.S. Treasury's Exchange Stabilization Fund (ESF) and the Federal Reserve System participated equally in these operations. To finance a portion of its share, the ESF "warehoused" $3,000 million equivalent of foreign currencies with the Federal Reserve, bringing the total of warehoused funds to $7,000 million equivalent.

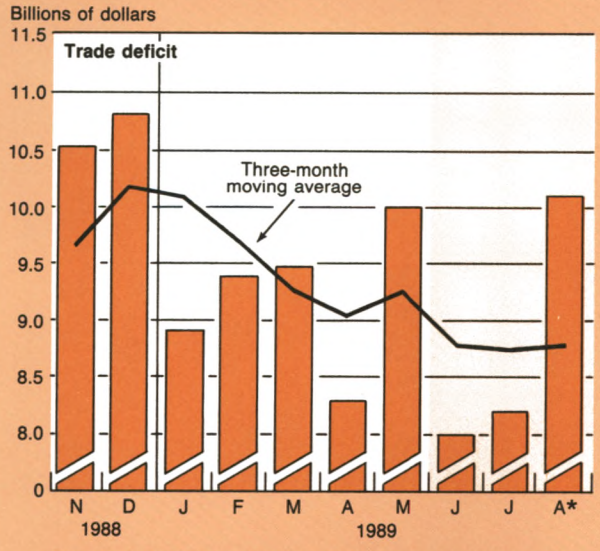
In other operations, on September 21, the Federal Reserve System and the ESF, together with the Bank for International Settlements (acting for certain central banks) and the Bank of Spain, agreed to provide a short-term credit facility totaling $2,000 million to the Bank of Mexico. The Federal Reserve's share in the facility was $825 million, of which the first $700 million was to be provided under the existing reciprocal swap line with Mexico and the remaining $125 million under a separate swap agreement. The ESF's share was $425 million, provided under a special swap arrangement. On September 25, Mexico drew $784.1 million from the Federal Reserve's portion and $384.1 million from the ESF's portion of the facility.

Also during the period, Bolivia repaid in full on September 15 its $100 million outstanding commitment on the short-term financing facility established with the ESF. Subsequently, the Treasury agreed to provide a new $100 million facility, and on September 22, Bolivia drew $75 million.

As of end October, cumulative bookkeeping or valuation gains on outstanding foreign currency balances were $1,366.5 million for the Federal Reserve and $870.3 million for the ESF (the second figure includes valuation gains on warehoused funds). These valuation

Chart 4

After narrowing in June and July, the U.S. trade deficit widened sharply in August.



The chart shows the monthly and three-month moving average U.S. merchandise trade deficit, seasonally adjusted and reported on a customs basis. The trade figures for June, July, and August were released on August 17, September 15, and October 17, respectively.

* The deficit for August, originally reported at $10.8 billion, was later revised to $10.1 billion.

Table 5

Net Profits (+) or Losses (—) on United States Treasury and Federal Reserve Foreign Exchange Operations

In Millions of Dollars

	Federal Reserve	U.S. Treasury Exchange Stabilization Fund
May 1, 1989 to July 31, 1989:		
Realized	0.0	+ 77.3
Valuation profits and losses on outstanding assets and liabilities, July 31, 1989	+1,045.5	+724.2†
August 1, 1989 to October 31, 1989:		
Realized	0.0	+119.6
Valuation profits and losses on outstanding assets and liabilities, October 31, 1989	+1,366.5	+870.3

Data are on a value-date basis.

†This figure takes into account warehoused funds as of July 31, 1989. Data as originally reported in Table 3 of the foreign exchange report in the summer 1989 issue of the *Quarterly Review* excluded valuation profit on warehoused funds. The amount of valuation profits including warehoused funds as of July 31, 1989, was $724.2 million.

gains represent the increase in the dollar value of outstanding currency assets valued at end-of-period exchange rates, compared with the rates prevailing at the time the foreign currencies were acquired.

The Federal Reserve and the ESF regularly invest their foreign currency balances in a variety of instruments that yield market-related rates of return and that have a high degree of quality and liquidity. A portion of the balances is invested in securities issued by foreign governments. As of end October, holdings of such securities by the Federal Reserve amounted to $6,746.5 million equivalent, and holdings by the Treasury amounted to the equivalent of $7,475.7 million.

Treasury and Federal Reserve Foreign Exchange Operations

May-July 1989

The dollar was under upward pressure in the first half of the period under review, continuing a tendency that had begun toward the end of the previous reporting period. The dollar was supported by strong investment demand until late May. In early June, after a brief period of relative market calm, the dollar came under renewed upward pressure amid large capital flows precipitated by escalating tensions in China. These two waves of upward pressure were met with heavy and sustained intervention.

After mid-June the dollar retreated and, on balance, ended the three-month period 1/4 percent lower on a trade-weighted basis as measured by the staff of the Federal Reserve Board of Governors. This reversal in the dollar's direction coincided with changes in the market's assessment of the U.S. economic outlook — in particular, emerging indications of a softening of economic growth and somewhat lessened price pressures led to market expectations of an easier U.S. monetary policy stance and lower short-term interest rates. Economic and political developments abroad also influenced movements in dollar exchange rates over the course of the three-month period.

Against individual currencies, the dollar's net movements varied considerably. The dollar closed the period approximately 3 percent higher against the Japanese yen and 1 1/4 percent higher against the British pound, while it was about 3/4 percent lower against the German mark and 1/4 percent lower against the Canadian dollar.

Intervention sales of dollars by the U.S. authorities between May and the end of July totaled $11,917 million, of which $7,237.5 million was sold against Japanese yen and $4,679.5 million against German marks — the largest U.S. intervention for any three-month reporting period. The bulk of these dollar sales occurred in May and early June when the U.S. monetary authorities were intervening vigorously, in keeping with the Group of Seven (G-7) policy commitments to foster exchange rate stability. At the same time, a White House statement expressed concern about the dollar's appreciation and indicated that, if sustained or extended, it could undermine international efforts to reduce global trade imbalances. For the balance of the period, intervention sales of dollars were modest as upward pressures on the dollar subsided.

The dollar firms in May

During May, as in earlier months of 1989, the dollar was buoyed by investment and commercial demand. At the opening of the three-month period, investors and commercial interests were gaining confidence about increasing the share of dollar assets in their overall portfolios and reducing the hedged proportion of their dollar assets. The relatively stable performance of the dollar during the previous year had led many to conclude that it was no longer necessary to maintain costly hedges to protect their dollar exposures against exchange rate loss. Actions to unwind these hedge positions continued to exert powerful upward pressure on the dollar, while adjustments in commercial leads and lags also contributed to the dollar's upward

A report presented by Sam Y. Cross, Executive Vice President in charge of the Foreign Group at the Federal Reserve Bank of New York and Manager of Foreign Operations for the System Open Market Account. Cathy Weintraub was primarily responsible for preparation of the report.

momentum. Meanwhile, investors continued to be attracted to the relatively high interest rates available on dollar-denominated instruments, even though interest rate differentials favoring the dollar had already narrowed considerably from levels of last fall and winter. Also, market sources reported the widespread view that the prospect for capital gains on long-term fixed income dollar securities seemed attractive given the growing perception that the U.S. economic expansion was slowing and that interest rates in the United States were likely to continue to decline.

With sentiment toward the dollar decidedly positive during early May, the dollar advanced smartly. To counter the upward pressure, the U.S. monetary authorities sold a total of $550 million against marks and $400 million against yen between May 1 and May 8, following through on operations begun at the end of April.

The upward pressures intensified after the May 12 report of a smaller than expected rise in U.S. producer prices during April buoyed both the U.S. bond and exchange markets. By May 15 the dollar broke through the significant technical and psychological level of DM 1.9250 against the mark. Attitudes toward the dollar became even more bullish following the May 17 release of preliminary U.S. trade data for March indicating a sharp improvement in U.S. external performance. On May 22, the dollar pierced the DM 2.00 level against the mark and ¥ 140 against the yen. By May 24, the dollar reached DM 2.0150 and ¥ 142.85, up roughly 7¼ percent against the mark and yen, respectively, from the end of April.

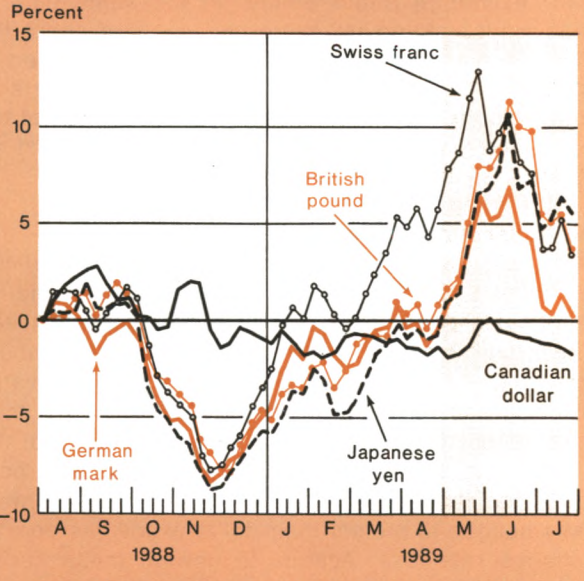
As the dollar moved to levels not seen since the February 1987 Louvre Accord, market participants increasingly came to question the will of the G-7 monetary authorities to halt the dollar's rise. Under these circumstances, official warnings about the negative consequences of dollar appreciation went unheeded. Instead, market participants gave more credence to statements by some U.S. and foreign officials that seemed to reinforce the idea that G-7 monetary authorities were prepared to tolerate the recent higher levels for the dollar. Upward pressure continued to mount as market participants bid for dollars amid fears that the currency would go even higher.

In this environment, the U.S. authorities intensified their intervention operations to resist the dollar's rise. They sold a total of $5,785 million between May 12 and May 31, reflecting sales of $3,000 million against marks and $2,785 million against yen. Of these amounts, a total of $2 billion was sold on May 18 and May 19 alone.

By late May, upward pressure on the dollar abated and a more cautious atmosphere returned to the for-

Chart 1

The dollar continued to rise early in the period, then declined after mid-June.



The chart shows the percent change of weekly average rates for the dollar from August 5, 1988. All figures are calculated from New York noon quotations.

Table 1

Federal Reserve Reciprocal Currency Arrangements

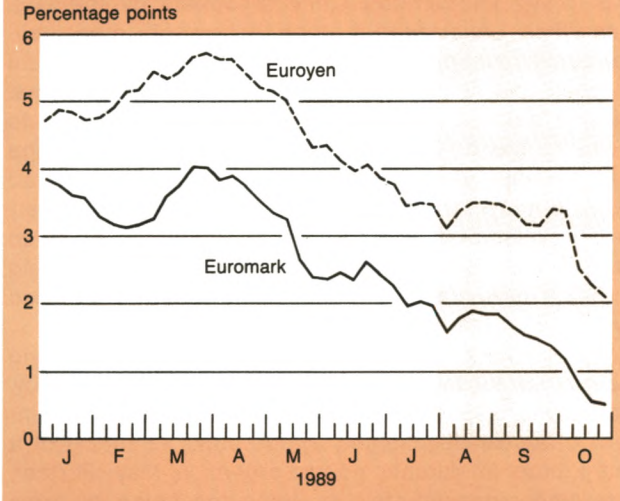
In Millions of Dollars

Institution	Amount of Facility April 28, 1989
Austrian National Bank	250
National Bank of Belgium	1,000
Bank of Canada	2,000
National Bank of Denmark	250
Bank of England	3,000
Bank of France	2,000
Deutsche Bundesbank	6,000
Bank of Italy	3,000
Bank of Japan	5,000
Bank of Mexico	700
Netherlands Bank	500
Bank of Norway	250
Bank of Sweden	300
Swiss National Bank	4,000
Bank for International Settlements:	
Dollars against Swiss francs	600
Dollars against other authorized European currencies	1,250
Total	30,100

eign exchange market. A confluence of factors contributed to the dollar's retracement at the end of the month: The cumulative effect of sizable and persistent central bank intervention operations came to weigh upon the currency and these operations were viewed as a strong signal that U.S. and foreign officials were seriously committed to fostering exchange rate stability and were determined to resist the dollar's rise. Official interest rate increases in Japan, Britain, Switzerland, and elsewhere in Europe late in the month, though prompted by domestic considerations, were also seen as contributing to a more stable exchange rate environment. Moreover, indications of a moderation in the pace of U.S. economic growth began to accumulate, reinforcing expectations that U.S. monetary policy might soon be eased and, therefore, that favorable interest rate differentials would continue to narrow.

Chart 2

Short-term interest rate differentials favoring the dollar continued to narrow, primarily because of interest rate increases abroad.



The chart shows weekly average interest rate differentials between three-month Eurodollar rates and three-month Euromarket deposit rates for marks and yen.

The financial markets took special note of the June 2 release of U.S. nonfarm payroll figures for May that showed slower employment growth than the markets had previously anticipated. These data were seen as increasing the likelihood that the Federal Reserve would soon ease its monetary stance. The dollar moved sharply lower, declining about 2 percent against the mark and 1¾ percent against the yen over the course of the day. The dollar closed on June 2 at DM 1.9420 and at ¥ 140.45, 3½ percent lower against the mark and 1¾ percent lower against the yen, respectively, from the levels reached on May 24, but 3¼ percent and 5½ percent higher, respectively, from the opening of the reporting period.

Renewed upward pressure in early to mid-June

On June 5, however, the dollar moved abruptly higher amid heightened market sensitivity to political instability. In particular, market attention shifted to news commentary on the Chinese government's efforts to suppress a student demonstration that reflected growing pressures for democratic reform in China. The escalating tensions in China led many market participants to anticipate capital outflows from East Asia for safe-haven considerations stemming from a reassessment of the prospects for economic and political stability in the region. A sharp decline in the Hong Kong stock index added to the uncertainty of the time. The dollar's rise was particularly pronounced against the yen as the Japanese currency remained vulnerable to selling pressures, in part because of the additional uncertainties associated with Japan's political situation. The dollar was bid up strongly, notwithstanding reduc-

Table 2

Drawings and Repayments by Foreign Central Banks under Special Swap Arrangements with the U.S. Treasury

In Millions of Dollars; Drawings (+) or Repayments (−)

Central Bank Drawing on the U.S. Treasury	Amount of Facility	Outstanding as of April 30, 1989	May	June	July	Outstanding as of July 31, 1989
Central Bank of Venezuela	450.0†	0	—	—	—	—
Central Bank of Bolivia	100.0‡	—	—	—	+100.0	+100.0

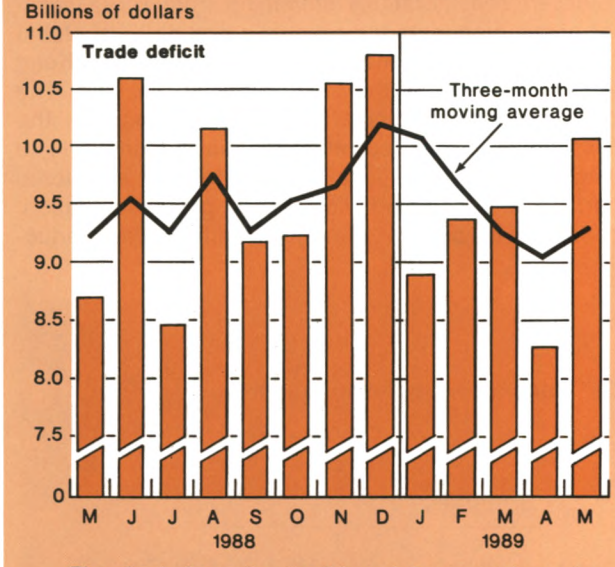
Data are on a value date-basis.
†The facility expired on May 15, 1989.
‡The facility was established on July 11, 1989.

tions in the prime lending rate at several U.S. banks on June 5 and an easing of the federal funds rate on the following day.

The bullish sentiment toward the dollar continued to build in advance of the June 15 release of U.S. trade data, which were expected to show a greatly reduced trade gap for April. The dollar moved higher immediately following the preliminary report of a narrowing of the trade deficit to $8.26 billion, from a revised $9.55 billion deficit in March. By midmorning in New York trading that day, the dollar was pushed up to DM 2.0470 against the mark and ¥ 151.90 against the yen, its highest levels in more than two years. At these levels, the dollar was 8¾ percent higher against the mark and 14¼ percent higher against the yen from end April and was trading roughly 31 percent and 26 percent higher, respectively, from the record lows reached on January 4, 1988.

Chart 3

The declining trend in the U.S. trade deficit since the beginning of the year provided support to the dollar throughout the three-month period. In mid-June market participants reacted quite favorably to the news of a sharp narrowing in the trade deficit reported for April.



The chart shows the monthly and three-month moving average U.S. merchandise trade deficit, seasonally adjusted and reported on a customs basis. The trade figures for March , April, and May were released on May 17, June 15, and July 18, respectively.

The dollar declined in late June

As impressive as the dollar's upsurge had been, market participants noted that the dollar failed to move above the key technical levels of DM 2.05 against the mark and ¥ 152 against the yen on June 15, and profit taking began to move the dollar lower. Selling momentum quickly built as market participants scrambled to unwind long-dollar positions. The dollar plunged in volatile trading, and many participants started to question whether this decline was the beginning of a sea change in the dollar's direction. The dollar closed on June 15 at DM 1.9820 against the mark and at ¥ 145.30 against the yen, down 3¼ percent and 4¼ percent, respectively, from the highs reached only hours earlier.

At the same time, the dollar was perceived as vulnerable to central bank intervention operations. Consistent and heavy intervention sales of dollars by the U.S. authorities, undertaken in coordination with other central banks, continued after the dollar moved down from its peak and helped convince market participants that the G-7 monetary authorities were firmly committed to resisting the dollar's rise and maintaining exchange rate stability. By mid-June, market participants had become more aware of the scale of intervention. Intervention sales of dollars by the U.S. authorities between June 6 and June 30 totaled $4,952 million, including $3,822.5 million sold against yen and $1,129.5 million sold against marks.

By late June, market attention had shifted back to the outlook for the U.S. economy and monetary policy. Indications of a softening in economic activity continued to appear, highlighted by the June 23 report of a sharp drop in durable goods orders in May. Further, emerging signs pointed to some lessening of price

Table 3

Net Profits (+) or Losses (−) on United States Treasury and Federal Reserve Foreign Exchange Operations

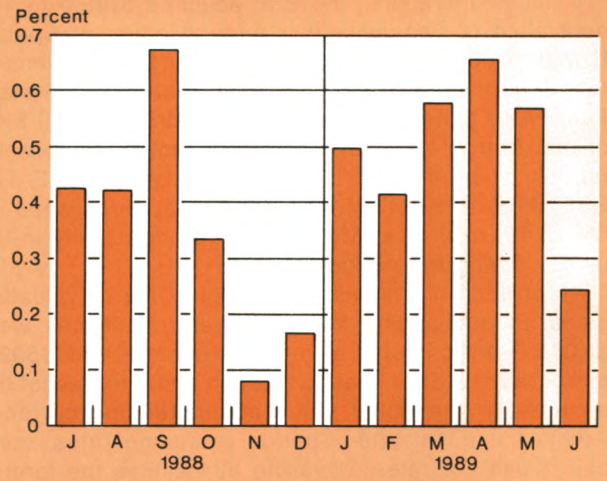
In Millions of Dollars

May 1, 1989 to July 31, 1989	Federal Reserve	United States Treasury Exchange Stabilization Fund
Realized	0	+ 77.3
Valuation profits and losses on outstanding assets and liabilities as of July 31, 1989	+1,045.5	+502.8

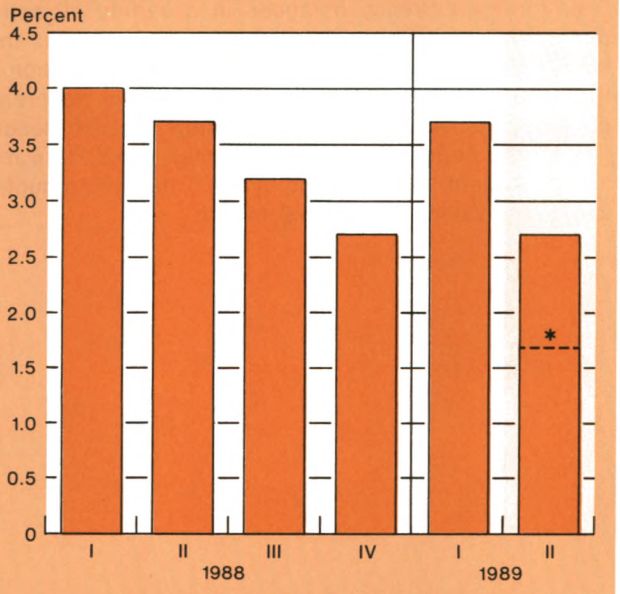
Data are on a value-date basis.

Chart 4

Data released during the period indicating some decline in the monthly rate of price increases . . .



and a slowdown in the pace of economic growth . . .



suggested that the balance of risks in the U.S. economy may have shifted away from greater inflation.

The top chart shows the month-to-month change in the U.S. consumer price index. The bottom chart shows the annualized change in U.S. real gross national product.

*The change in real gross national product for second quarter 1989, originally reported at +1.7 percent on July 27, was later revised to +2.7 percent after the close of the reporting period.

pressures and to an underlying trend in inflation that was less severe than markets had previously feared. Market participants noted the easing in the federal funds rate that had already taken place earlier in the month and expected further declines. The dollar moved lower as market participants anticipated that favorable interest rate differentials would narrow further, thereby diminishing the relative attractiveness of dollar-denominated instruments.

An undertone of caution set in as the perceptions of downside risk associated with holding dollar assets increased. By late June, portfolio adjustments to reduce hedging ratios appeared to taper off. Capital flows from East Asia also appeared to diminish. Furthermore, corporations reportedly refrained from buying dollars as the currency continued to decline. Under these circumstances, the dollar experienced only a brief bout of upward pressure in the aftermath of a June 25 upper house by-election in Japan.

The dollar subsequently resumed its decline as market attention again centered on the prospects for further narrowing of favorable interest rate differentials. Accumulating signs of slowing U.S. economic growth were seen by market participants as increasing the likelihood that the Federal Reserve would again ease its monetary stance. At the same time, economic statistics were suggesting buoyant growth and increasing inflationary pressures abroad. In these circumstances, the monetary authorities in Germany and several other continental countries announced increases of one-half

During the three-month period, the Federal Reserve warehoused foreign currencies for the Exchange Stabilization Fund (ESF) of the Treasury. Such warehousing operations have been carried out from time to time since 1963. In carrying out such an operation, the Federal Reserve buys the foreign currency in a spot purchase from the Treasury and simultaneously sells it back to the Treasury at the same exchange rate for a future maturity date. A key aspect of this type of transaction is that, since both the Federal Reserve and the Treasury agree to pay and to receive the same amount of foreign currency, as specified by the use of the same exchange rate, neither party incurs any foreign exchange rate risk by virtue of this transaction. The ESF may realize a profit or loss at the time the warehousing transaction is undertaken and remains exposed to valuation gains or losses on the foreign currencies being warehoused (see Table 3). A warehousing transaction is reversed when the Treasury repays dollars and the Federal Reserve repays the foreign currency it has acquired from the Treasury.

to one full percentage point in their official interest rates on June 29. On July 6, the dollar traded as low as ¥ 137.85 against the yen, down 5¾ percent from the June 9 close.

During the second week in July, however, sentiment toward the dollar turned temporarily more positive. A series of economic reports released on July 14 was viewed in the exchange market as favoring the dollar. These reports confirmed economic activity was settling into a sustainable rate, while price data suggested the Federal Reserve might not have as much leeway to lower interest rates as previously supposed. But then, in his congressional testimony on July 20, Chairman Greenspan stated that the balance of risks in the U.S. economy had shifted away from greater inflation and that monetary policy had been adjusted accordingly. The testimony temporarily revived expectations that U.S. interest rates would continue to move lower, and dollar rates subsequently drifted irregularly lower through the balance of the month.

During July, at times when there appeared to be upward pressure building toward the dollar, the U.S. authorities entered the market to contain the pressure. These operations, however, were modest and intermittent. In fact, the Desk operated on only three days during July, selling a total of $230 million dollars against yen between July 11 and July 21. On July 31, the dollar closed the three-month reporting period at DM 1.8648 against the mark and at ¥ 136.90 against the yen.

The total intervention sales of $11,917 million during the three-month reporting period were shared equally by the U.S. Treasury, through the Exchange Stabilization Fund (ESF), and the Federal Reserve System. To finance a portion of these operations, the ESF "warehoused" $4,000 million equivalent of foreign currencies with the Federal Reserve (see Box).

In other operations, the ESF acquired $198.0 million equivalent of Japanese yen through sales of Special Drawing Rights and repayments under the Supplementary Financing Facility of the International Monetary Fund. Also during the period, Bolivia drew the full $100 million from a short-term financing facility established on July 11 by the U.S. Treasury through the ESF. The ESF short-term facility with Venezuela, established on March 10, expired in May. There was no activity in the facility during the period.

As of end July, cumulative bookkeeping or valuation gains on outstanding foreign currency balances were $1,045.5 million for the Federal Reserve and $502.8 million for the ESF. These valuation gains represent the increase in the dollar value of outstanding currency assets valued at end-of-period exchange rates, compared with the rates prevailing at the time the foreign currencies were acquired.

The Federal Reserve and the ESF regularly invest their foreign currency balances in a variety of instruments that yield market-related rates of return and that have a high degree of quality and liquidity. A portion of the balances is invested in securities issued by foreign governments. As of end July, holdings of such securities by the Federal Reserve amounted to $5,113.6 million equivalent, and holdings by the Treasury amounted to the equivalent of $5,856.9 million.

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