Appendix A

This appendix provides background information on the procedures to construct composite indices. Much of the discussion on the construction is related to measurement of the business cycle. This section traces the history of the economic thought underlying the construction of composite indices for tracking the business cycle. It also describes the Economic Cycle Research Institute (ECRI) method employed in this paper that is based on the National Bureau of Economic Research (NBER) procedure for construction of indices.

Composite Index Construction: Issues and Procedures

Diffusion Indices and the Business Cycle

The business cycle, according to its classic definition (Mitchell and Burns, 1946), "consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions…" in many economic activities. In other words, the key attribute of the business cycle is the concerted nature of cyclical upswings and downswings, i.e., the cyclical co-movements. It was therefore "necessary to have some measure of the scope of the fluctuations being considered. For this purpose diffusion indexes (were) constructed" (Moore, 1982).

However, diffusion indices, which simply measure the proportion of a set of indicators showing improvement over a fixed time span, do not take into account the magnitude of movements; they reflect neither the depth of a contraction nor the vigor of a recovery. A method was needed to combine the movements of a heterogeneous set of series that could not be combined by quantity, price, or any other logical set of weights. This was the motivation for creating a composite index.

Composite Indices

A composite index combines different cyclical series into a single time series because some series would "prove more useful in one set of conditions, others in a different set. To increase the chances of getting true signals and reduce those of getting false ones, it is advisable to rely on all such potentially useful (series) as a group" (Zarnowitz and Boschan, 1975).

Geoffrey Moore (1958) developed the original method of combining cyclical indicators, in order to predict industrial production. He was concerned with the problem that once magnitudes were considered, time series which typically moved in wide swings had a much larger influence on the movement of the combined index than those which typically moved in narrow swings. He solved this problem by adjusting the amplitudes of each of the components by the relationship between its own cyclical volatility and that of a target series, which in this case was industrial production. He then combined the amplitude-adjusted changes. Later, Shiskin (1961) generalized this procedure by standardizing each component according to its own volatility, without regard to a target series.

Since this original work, various methodologies for constructing composite indices were devised for different purposes. However, they used essentially the same idea for combining time series.

Standardization

The issue of amplitude standardization (i.e., expressing a cyclical indicator in terms of its own historical amplitude) is central to composite index construction because it arises from the key difference between diffusion indices and composite indices. This issue also lies at the heart of the differences between various methods of constructing composite indices. The original Moore-Shiskin method of composite index construction is essentially a diffusion index that takes magnitude into account. This becomes clear when one considers the method of composite index construction, including the standardization procedure. In that method, the month-to-month changes in each indicator are divided by the indicators' own standardization factor, defined as the average of its absolute month-to-month changes over a specified time period. The standardized changes may then be explicitly weighted and added together, and the resulting sum of changes cumulated to get the composite index. Finally, this index may be trend and amplitude adjusted. This method ensures that if every month-to-month change for each series happens to be equal in magnitude to the series' standardization factor, the composite index will be identical to the diffusion index.

Thus, the Moore-Shiskin composite index differs from a one-month-span diffusion index only to the extent that the magnitudes of the month-to-month changes differ from the standardization factors of the series. It is interesting to note that standardization was meant to be a form of amplitude adjustment that "equalizes the average cyclical amplitude of the series…" (Moore, 1961). However, the Moore-Shiskin method standardizes on the basis of month-to-month changes, which include the cyclical, the trend as well as the irregular movements. Of two series with identical cyclical amplitudes, the one with a larger trend (and/or irregular) component has a much larger standardization factor, and its cyclical movements may therefore be eclipsed by that of the smoother, lower-trend series that it is combined with. This is one reason why the OECD uses as its standardization factor the average absolute deviations of the detrended series from its mean (OECD, 1987), which is divided into the detrended series. The standardized series are then added up to yield the composite index, and a designated trend is added in to match the trend of a target series, typically industrial production.

Problems with the OECD Procedure

While this method mitigates the Moore-Shiskin methods' problem of possible dominance of the trend or irregular movement over the cyclical movement, they create new problems in the process (Cullity and Banerji, 1996). The key issue is the need to estimate the trend on an ongoing basis in real time. It is true that the Phase Average Trend (PAT, Boschan and Ebanks, 1978) used by the OECD is superior to the well-known Hodrick-Prescott and Baxter-King trend measures in terms of its ability to separate trend from cyclical movements. However, any trend needs to be reestimated each month as data are added. The PAT, while very good for historical estimation of the trend, is susceptible to

occasional large revisions of the most recent year or two of the estimated trend, particularly when new cyclical turns are recognized. This makes real time monitoring of the composite index difficult since it would be susceptible to substantial revisions. Given that the main role of a composite index is real time monitoring of an economy, this is a serious shortcoming indeed.

These are some of the key issues pertaining to the appropriateness of various methods of composite index construction. These and other issues are discussed in detail in Boschan and Banerji (1990). As shown by Cullity and Banerji (1996), the ECRI procedure, which takes these issues into account, shows superior results to both the OECD procedure and the Moore-Shiskin procedure.

The ECRI Procedure

The ECRI composite index procedure, which is used to create the index presented in this study, makes sure that the standardization factor reflects only the cyclical amplitude, not the trend or irregular movements. In order to do that, each series is smoothed and detrended using the PAT, and the standard deviation of this series is used as the standardization factor. This is a fixed number for each component of the index. Thus, the earlier objection to the use of the PAT does not apply, since the PAT is not recalculated each month as new data points are included. All this is done after taking logarithms of the series in order to ensure amplitude stationarity, which is achieved when the variance of the series about its trend line, measured separately for each cycle, remains invariant from cycle to cycle (Boschan and Banerji, 1990).

After the standardization factor is determined for each component of the index, the series are divided by their respective standardization factors and added up to yield the composite index. This series is multiplied by a factor to adjust its cyclical amplitude to the target series. The antilogarithm of this series is then trend-adjusted by adding to the month-to-month change in this series, the average monthly difference in trend between this series and the target series. The result is the desired composite index.