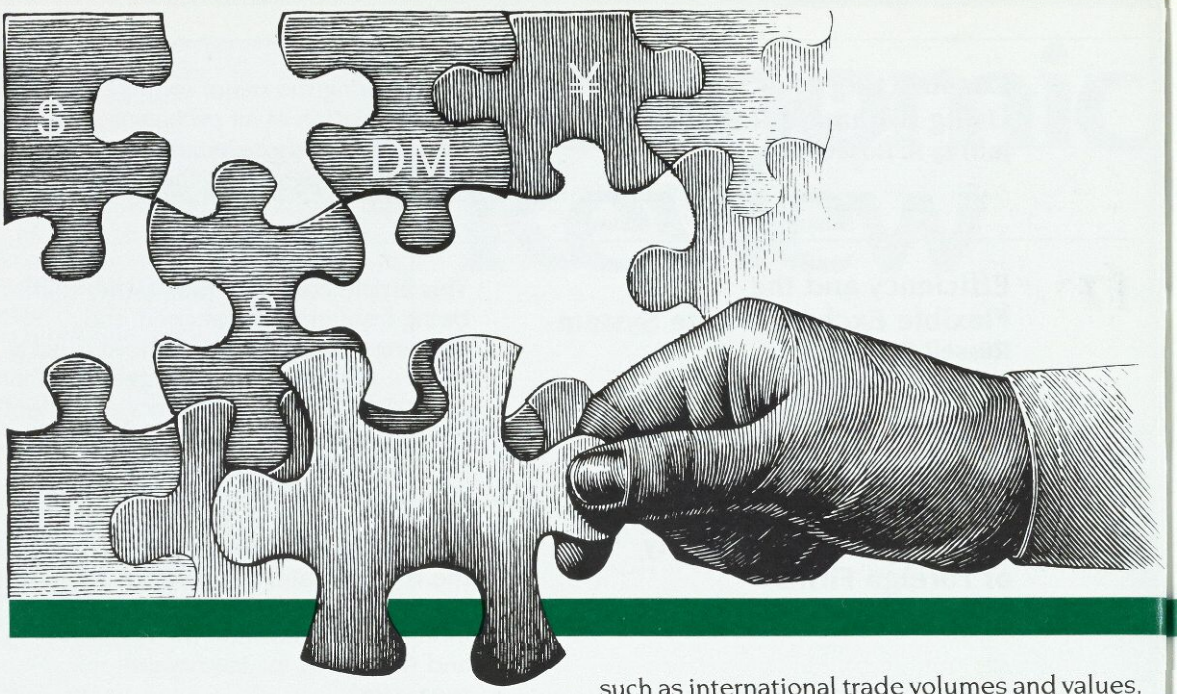

Exchange rate indexes have been crucial indicators of currency values since the advent of floating exchange rates in the early seventies. The slow response of the U.S. trade balance to recent declines in the dollar's value has stimulated still more interest in how exchange rate indexes are constructed and what they tell us. In the past year alone, a number of new dollar indexes, including the three constructed at the Federal Reserve Banks of Atlanta, Dallas, and Chicago, have emerged alongside the more familiar Federal Reserve Board and Morgan Guaranty Trust indexes. Each of these reflects a different way of dealing with the issues that arise in exchange rate index construction, and each therefore provides a slightly different picture of the dollar's value against other currencies. (Their features are outlined in Box 1.) Examining the major issues should help clarify differences in exchange rate indexes and help index users determine which one best suits their purposes.

Exchange rate indexes summarize information contained in the many bilateral exchange rates that apply to a particular currency in order to gauge the average value of that currency against others.[1] They are used to analyze or forecast the influence of that currency's international value on important economic variables, such as international trade volumes and values, asset demands, and prices.[2]

We need exchange rate indexes because the value of a currency cannot be counted upon to move by the same amount or even in the same direction against all other currencies. If, for instance, the value of the dollar during the last decade is measured by its movement against the British pound, the Japanese yen, or the Korean won, a variety of views emerges on the dollar's changing fortunes (Chart 1).

An exchange rate index is a summary statistic that indicates a currency's average value in terms of other currencies. Designing such a summary may be a complex process. Indeed, the value of any single currency can be expressed in terms of more than 200 rates of exchange against other currencies. This number includes the multiple exchange rates maintained by some countries to account for separate categories of economic transactions. The number and variety of exchange rates defy comprehension, not to mention inclusion in economic models.

Compressing the disparate movements of many currencies into a single index involves several important decisions. Since all currencies are not of equal importance in their influence on trade or capital flows, a weighting scheme and a representative time period from which weights are to be measured must be selected. Deciding upon the currencies to be covered requires balancing breadth of coverage both against distortions caused by inflation and

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Constructing and Using Exchange Rate Indexes

Jeffrey A. Rosensweig

Exchange rate indexes are essential tools for determining the average value of a currency as compared with other currencies. Because none of the available indexes is free of drawbacks, index users must choose the constellation of features most closely matched to their particular needs.

against timeliness. The index builder must also choose between an index computed in market exchange rates and one in which exchange rate movements are adjusted for international differences in inflation rates. Recently, the question of building subindexes that point out regionally distinct movements in the exchange rates included in an overall index has been broached.[3]

Index designers typically decide these issues on the basis of the expected use or uses of their index. Their decisions have important implications for what their indexes measure.[4] Users should be aware of the major types of decisions that go into an exchange rate index. In order to provide a guide to these issues and implications, the remainder of this article discusses the issues which were outlined above and the implications of various solutions to each.

Choosing a Weighting Scheme

The Basic Transactions. The weights or emphases assigned to various currencies in an exchange rate index should depend on its intended application. Currency indexes are used predominantly to summarize the effects of various exchange rate changes on a nation's trade balance, trade flows, or export and import price levels. Indexes designed to answer trade-related questions (the focus of the discussion that follows) are normally "trade-weighted." A recent alternative approach to weighting exchange rates recognizes the importance of capital flows in the overall balance of payments. See Box 2 and Ott (1987).

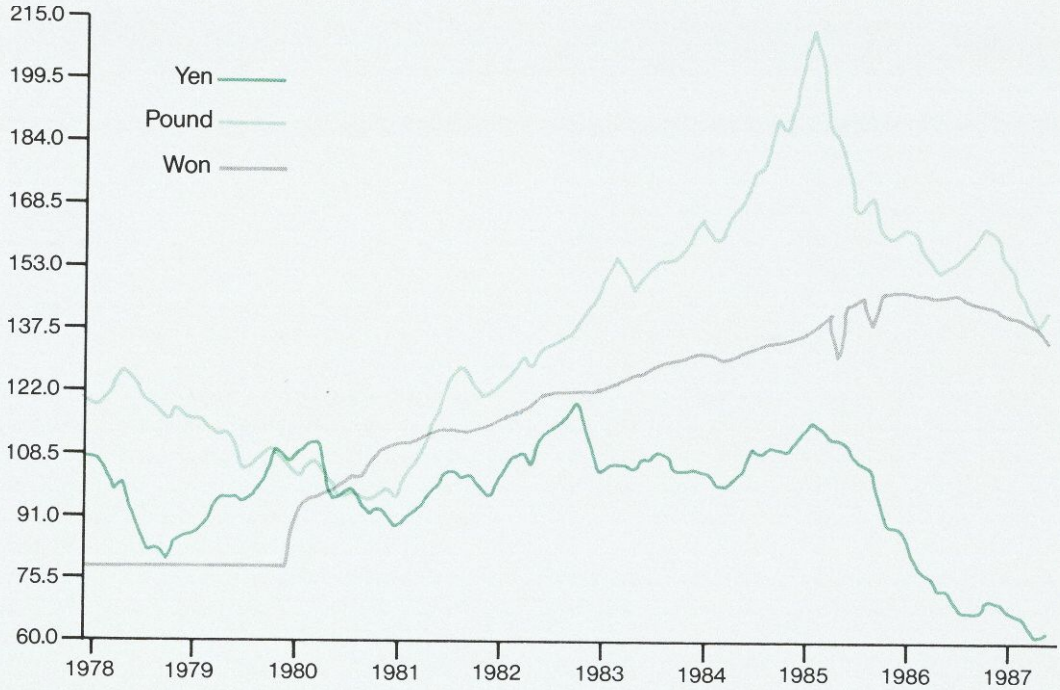
In constructing an index to answer questions about trade flows and prices, one key decision is whether to use weights based only on exports, only on imports, or on exports plus imports. Here again, construction should follow purpose. To predict import volumes or prices only, weights derived solely from import shares are most useful. Likewise, export shares alone are the best basis for export or export price projections.

To evaluate overall trade balance and competitiveness, weights derived from shares of total exports plus imports are generally more appropriate, especially when the weights are based on a recent year or are frequently updated. For example, assume that the local currency depreciates sharply against another country's currency. After some time, if flows are relatively responsive to the price changes that follow this depreciation, the local nation's imports will plunge and exports will surge in trade with the other country. Updated import-only weights would place only a small weight on the significant movement of the other nation's currency, because depreciation of the local currency would have caused imports to shrink. Conversely, updated export-only weights would overweight the exchange rate change because the depreciation would have boosted exports.

Box 1.
Features of Various Dollar Indexes

Index Originator	Number of Countries	Trade-Weight Period	Multilateral, Bilateral, or Other Weighting Scheme	Relative Price Adjustment (nominal or real)	Inclusion of High-Inflation Nations
Federal Reserve Board	10	1972-1976	Multilateral	Nominal	No
Federal Reserve Board	10	1972-1976	Multilateral	Real, CPI-based	No
Morgan Guaranty	15	1980	Bilateral (trade in manufactures)	Nominal	No
Morgan Guaranty	15	1980	Bilateral (trade in manufactures)	Real wholesale prices of manufactured goods	No
Morgan Guaranty	40	1980	Bilateral: modified	Real wholesale prices of manufactured goods	Yes
International Monetary Fund	17	1972 (years through 1974); 1977 (years 1975 on)	Multilateral: structural economic model	Nominal	No
Atlanta Fed	18	1984	Bilateral	Nominal	No
Dallas Fed	131	Moving average, three-year	Bilateral	Nominal	Yes
Dallas Fed	101	Moving average, three-year	Bilateral	Real, CPI-based	Yes
Chicago Fed	16	Moving average, 12 quarters	Bilateral	Nominal	No
Chicago Fed	16	Moving average, 12 quarters	Bilateral	Real, CPI-based	No

Chart 1.
Movement of the Dollar Against Three Different Currencies
(1978-June 1987, 1980 = 100)



During the last decade, the dollar's value has taken divergent turns against different currencies, as this comparison of its movement in relation to the Japanese yen, the British pound, and the Korean won demonstrates.

Source: Calculated by the Federal Reserve Bank of Atlanta with data from the Federal Reserve Bank of New York.

Fortunately, as long as there is significant two-way trade between the nations, the effects of sharp changes in the exchange rate on weights will be minimized if weights are based on exports plus imports. In this case, even if one country's currency moves out of line, total trade with that country should not change dramatically. Therefore, using weights based on exports plus imports should mitigate the systematic bias that can arise with updated weights.[5]

More specialized uses may dictate using special weights. For example, an index designed to capture the dollar's effect on U.S. textile trade should employ weights derived from exports plus imports of textile products.

Alternative Forms of Trade Weights. Despite their narrowed focus, trade-weighted indexes still require crucial choices about the most apt weighting scheme. The primary issue is whether to use multilateral, bilateral, or even more complex trade weights.

Multilateral trade weights are based on each country's share of the total worldwide trade conducted by all the countries in the index. Using a multilateral approach, the weight for each country "k" is calculated as:

$$W_k = \frac{\text{worldwide exports + imports of country k}}{\text{sum of the worldwide exports + imports of all the included countries.}}$$

Bilateral weights are derived from direct trade between the local nation and other countries. If an index is being constructed for the United States, for example, the weight of country k is determined by its trade with the United States as a share of total trade between the United States and the various countries included in the index:

$$W_k = \frac{\text{U. S. exports to + imports from country k}}{\text{sum of the U. S. exports to + imports from all the included countries.}}$$

Box 2

Exchange rate indexes can also be constructed to ascertain the relative international price of all the assets denominated in a particular currency. This "modern asset market approach" holds that the worldwide demand for dollar-denominated assets relative to assets denominated in other currencies, rather than trade flows, determines the dollar's exchange rate. The relative demand for the global supply of dollar-denominated assets arises from the desires of investors worldwide to hold particular shares of their portfolios in assets denominated in various currencies. Since from this perspective monetary policy changes induce portfolio shifts (capital flows) that alter floating exchange rates, asset-based indexes are useful in evaluating current monetary policy stances. Indexes can also measure the impact of changes in relative interest rates or other asset market variables on the average foreign exchange value of the home currency. In either of these cases, weighting exchange rates in proportion to capital flows between countries may be appropriate.[6]

Each alternative has a major advantage, and there is no *a priori* way to choose between them on conceptual grounds. Multilateral weights, by incorporating worldwide trade, attempt to capture competition between two nations in "third countries" as well as with the products of various third countries in both of their domestic markets. For example, a change in the U.S. dollar-Dutch guilder rate affects relative prices of American, Dutch, and other countries' goods in Belgium as well as in the United States and the Netherlands. Multilateral weights' inclusion of total rather than one-on-one trade would seem to take better account of these "third-country" effects. The disadvantage of multilateral weights is that they may give too much weight to nations that trade extensively with each other. Because the Netherlands and Belgium trade heavily with each other, the Benelux nations receive a greater weight in a multilateral U.S. dollar index than does Canada, the largest U.S. trade partner. Conversely, bilateral weights emphasize the direct trading patterns of the nation.[7]

The choice between multilateral and bilateral weights may hinge on how well shares of total worldwide trade happen to reflect a particular nation's competitors. If the reflection is adequate, multilateral weights may be preferable. In the case of the United States, however, multilateral weights may place too much emphasis on Europe, where nations engage in substantial trade among themselves, and not enough on Canada.[8]

As Charts 2 and 3 show, the selection of a formula can affect weights and index performance significantly. Chart 2 depicts the weights that multilateral and bilateral versions of the Atlanta Fed index assign to various world regions. Chart 3 portrays the recent patterns traced by the multilateral and bilateral versions of the Atlanta Fed index. The main practical difference for the dollar is that the large weight on Canada in the bilateral dollar index significantly reduces the magnitude of most changes, because in general the U.S. dollar fluctuates by more against the European currencies and the yen than it does against the Canadian dollar. Particularly, the dollar's decline since February 1985 is much less pronounced in the bilateral index owing to the dollar's relatively minor depreciation against the Canadian dollar.

In the case of many countries, constructing a multilateral as well as a bilateral index, and monitoring both, ultimately could prove informative. Multilateral weights are useful when third-country effects seem crucial, as in analyses of the likely competition when developing potential new export markets. Conversely, bilateral weights may be more useful in analyzing the short-run impact of exchange rate changes on a nation's import prices.

Finally, there are also more complex approaches for deriving trade weights, including "modified" bilateral weights or use of a structural economic model to generate weights. These approaches, however, often rely on ad hoc assumptions—regarding the elasticities of various trade flows employed in structural models, for instance. They also usually require substantial resources to implement them. Therefore, despite their theoretical appeal, more complex approaches are only mentioned here, and interested readers are referred to primary sources.[9]

Selecting a Base Period. Another major weighting issue in constructing an exchange rate index is choice of a base period for the trade flows on which weights are based. Should an index employ fixed weights or ones that are continually updated to reflect current trade patterns? If fixed weights, should they be from one recent year or an average over a few years? If one year, which one?

Indexes recently presented by the Federal Reserve Banks of Chicago and Dallas use continually updated weights in an attempt to portray current trade patterns. This procedure has a major disadvantage. The practical effect of employing changing weights is to confound changes due to exchange rate shifts with changes

due to shifting weights in the index. If the weights assigned to various currencies are revised because of shifts in trade shares, for example, then the value of an aggregate index can change even if no exchange rates change. When the value of one of these indexes changes, a question always exists whether the movement reflects alterations in exchange rates or merely shifting trade weights.

Weights such as those used in the Federal Reserve Board, Morgan Guaranty, and Atlanta Fed indexes are derived from a fixed base period and avoid these problems of interpretation. However, if trade patterns shift, fixed weights may become misleading over longer periods of time. To offset this possibility, the base period for the fixed weights can be updated periodically, and the index, including historical data, can be revised using the new weights. This should make interpretation problems more tractable by eliminating occasions when weights, as well as exchange rates, change.

When using fixed weights from one period, which period should be selected? If trade shares have changed significantly, a fairly current period is best, but it should not be too current since very recent data are likely to be substantially revised. Further, a single recent year should be used only if it appears representative of trade structure over longer periods; otherwise, use of a simple average of perhaps three recent years is preferable.[10]

How Exchange Rates Are Averaged. The final weighting issue concerns the technique used to aggregate or average the various weighted exchange rates. Of the two options available, analytical arguments strongly favor the geometric over the arithmetic averaging technique. All the recently developed indexes use the geometric approach.

An arithmetic average merely multiplies each currency's weight in the index by its percentage change from an arbitrary starting point and sums up these weighted changes. The major drawback of this approach is that it does not treat increases and decreases symmetrically and, further, it could result in an upward bias.[11] For example, if an exchange rate moves from 2 to 4, then back to 2, an arithmetic approach reports a 100 percent increase followed by a 50 percent decrease—even though the actual decrease fully reversed the earlier increase.

A desirable method of averaging weighted exchange rates emphasizes proportional, not absolute, changes. Geometric averaging techniques satisfy this requirement. The geometric technique, unlike the arithmetic, yields the same percentage change in an index even if the base period for the index is changed, and even if the exchange rates in the index are defined in reciprocal terms.

For all these reasons, geometric averaging is favored. This technique uses either of these two equivalent formulas for the index at time t:

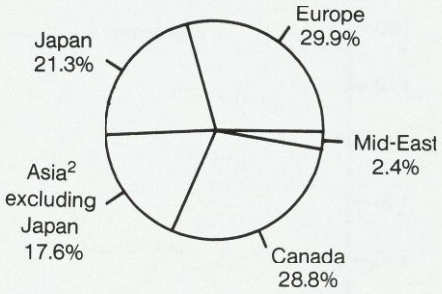
$$\text{Index}_t = 100 \prod_i R_{it}^{w_i}$$

or equivalently,

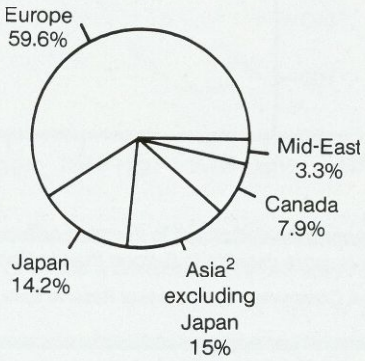
$$= 100 \exp \sum_i w_i \log_e R_{it},$$

Chart 2.
Comparative Weighting in Multilateral and Bilateral Indexes

Bilateral Atlanta Fed Index[1]



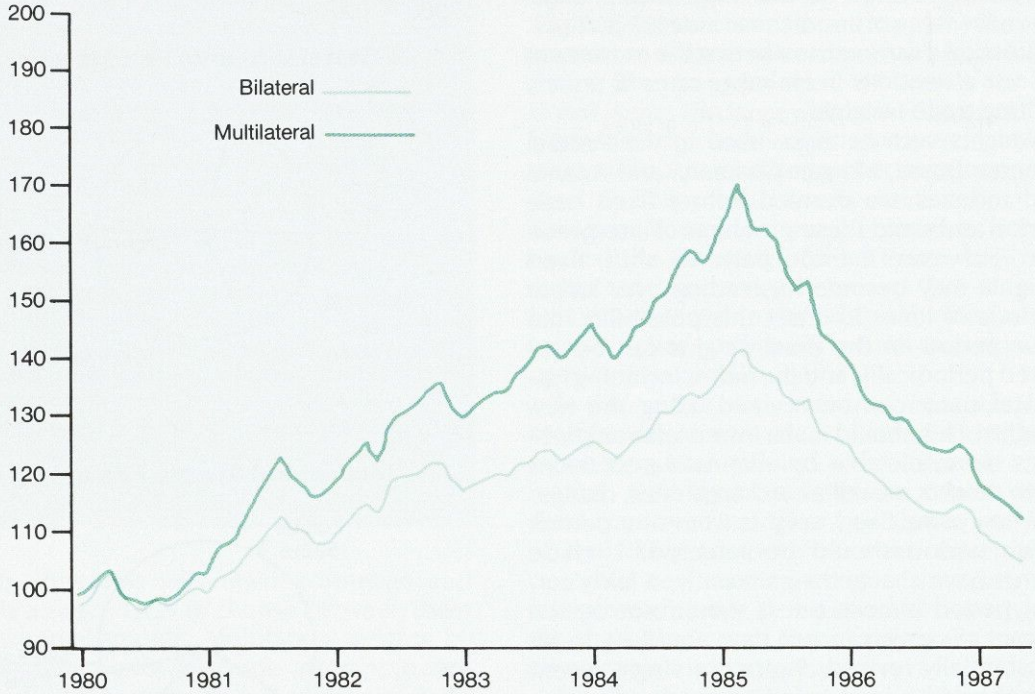
Multilateral Atlanta Fed Index[1]



Compared with the bilateral index, the multilateral Atlanta Fed dollar index emphasizes Europe and places relatively less weight on Canada and Asia.

[1] Weights derived from International Monetary Fund and Central Bank of China (Taiwan) data.
[2] Includes Australia.

Chart 3.
Comparing Two Versions of the Atlanta Fed Dollar Index
(1980-May 1987, 1980 = 100)



The emphasis on Canada in the bilateral index tends to reduce the magnitude of changes in the dollar's value, because the dollar is more variable in Europe than in Canada.

Source: Constructed by the Federal Reserve Bank of Atlanta with data from the Board of Governors and the International Monetary Fund.

where w_i is the weight assigned the currency of country i, R_{it} is the value at time t of the home currency in terms of currency i divided by its value in the base period, $\prod_i$ is the product over all i, $\sum_i$ the sum over all i, $\log_e$ the natural log, and exp means "take the anti-$\log_e$."

Country Coverage

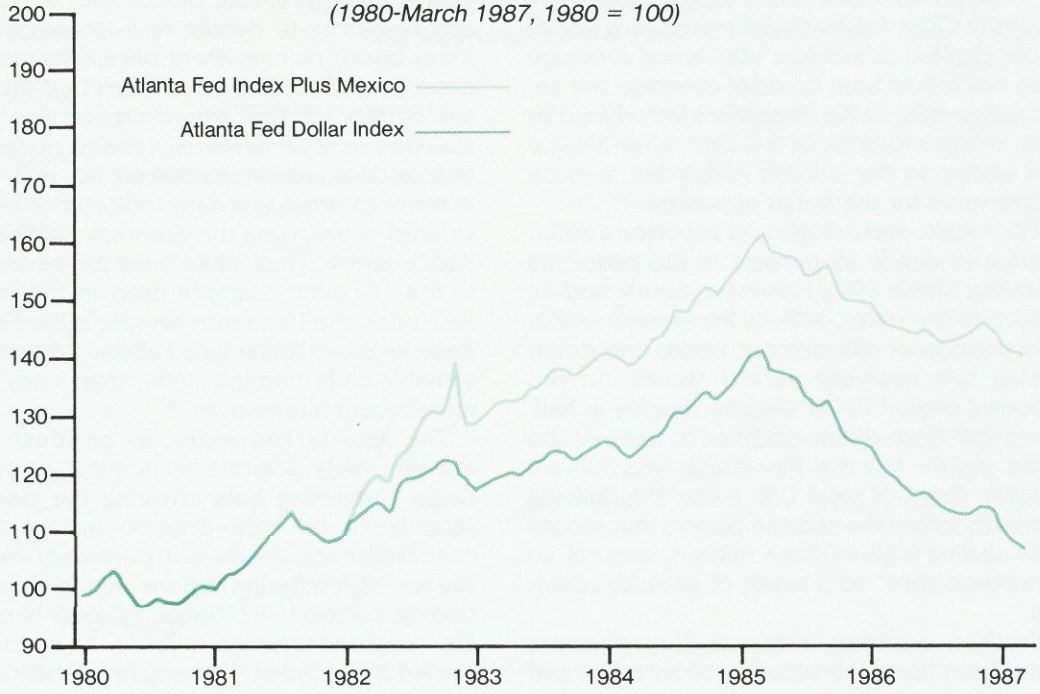
Choosing which countries to cover in an exchange rate index requires one to confront inflation and its impact on exchange rates and trade. Exchange rate movements reflecting only inflation would be likely to have little impact on trade flows because relative prices of trading nations' goods would not change. Movements that do induce changes in relative prices, on the other hand, would be expected to change trade flows. Clearly, an index that purports to aid the analysis of trade flows should attempt to capture changes in relative prices and not merely track different inflation rates.

There are essentially two ways of handling differing rates of inflation. One is to deflate exchange rate changes by relative movements in price levels, producing a real exchange rate index. This is the subject of the next section. The other way is to confine an index of market rates to a set of countries with a weighted average inflation rate similar to the home country's.

The selection of a proper sample of countries to include is probably the most critical issue in nominal index design. As with weighting schemes, the purpose of the index should guide the choice of the countries that are included. Certainly, a multilateral index should cover major worldwide trading nations, and a bilateral index, a country's major trading partners.

Beyond this consideration are several important issues that arise in deciding which countries to include in an index. A sufficient number of countries must be represented to mirror

Chart 4.
A Comparison of the Atlanta Fed Dollar Index and the Atlanta Fed Index Plus Mexico
(1980-March 1987, 1980 = 100)



Adding even one hyperinflationary currency to a dollar index can create a misleading portrayal of the dollar's movement.

Source: Constructed by the Federal Reserve Bank of Atlanta with data from the Board of Governors and the International Monetary Fund.

trade accurately. Using a very large number, however, introduces an impractical degree of complexity. While it is important to choose countries that reflect the local nation's trade patterns, distortions produced by high inflation or multiple exchange rates must also be heeded in deciding which countries to include. Treatment of these aspects of country coverage can have a marked influence on how a particular currency's value and movement appear in the index.

Most dollar indexes contain between 10 and 20 nations typically accounting for between 50 and 80 percent of both U.S. and world trade, though some new ones (Cox, 1986) try for virtually complete coverage. Including only 10 to 15 advanced nations, as some traditional indexes do, is perhaps too narrow for many purposes, especially considering the increasing trade role of industrializing Asian nations. While accounting for all major U.S. trading partners in a bilateral dollar index might seem optimal, such inclusiveness can lead to significant distortion of an index's portrayal of relative price changes in two ways: some nations have very high inflation relative to the United States and some developing nations resort to multiple exchange rate regimes. In this latter case it is extremely difficult to justify using only one of the rates or to weight a weighted average of the multiple rates properly.[12]

In constructing the Atlanta Fed index, for example, 18 nations were chosen. The goal was to broaden the index from some of the traditional models so that it would account for increasing U.S. trade with industrializing Asian nations, but to avoid including currencies that would produce distortions. Mexico, Brazil, and Venezuela were excluded from the Atlanta Fed index even though they are important trading partners, because they lead to one or both of the two forms of distortion.

Certain new indexes with very broad coverage, including high-inflation nations, seem to

have found that, if previously omitted trading partners are added, the dollar has barely declined since early 1985. Chart 4 illustrates how adding even one high-inflation nation to a nominal dollar index leads to distortion. The results in Chart 4 show that the surprising lack of dollar decline in indexes with broad coverage does not follow from broader coverage per se, but rather reflects the distortions introduced by high-inflation nations. In this case, when Mexico was added to the Atlanta Fed index, a much higher value for the dollar appeared.[13]

The Atlanta Fed dollar index reported a dollar decline of nearly 25 percent in the two years following March 1985. However, merely adding Mexico to the index, with its immense nominal depreciation of 432 percent versus the dollar during this two-year period, would cut the reported overall dollar decline roughly in half. Given the large dollar declines in most of the world and the fact that Mexico has less than a 6 percent share of total U.S. trade, this halving seems to reflect the skewed picture that results from adding high-inflation nations, and not an "improved view" as a result of broader coverage.

Further, omitting minor trading partners should not harm the accuracy of an index and may enhance it. For example, the Atlanta Fed index happens to exclude all nations that account for less than 1/120 of U.S. trade. Excluding any one of these nations could not affect a geometrically averaged index significantly (say by more than one percent) unless the value of that nation's currency moved by a margin of nearly 250 percent more or less than the weighted average rates of the nations included. True underlying relative price changes of this magnitude are exceedingly rare because they are offset by international geographic (spatial) arbitrage and inflationary attempts by labor to restore their real wages after huge nominal devaluations. Hence, if encompassing such a small partner really affects an index, it is probably by introducing "distortion," such as price level measurement error in a real index or the inclusion of a hyperinflating currency in a nominal index.

Nominal Versus Real Indexes

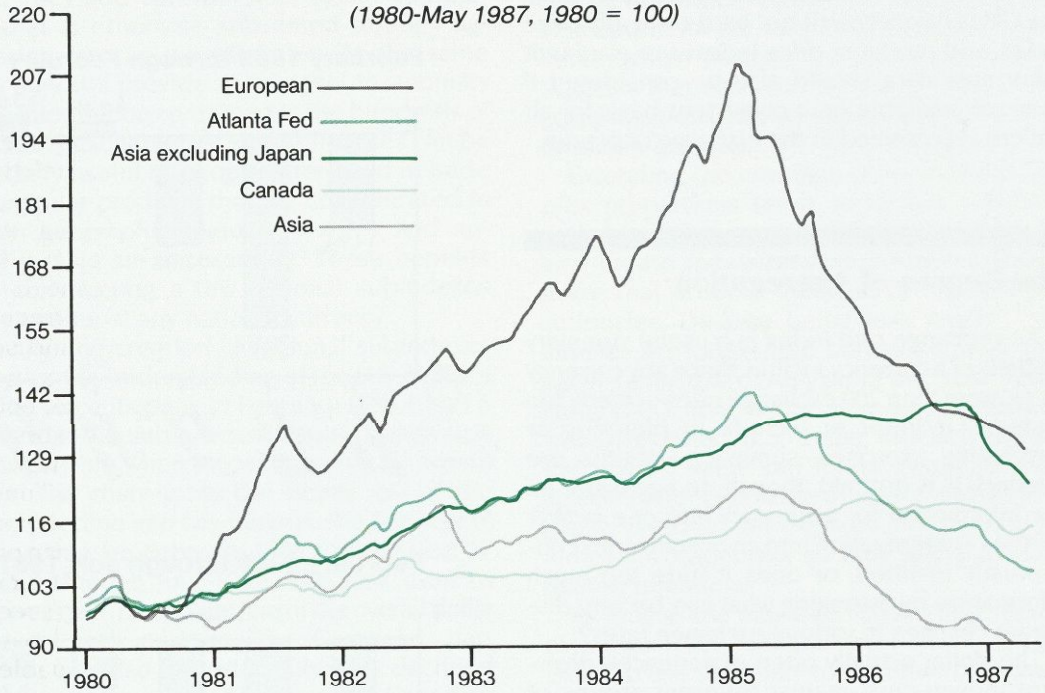
Another way of addressing the misrepresentation caused by high inflation is to compute a real rather than a nominal index. In hyperinflationary cases, however, the price levels used for adjustment frequently embody huge measurement errors. Real indexes also sacrifice timeliness by relying on price level data reported with a significant lag. Unless one has the time and resources to devote to a large-scale real index based on consistent price data for every nation included, a nominal index that excludes any currencies that would create significant measurement problems is probably preferable. Indexes that are run in nominal, not real, terms in order to serve as a daily indicator to be considered in analyzing the economy may be justifiably narrow. Thus, while there are advantages to the 18-country sample used in the Atlanta Fed index, the 10-country sample in the Federal Reserve Board dollar index allows a much more sensible daily (nominal) index than many of the more recent alternatives.[14]

The Atlanta Fed index, as an illustration, appears fairly accurate in nominal terms because converting data covering the past few years into a real index does not make a significant difference. Because it purposely omitted the few high-inflation nations among major U.S. trading partners, U.S. inflation roughly equals the weighted average inflation of nations included in the index.[15] Among the 18 nations are a few with slightly higher inflation (e.g., Spain, Canada, Australia) than the United States, and a few with slightly less (e.g., Japan, Belgium, Singapore).

The advantages of constructing a nominal index, if it adequately proxies an underlying real one, are numerous. First, the index is timely, since it can be reported with almost no lag instead of the delay of several months needed for the price data used in real indexes. Timely availability is critical if the index is to be useful as an indicator for monetary policy, for example. Forecasting and planning are also enhanced by eliminating the several-months lag. Another major benefit is the increased frequency of data available in a nominal index. A nominal index can be reported daily, or almost instantly, as market exchange rates are reported, whereas a real index is limited by the frequency of price level data. Real index data are available monthly at best, and perhaps only quarterly, or annually, depending on the frequency of reliable price reports for each nation covered. A nominal index thus yields more observations. This is a useful feature for econometric applications such as forecasting and for measuring changes from specific dates.

Nominal indexes also minimize resource costs. A real index with broad coverage de-

Chart 5.
Atlanta Fed Dollar Index and Subindexes for Major European and Asian Economies and Canada*
(1980-May 1987, 1980 = 100)



The dollar's value moves divergently against currencies in different world regions.

*Based on bilateral weights derived from U.S. trade in 1984.

Source: Constructed by the Federal Reserve Bank of Atlanta with data from the Board of Governors and the International Monetary Fund.

mands that a significant amount of time be spent gathering price data and analyzing its consistency across countries. This points to the final benefit of a sample of nations that excludes those with high inflation, such as a proper sample for a nominal index—the likely absence of significant measurement error in the price series used to construct real indexes. Measurement errors occur from using price series that are not strictly comparable and using series that contain large errors. The last problem is potentially most serious in high-inflation developing countries, especially those with few resources to devote to the collection of economic statistics.

Real Indexes: Which Price Level to Use? There is no consensus about which price level measure should be used in real exchange rate indexes, because no available price index is ideal. Almost all the recently developed real dollar indexes use the Consumer Price index (CPI), often without giving a justification, perhaps because CPI data are readily available on a roughly consistent basis across countries. However, if the goal of a real index is to measure the relative price of a nation's tradable goods against those of other nations, the CPI may be a flawed measure. It encompasses many nontraded goods and services, and prices of traded and nontraded goods may not follow the same path.

Wholesale (producer) price indexes are not as heavily influenced by the prices of nontraded products, and thus may be more representative. The various Morgan Guaranty real indexes use wholesale prices of manufactured products. These could be preferable to the CPI, but omission of nonmanufactured tradable products (various commodities and tradable services, for example) and the varying composition of these price indexes across countries are potential pitfalls.

Although a nominal index is often preferable, it is not ideal in every situation. If a nominal index cannot proxy well for a real index because of significant inflation differences, then a relative price level adjustment is necessary. Again, the CPI is a convenient but hard-to-justify price index, and producer price indexes or even unit labor cost data should also be considered if they are available on a consistent basis for all nations represented in the exchange rate index.

The Degree of Aggregation

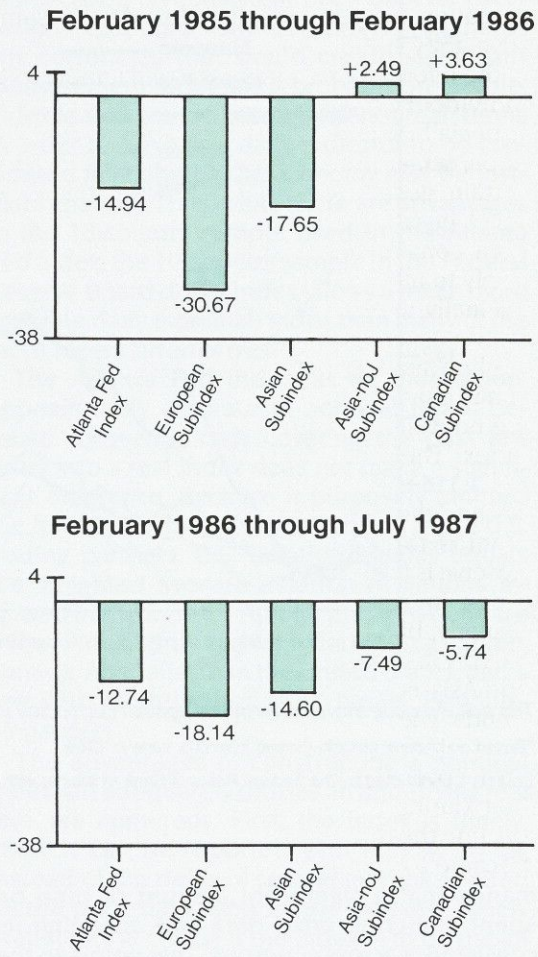
An exchange rate index is a useful summary statistic of a currency's value. Since any currency faces more than 200 exchange rates—clearly too many to monitor or include in planning or forecasting exercises—summary statistics are needed. Is it optimal, though, to aggregate all the information for a currency into one index? Further, is aggregation into an overall index conceptually justified, or does it hide too much information by averaging what can be very disparate changes in various exchange rates?

The dollar actually often experiences divergent movements against different groups of currencies. Therefore, reporting only one index may involve an overly large degree of aggregation for some users. Fortunately, currencies often seem to move somewhat in "regional blocs." There are U.S. dollar-linked blocs in the Caribbean and Central America, the Middle East Gulf region, and Far East Asia. The European Monetary System forms the core of a larger European bloc.

Regional blocs occur in part because some countries within regions undertake foreign exchange intervention or otherwise attempt to align their currencies with those of certain other nations, which, because of geographic proximity, are often major trading partners. Perhaps because they also share similar structure, comparative advantage, and hence terms of trade, various world regions exhibit fairly rigid relative currency prices within regions, and thus aggregation seems appropriate within regions.[16]

The advantages of monitoring a few regional subindexes as well as an overall index are illustrated in Chart 5, which plots the Atlanta Fed dollar index and its regional subindexes. The dollar clearly moved divergently in the varying world regions, as captured by the Asian, European, and Canadian subindexes. A separate "Asia excluding Japan (Asia-noJ)" subindex, comprising Australia and five industrializing Pacific basin nations, shows that their exchange rates often move together but change relative to Japan's. The chart also indicates that the overall Atlanta Fed index varied somewhat less than the European subindex but more than the

Chart 6.
The Dollar's Decline by Region
(in percent)*



In 1985, the dollar declined sharply according to European and Asian subindexes but appreciated in relation to the Asia-without-Japan and Canadian subindexes. In 1986 and through July 1987, the dollar's decline became a more global event.

*Percentage changes are measured as first differences of the natural logarithm. Logarithmic changes are used because they treat percentage increases and decreases symmetrically. The data used are averages for the months indicated.

Canadian and Asia-noJ subindexes, because the overall index is a weighted average of its component subindexes.

The rationale for subindexes is clear from the chart. They add considerable, useful information that is otherwise subsumed through aggregation into an overall index. At the same time, they still provide a manageable summary of the information contained in the hundreds of individual exchange rates. Subindexes can be especially useful to people interested in trade in particular products that are concentrated in certain geographic regions. Textiles and apparel in Asia are an example. These benefits from constructing a few regional subindexes apply to almost any national currency.

Finally, the creation of regional subindexes improves our understanding of the U.S. dollar's decline since its peak in February 1985. Chart 6 shows that the subindexes display trends that are not visible when inspecting only an overall index. The chart splits the recent era of the dollar's decline into two periods: the first year of decline through February 1986 and the next 17 months through July 1987. The first item to observe is the marked decline of the overall dollar index in both periods. The European, particularly, but also the Asian subindex declined sharply in both periods. However, the Canadian and Asia-noJ subindexes point to very different trends. The dollar actually rose slightly in these two major regions during its first year of decline on the overall indexes, but the subindexes show that during the second year of overall dollar decline the depreciation of the dollar belatedly became a more global event.

Summary

No single method of constructing an exchange rate index is ideal for every application. This outline of the various choices involved in index design portrays the viable options, but suggests that each has pros and cons. Certain generalizations about index construction are possible, however.

Extending the coverage of an index to complex proportions tends to reduce timeliness and clouds interpretation. Adding nations can also create measurement problems such as those that arise in the case of hyperinflating currencies. Despite being less timely, "real" indexes are preferable unless nominal alternatives exist that closely proxy the "real" values. Fortunately, this is the case for a number of widely-reported U.S. dollar indexes. Because the dollar's value can follow disparate paths against currencies in the different regions of the globe, regional subindexes can be valuable indicators, especially as they apply to trade-related questions.

As long as the major currencies have flexible exchange rates, debates over which currency index to use are likely to continue because no index is perfect. In most cases, the particular application planned for the index will finally determine which constellation of features is critical.

Maria McGinnis and Shannon Mudd provided expert research assistance. I also thank Craig Hakkio, Frank King, Dianne Pauls, Joseph Whitt, Harriette Grissom, David Deephouse, and Christopher Beshouri.

Notes

[1]Previously, researchers attempted to do this with only one summary aggregate index, but this paper will explore the new concept of subindexes for various world regions.

[2]See for instance Whitt, Koch, and Rosensweig (1986) or Hooper and Lowrey (1979).

[3]See Rosensweig (1986a and 1986b) for a discussion of this issue and an example of subindexes.

[4]See Rosensweig (1986a, b) or Hervey and Strauss (1987) for detailed comparisons of various dollar indexes, including the Atlanta Fed index.

[5]For example, the Atlanta Fed dollar indexes employ updated weights compared with those used in traditional indexes, and the focus of these Atlanta Fed indexes is the U.S. trade balance; thus they use export plus import weights exclusively.

[6]See Mack Ott (1987) for an excellent and original analysis of capital flow-based weights and other approaches, as well as of traditional trade-weighted index formulations. Indexes can be tailored to other uses as well. For instance, Rosensweig (1985) used U.S. bilateral foreign tourism revenue-based weights to measure the dollar's impact on the U.S. travel balance.

[7]For a more detailed discussion of multilateral and bilateral weights, see Rosensweig (1986a).

[8]Constructed to reflect direct U.S. trade patterns, the main Atlanta Fed index and subindexes employ bilateral weights. However, because strong arguments exist in support of a multilateral scheme as well, the Atlanta Fed also maintains a dollar index identical to the main one in all ways except that it employs multilateral-based trade weights.

[9]See J.R. Artus and A.K. McGuirk (1981), Morgan Guaranty (1986), and B. Dianne Pauls (1987).

[10]Atlanta Fed researchers (see Rosensweig, Lium, and Welch, 1986) found 1984 data to be reliable and representative of recent years; therefore, the Atlanta Fed indexes employ U.S. trade data from the single year 1984. The fixed weights will be updated if and when trade patterns are found to change significantly.

[11]Therefore an arithmetic index will yield different results, unfortunately, if exchange rates are defined in reciprocal terms; for instance, in dollars per yen rather than yen per dollar.

[12]A few of the very broad coverage indexes issued recently attempt to adjust for the inflation problem by constructing CPI-adjusted

indexes, but their designers seem essentially unaware of the price level measurement error and the multiple exchange rate problems. No mention is made of which exchange rate they use. By default they may use the official reported rate, which in many developing nations like Venezuela, Nicaragua, Egypt, Guatemala, and Paraguay differs from the free market rate by orders of magnitude. It is argued here that the only options are to exclude these nations, as was done, or construct a weighted average rate for each of these nations if data are available on the magnitude of the flows sensitive to each exchange rate.

[13]Mexico's recent inflation rates certainly have been "high." For instance, the annual rate has exceeded 100 percent during 1986-87.

[14]For an excellent discussion of issues in exchange rate index construction, with particular application to the prominent Federal Reserve Board Index among others, see B. Dianne Pauls (1987).

[15]Indeed, calculations show that for the first 20 months following the dollar's peak in February 1985, the change in the U.S. producer price index was virtually identical (differing by only .01 of a percentage point) to that of the weighted average of the 18 nations included in the Atlanta Fed index.

[16]Therefore, research at the Atlanta Fed into dollar indexes initiated the concept of *subindexes* that show a currency's value in various world regions. This concept could prove useful for a wide variety of countries. The Indian rupee, for instance, could be found to be moving one way in Europe, and the other way in the dollar-linked blocs in East Asia or in North America.

References

Artus, Jacques R., and Anne K. McGuirk. "A Revised Version of the Multilateral Exchange Rate Model," *IMF Staff Papers*, vol. 28 (June 1981), pp. 275-309.

Belongia, Michael T. "Estimating Exchange Rate Effects on Exports: A Cautionary Note," Federal Reserve Bank of St. Louis *Review*, vol. 68 (January 1986), pp. 5-16.

Board of Governors of the Federal Reserve System. "Index of the Weighted-Average Exchange Value of the U.S. Dollar. Revision," *Federal Reserve Bulletin*, vol. 64 (August 1978), p. 700.

Cox, W. Michael. "A New Alternative Trade-Weighted Dollar Exchange Rate Index," Federal Reserve Bank of Dallas *Economic Review* (September 1986), pp. 20-28.

Deephouse, David. "Using a Trade-Weighted Currency Index," Federal Reserve Bank of Atlanta *Economic Review*, vol. 70 (June/July 1985), pp. 36-41.

Hervey, Jack L., and William S. Strauss. "The New Dollar Indexes Are No Different from the Old Ones," Federal Reserve Bank of Chicago *Economic Perspectives*, vol. 11 (July/August 1987), pp. 3-22.

Hooper, P., and B. Lowrey. "Impact of the Dollar Depreciation on the U.S. Price Level: An Analytical Survey of Empirical Estimates," Staff Studies 103. Washington, D.C.: Board of Governors of the Federal Reserve System, 1979.

Morgan Guaranty Trust Company of New York. *World Financial Markets* (August 1976, May 1978, August 1983, and October/November 1986).

Ott, Mack. "The Dollar's Effective Exchange Rate: Assessing the Impact of Alternative Weighting Schemes," Federal Reserve Bank of St. Louis *Review*, vol. 69 (February 1987), pp. 5-14.

Pauls, B. Dianne. "Measuring the Foreign-Exchange Value of the Dollar," *Federal Reserve Bulletin*, vol. 73 (June 1987), pp. 411-22.

Rosensweig, Jeffrey A. "A New Dollar Index: Capturing a More Global Perspective," Federal Reserve Bank of Atlanta *Economic Review*, vol. 71 (June/July 1986a), pp. 12-23.

_____. "The Atlanta Fed Dollar Index and Its Component Subindexes," Federal Reserve Bank of Atlanta Working Paper no. 86-7 (August 1986b).

_____. "The Dollar and the U.S. Travel Deficit," Federal Reserve Bank of Atlanta *Economic Review*, vol. 70 (October 1985), pp. 4-13.

_____, Gretchen Lium, and Kelly Welch. "The Changing Pattern of U.S. Trade: 1975 to 1985," Federal Reserve Bank of Atlanta *Economic Review*, vol. 71 (October 1986), pp. 36-42.

Whitt, Joseph A., Jr., Paul D. Koch, and Jeffrey A. Rosensweig. "The Dollar and Prices: An Empirical Analysis," Federal Reserve Bank of Atlanta *Economic Review*, vol. 71 (October 1986), pp. 4-18.